

NORSEMAN GOLD PROJECT

Supporting Document

Native Vegetation Clearing Permit (Purpose Permit) Application - Assessment of Clearing Principles

Green Lantern: M63/36, M63/112-I & M63/325-I

Prepared by:



PANTORO SOUTH

Pantoro South Pty Ltd

Version: 1.0

Date of Submission: 16 February 2022

Environmental Group Site Name: Central Norseman Environmental Group

Environmental Group Site Code: S0223207

Phone: (08) 6263 1110

Address: Level 2, 46 Ventnor Avenue, West Perth WA 6005

Email: admin@pantoro.com.au

Revision Summary

Date	Revision	Document Title
16 February 2022	Version 1.0	Norseman Gold Project Supporting Document – Native Vegetation Clearing Permit (Purpose Permit) Application - Assessment of Clearing Principles <u>Green Lantern</u> : M63/36, M63/112-I & M63/325-I

Table of Contents

1.	INTRODUCTION	1
1.1	PROJECT BACKGROUND	1
1.2	PROPONENT	1
1.3	LOCATION, ACCESS AND TENURE.....	1
2.	EXISTING ENVIRONMENT	10
2.1	LANDSCAPE	10
2.2	CLIMATE	10
2.3	SOILS AND LANDFORMS.....	11
2.4	FLORA AND VEGETATION	12
2.4.1	Pre-2020 Surveys.....	12
2.4.2	Detailed Surveys 2020	13
2.4.3	Weeds	27
2.4.4	Great Western Woodlands	27
2.5	TERRESTRIAL VERTEBRATE FAUNA AND HABITAT	28
2.5.1	Basic Survey 2020.....	28
2.5.2	Introduced Species.....	41
2.6	HERITAGE AND SOCIAL SETTING	42
2.6.1	Land Use and Community	42
2.6.2	Aboriginal Heritage	42
2.6.3	European Heritage	43
3.	PROPOSED LAND CLEARING	45
4.	ASSESSMENT OF CLEARING PRINCIPLES	46
5.	ENVIRONMENTAL MANAGEMENT MEASURES	50
6.	REHABILITATION	51
7.	REFERENCES	52

Tables

Table 1:	NVCP Application - Project Areas	1
Table 2:	Overview of Flora and Vegetation Studies for the NGP	14
Table 3:	Results Summary of Flora and Vegetation Studies for the NGP	15
Table 4:	Vegetation Communities of the Green Lantern Survey Area.....	20
Table 5:	Survey Area Extent of Fauna Habitats (Western Wildlife 2021)	29
Table 6:	Summary of Conservation Significant Vertebrate Fauna (Western Wildlife 2021).....	31
Table 7:	Fauna Habitats of the Survey Area.....	37
Table 8:	Native Vegetation Clearing Principles	47

Figures

Figure 1:	Location Plan.....	2
Figure 2:	Site Layout – Green Lantern	4
Figure 3:	Site Layout Clearing – Green Lantern	6
Figure 4:	Purpose Permit Area	8
Figure 5:	Green Lantern Vegetation Communities and Conservation Significant Flora.....	23
Figure 6:	Overview – Threatened and Priority Flora.....	25
Figure 7:	Overview – Targeted Malleefowl Search.....	34
Figure 8:	Green Lantern Fauna Habitats and Conservation Significant Fauna	39

Appendices

Appendix 1:	CNGC-Pantoro Letter of Authority
Appendix 2:	Flora and Vegetation Assessment - Autumn (Mattiske 2020a)
Appendix 3:	Flora and Vegetation Assessment - Spring (Mattiske 2020b)
Appendix 4:	Scotia Reconnaissance Flora and Vegetation Survey (Biota 2020)
Appendix 5:	Basic Vertebrate Fauna and Targeted Malleefowl Survey (Western Wildlife 2020)

1. INTRODUCTION

1.1 Project Background

This document has been prepared in support of a Native Vegetation Clearing Permit (NVCP) (Purpose Permit) application for the development of the Green Lantern Project (Green Lantern (M63/36, M63/112 and M63/325)). Green Lantern is located to the immediate southwest of the Scotia Project (Scotia (M63/36)) and both Projects form part of the larger Norseman Gold Project (NGP). The NGP is operated and managed by Pantoro South Pty Ltd (Pantoro), and tenements are held by Central Norseman Gold Corporation Pty Ltd (CNGC) under a 50/50 unincorporated Joint Venture (JV) agreement.

The location, key mine infrastructure and associated Mining Proposal details regarding Green Lantern is provided in Table 1. Green Lantern will share common infrastructure and a waste rock dump (WRD) with Scotia. A clearing permit exists for Scotia (CPS 9466/1, valid from 5 March 2022 to 4 March 2027) which covers mine components pertaining to Scotia on M63/36. This Green Lantern NVCP application consists of additional clearing required for the development of Green Lantern on M63/36, M63/112-I and M63/325-I. Due to the use of common infrastructure for both Projects, the Purpose Permit Area (PPA) boundaries for this Green Lantern application and CPS 9466/1 overlap.

This NVCP application requests approval to progressively clear a combined total of 340.9 ha of native vegetation within a PPA of 918.7 ha.

Table 1: NVCP Application - Project Areas

Project Area	Tenement(s)	Location Description	Figure(s)	Key Mine Infrastructure	Mining Proposal, Registration ID (status as of February 2022)
Green Lantern	M63/36 M63/112-I M63/325-I	Located approximately 30 km southeast of the town of Norseman, adjacent to Lake Dundas.	Figure 1 Figure 2 Figure 3	Proposed: <ul style="list-style-type: none"> Mining of an open pit. Construction and expansion of waste rock dumps. Construction of supporting infrastructure. 	<ul style="list-style-type: none"> Reg ID 102621 Version 1.0 submitted to DMIRS for assessment on 26 January 2022 (approval pending).

1.2 Proponent

The NGP is solely operated and managed by Pantoro South Pty Ltd (Pantoro), a wholly owned subsidiary of Pantoro Limited. Pantoro Limited is listed on the Australian Stock Exchange (ASX: PNR). Tenements are held by Central Norseman Gold Corporation Pty Ltd (CNGC) under a 50/50 unincorporated Joint Venture (JV) agreement (Appendix 1).

All compliance and regulatory requirements regarding this assessment should be forwarded by email, post or courier to the following address:

Proponent: Pantoro South Pty Ltd
Level 2, 46 Ventnor Avenue
West Perth WA 6005

Contact: Karen de Roer
Title: Environment and Approvals Manager
Company: Pantoro South Pty Ltd
Phone: (08) 6263 1110
E-mail: admin@pantoro.com.au

1.3 Location, Access and Tenure

The NGP is located approximately 725 km east of Perth, 200 km south of Kalgoorlie-Boulder, and 200 km north of Esperance within the Shire of Dundas and Goldfields-Esperance region of Western Australia (Figure 1). It is situated adjacent to the historic mining town of Norseman within the Eastern Goldfields of Western Australia.

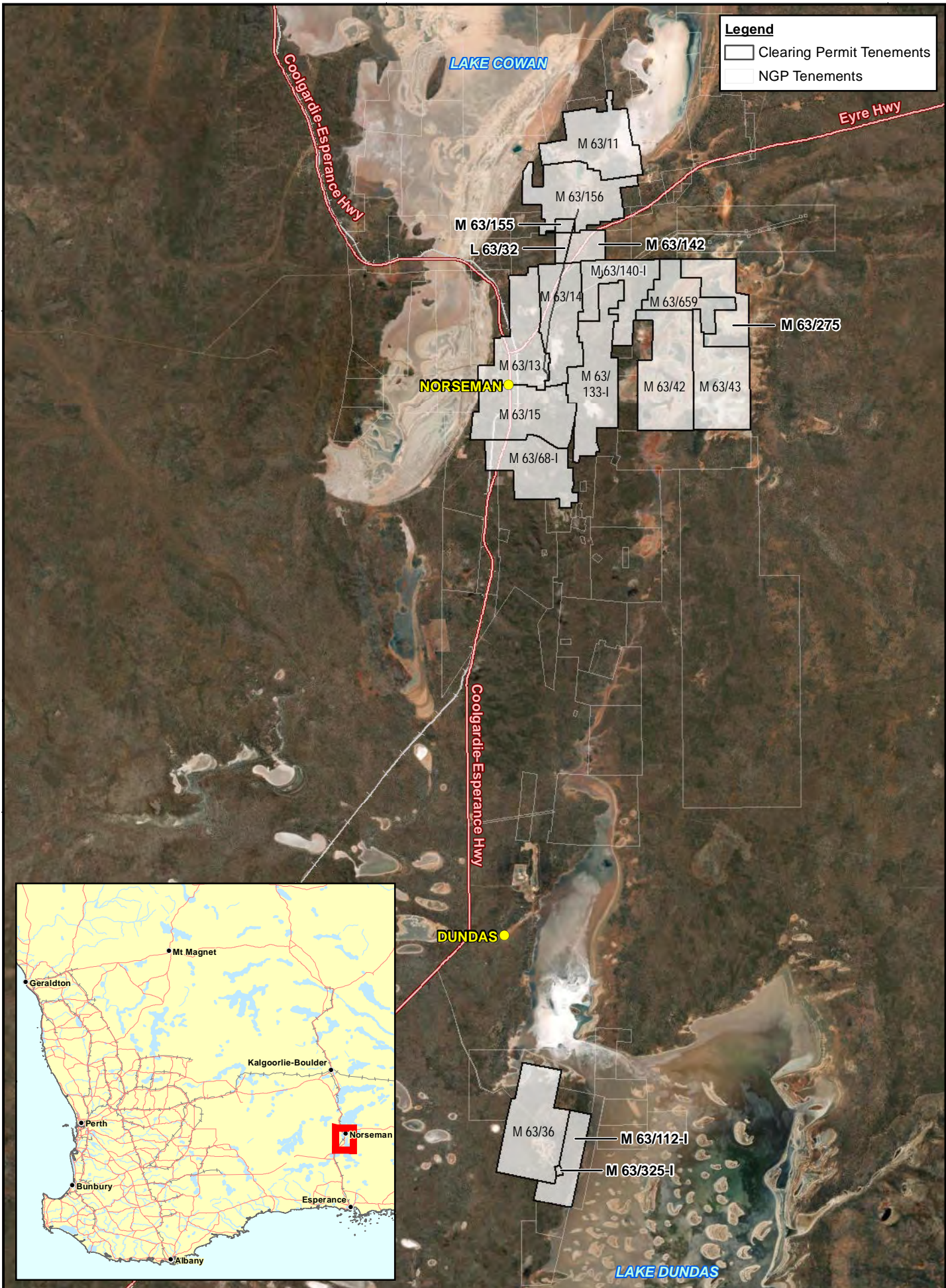
The NGP is accessed via the main public route of Coolgardie-Esperance highway. Access to various NGP tenements is via existing well defined bitumised highways/roads and gravel roads.

Green Lantern is situated on M63/36, M63/325-I and M63/112-I and is located approximately 30 km southeast of the town of Norseman and about 1.5 km inland from the north-western shore of Lake Dundas. Green Lantern shares a tenement (M63/36) with Scotia and Scotia is located to the immediate north-west of Green Lantern. Access to the site is via existing highways and gravel roads.

Figure 1: Location Plan

Legend

- Clearing Permit Tenements
- NGP Tenements



Date: 14/02/2022
 Scale: 1:200,000 @ A4
 Projection: GDA 1994 MGA Zone 51
 Tenements - DMIRS Ortho - Open Source

0 1.5 3 4.5 6 km

Pantoro South Pty Ltd
 Norseman Gold Project
 Green Lantern Clearing Permit

Figure 1
 Location Plan



6440000

6420000

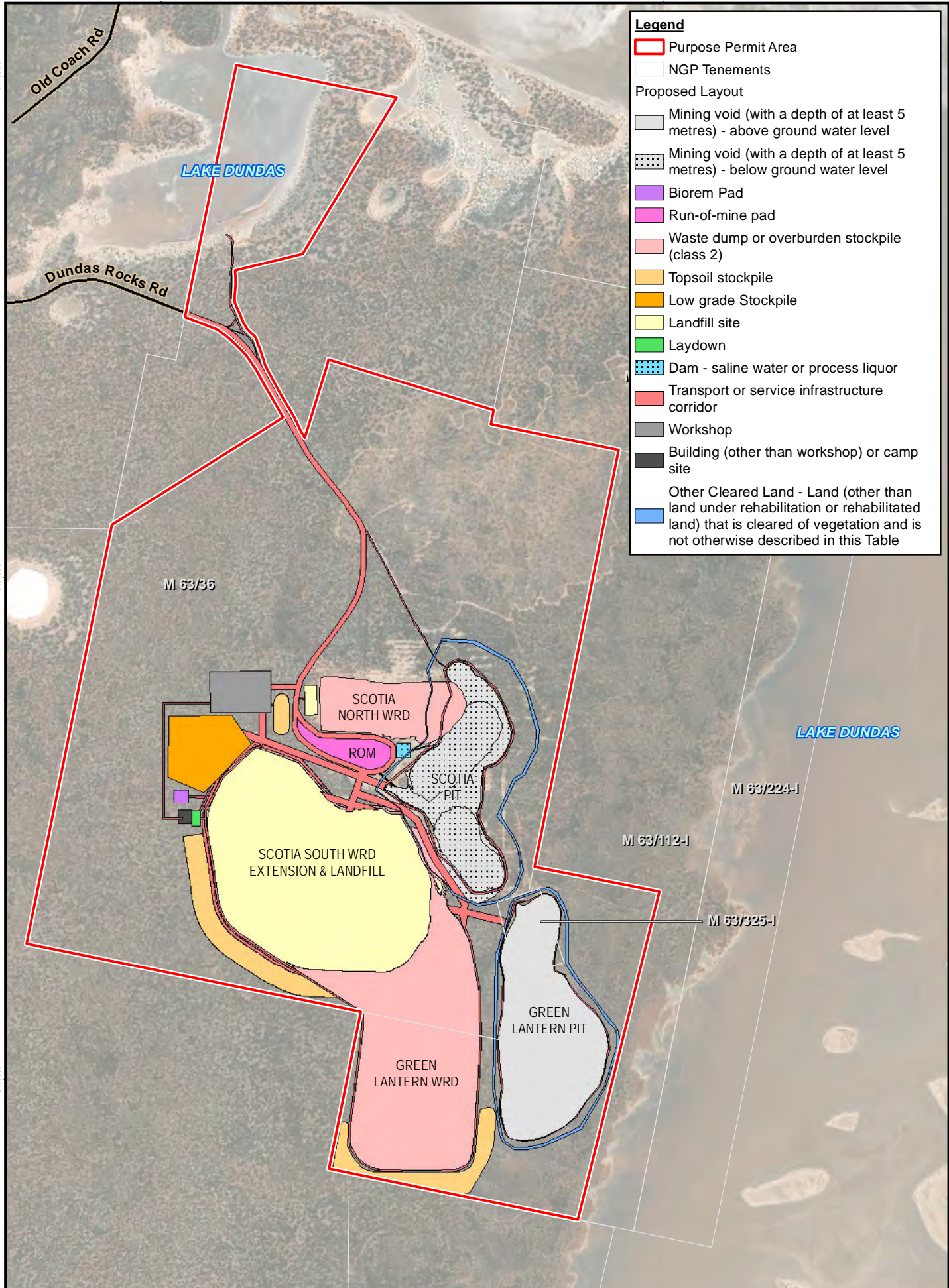
6400000

000049

000249

000049

Figure 2: Site Layout – Green Lantern



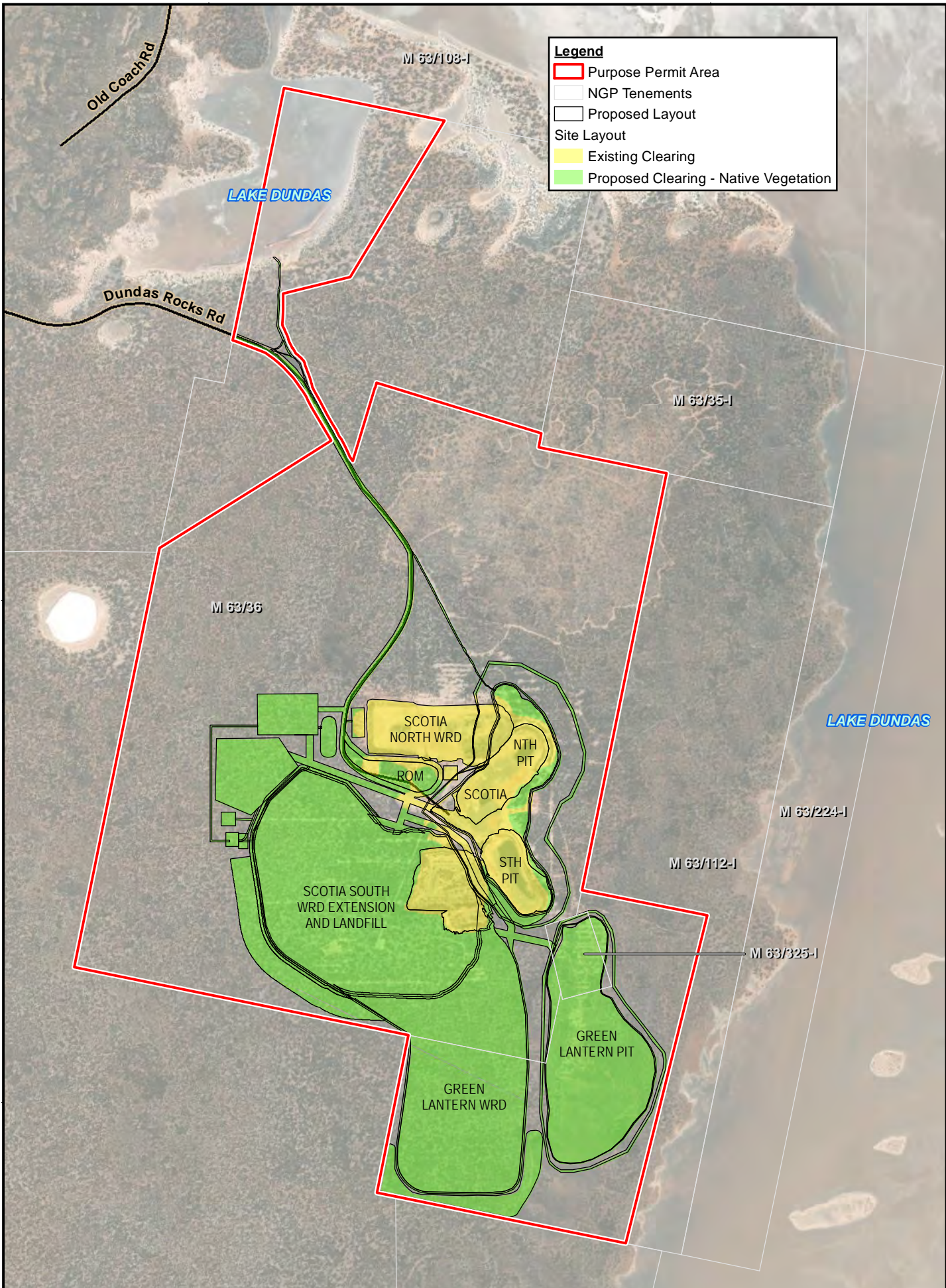
Date: 14/02/2022
 Scale: 1:25,000 @ A4
 Projection: GDA 1994 MGA Zone 51
 Tenements - DMIRS Ortho - Open Source

Pantoro South Pty Ltd
 Norseman Gold Project
 Green Lantern Clearing Permit

Figure 2
 Site Layout
 Scotia & Green Lantern



Figure 3: Site Layout Clearing – Green Lantern



Legend

- Purpose Permit Area
- NGP Tenements
- Proposed Layout

Site Layout

- Existing Clearing
- Proposed Clearing - Native Vegetation

Date: 14/02/2022
 Scale: 1:25,000 @ A4
 Projection: GDA 1994 MGA Zone 51
 Tenements - DMIRS Ortho - Open Source

Pantoro South Pty Ltd
 Norseman Gold Project
 Green Lantern Clearing Permit

Figure 3
 Site Layout
 Scotia & Green Lantern



Figure 4: Purpose Permit Area

Legend

- Purpose Permit Area
- NGP Tenements



Date: 14/02/2022
 Scale: 1:25,000 @ A4
 Projection: GDA 1994 MGA Zone 51
 Tenements - DMIRS Ortho - Open Source

Pantoro South Pty Ltd
 Norseman Gold Project
 Green Lantern Clearing Permit

Figure 4
 Purpose Permit Area



2. EXISTING ENVIRONMENT

2.1 Landscape

The NGP area lies within the Coolgardie Botanical District of the Southwestern Interzone (Beard 1990). The vegetation of Western Australia has been assigned to bioregions and subregions under the Interim Biogeographical Regionalisation for Australia (IBRA), with the survey area located within the 'Coolgardie 3 – Eastern Goldfields Subregion' of the Coolgardie Bioregion (Cowan 2001). The 'Coolgardie 3 Subregion' is rich in endemic *Acacia* spp. and the vegetation of the area is described as mallees, *Acacia* thickets and shrub heaths on sandplains. Diverse Eucalyptus woodlands occur on ranges, in valleys and around salt lakes. Salt lakes support dwarf shrublands of samphire (Cowan 2001).

Beard (1990) described the vegetation of the Coolgardie Botanical District as predominantly Eucalypt woodland, becoming open and with saltbush-bluebush understorey on calcareous soils. *Allocasuarina* thickets and scrub-heath occur on sandplains and there are patches of shrub steppe adjoining the Great Victoria Desert (Beard 1990).

The topography is of gently undulating plains, interrupted by occasional ranges of low hills and ridges of Archaean greenstones, playa lakes and sandplains in the west. A horst of Proterozoic basic granulite interrupts the undulating plains to the east (Beard 1990, Cowan 2001).

There is a regional slope from north-west to south-east and there are a chains of hills in the north west of the area near Norseman and altitudes in this area vary from 250 m to 350 m above sea level (Hall and McKenzie 1993). The area around Norseman town and the mine administration area is generally flat with slopes less than 5%.

The area directly east of the administration area and processing plant has slopes of around 20% in the vicinity of the Beacon Lookout. In the northern tenements around North Royal and Harlequin mines, slopes are around 2% to 6%. In the southern tenements (which includes Scotia and Green Lantern), slopes are up to 25% around Scotia/Green Lantern and around 18% at Maybell mine (Landgate 2017).

The dominant salt lakes in the Norseman area are Lake Dundas and Lake Cowan of which Lake Cowan is a wetland of sub regional significance. These endorheic salt lakes drain a combined catchment area of about of 15,225 km², with Lake Cowan having a surface area of some 970 km² with few islands and Lake Dundas having a surface area of about 280 km².

2.2 Climate

The climate of the NGP is characterised as an arid non-seasonal to semi-arid Mediterranean climate with hot dry summers and mild winters. The closest active Bureau of Meteorology (BoM) weather station is Norseman Aero (site number 012009, commencing data collection in 1999 at an elevation of 262 m). This station reports an annual average rainfall of 293.7 mm (BoM 2020). The highest rainfall typically occurs during January (35.5 mm) with summer thunderstorms and the lowest rainfall occurs in June (17.0 mm) with winter rains resulting from low pressure cells moving in an easterly direction. Mean monthly rainfall is shown in Plate 1. Rainfall is low and unreliable and the mean number days of rain is 46.1 (BoM 2020).

Temperatures show a range with a summer maximum in January of 32.6°C (Plate 1) and a winter minimum in July of 4.0°C. Frosts may be expected in any of the winter months but are not severe and are within the tolerance of native vegetation. It is common for heavy fog to envelop lower lying areas in the winter months e.g., the processing plant area which is surrounded by old tailings dams and waste rock dumps. The annual mean relative humidity varies considerably, ranging from 37 % (at 3pm) to 63 % (at 9am) (BoM 2020). The average wind speeds vary throughout the year from 17.4 km/h in the morning to 19.8 km/h in the afternoon (BoM 2020).

Plate 1: Climate Statistics for Norseman Aero Weather Station



Source: BOM 2020

2.3 Soils and Landforms

Soil-landscapes zones of Western Australia's rangelands and arid interior were defined by Tille (2006). The NGP predominantly falls within the Kambalda Zone (265) of the Kalgoorlie Province, although some of the southern tenements are likely to cross into the northern section of the Salmon Gums Mallee Zone (246) of the Stirling Province. The majority of the Scotia Project lies within the Salmon Gums Mallee Zone (246) and a western portion of the tenement (M63/36) lies within the Kambalda Zone (265). The Green Lantern Project (M63/112-I, M63/325-I) lies within the Salmon Gums Mallee Zone (246).

The area is characterised by flat to undulating plains, hills, ranges, stony plains and salt lakes on greenstone and granite of the Yilgarn Craton (Tille 2006). Soils of the area include:

- Salt lake soils.
- Red loamy earths.
- Hardpan shallow loams.
- Sandy duplexes.
- Calcareous loamy earths.

Calcareous earths are the predominant soil in the area, covering most of the plains and greenstone areas (Beard 1990, Cowan 2001 and Tille 2006). Tille (2006) notes that the Stirling and Kalgoorlie Provinces grade into each other and that the boundary between the two reflects the change in terrain from Tertiary marine sediments supporting predominantly mallee vegetation with *Melaleuca* spp. understorey, to terrain formed by aeolian deposits in the north that supports predominantly eucalypt woodland with halophytic understorey.

2.4 Flora and Vegetation

2.4.1 Pre-2020 Surveys

The following surveys were undertaken pre-2020 for the NGP and the results are summarised below:

- A baseline vegetation survey (Phase I) was undertaken by Landcare Services Pty Ltd for Western Mining Corporation (WMC) in March 1995 titled '*Baseline Vegetation Survey, Central Norseman Gold Corporation Ltd, Norseman Western Australia*' (Landcare Services 1995):
 - The survey covered 'a range of WMC's tenements' (none specified) and of the 266 taxa recorded in this baseline survey, 12 were regarded as Priority taxa and one was classed as Declared Rare Flora (DRF) taxon. The DRF taxon *Eucalyptus platydisca* (as of 2021, it is a Threatened species) and three of the Priority taxa *Eriostemon apiculatus* (as of 2021 this species name has changed to *Philotheca apiculata* (Paul G. Wilson) and it is a Priority 1 species), *Grevillea phillipsiana* (as of 2021 it is a Priority 1 species) and *Melaleuca cliffortioides* (as of 2021, this species is Not Threatened) were recorded in general collections around the Norseman area and not within CNGC leases.
 - The range of vegetation associations studied reflected the wide range of landforms encountered and ranged from low chenopod shrublands fringing Lake Cowan to several distinct types of eucalypt woodland and diverse woodland/shrublands encountered on the Dundas Hills (Landcare Services 1995).
- A baseline vegetation survey (Phase II) was undertaken by Landcare Services Pty Ltd for CNGC in June 1996 titled '*Baseline Flora and Vegetation Survey, Phase II, Norseman WA*' (Landcare Services 1996):
 - The survey covered 'several operational sites near Norseman' and revealed 369 endemic taxa for the Norseman region. Species recorded in these surveys included nine as yet undescribed varieties, 17 priority taxa, two DRF taxa and significant range extensions for 6 species. In addition, several new combinations of flora were noted (Landcare Services 1996). The report does not detail the names of the species found.
- A baseline vegetation survey (Phase III) was undertaken by Landcare Services Pty Ltd for CNGC in July 1997 titled '*Baseline Flora Survey, Phase III, Norseman WA*' (Landcare Services 1997):
 - Albion, Bromus - Goodia, East Polar Bear and Lady Miller – Penneshaw lease areas were surveyed over a total area of approximately 218 sq km. The survey resulted in a large population of *Eremophila lucida* (Chinnock) (as of 2021 this species is a Priority 1) being found and mapped in the western Polar Bear Peninsula. A cumulative total of 467 endemic taxa was recorded in the Norseman area.
- A baseline survey was undertaken by Mattiske Consulting Pty Ltd (Mattiske) for CNGC in August 2001 titled '*Flora and Vegetation Survey, Gladstone and Daisy Project Areas, Norseman*' (Mattiske 2001):
 - The surveyed covered 10 square km and is located to the north and east of the Norseman townsite. A total of 144 plant taxa and 139 species from 83 genera and 44 families were recorded in the Gladstone and Daisy project area. Species representation was greatest amongst families Chenopodiaceae, Mynaceae, Asteraceae, Mimosaceae and Myoporaceae, a flora composition typical of the Coolgardie Botanical District (Mattiske 2001).
 - Two DRF species *Daviesia microcarpa* and *Eucalyptus platydiscus* (as of 2021, both are Threatened species) and *Styphelia pulchella* Priority 1 (as of 2021, name changed to *Styphelia exserta* and not a Priority species), *Eremophila purpurascens* Priority 3 (correct status of as 2021) and *Darwinia polycephala* Priority 4 (correct status as of 2021) were located within the survey area (Mattiske 2001).
 - A total of seven vegetation communities were recorded in the area and no threatened ecological communities (TEC) were present (Mattiske 2001).
- A flora and vegetation survey was undertaken by Mattiske in August 2002 of the North Cobbler area (Mattiske 2002). The key findings comprised of (Mattiske 2002):
 - A total of 34 plant families, 53 genera and 89 plant taxa (including subspecies and varieties) were recorded within the survey area. Dominant families included Chenopodiaceae, Myrtaceae and

- Myoporaceae. There was one introduced (weed) species located within community NC2 (Chenopod shrublands), **Carthamus lanatus* (Saffron Thistle), which, as of 2020, is listed on DPIRD 2020 as Permitted s11.
- The species *Lepidosperma pruinosum* was reported as a Priority 3 and was found to be outside of its normal range of occurrence within communities NE1 and NE5 (*Eucalyptus* woodlands) however as of 2020, *Lepidosperma pruinosum* is listed as 'not threatened' (Florabase 2020). Few annual or Asteraceae (daisy) and Poaceae (grass) species were recorded due to the paucity of annual species as a result of the timing of the survey.
 - No threatened flora species were located during the survey. One Priority One species (*Eucalyptus websteriana* subsp. *norsemanica*) and one Priority Three species (*Eremophila purpurascens*) were located within vegetation communities NE1, NE2, NE3 and NE5 (*Eucalyptus* woodlands).
 - A total of eight plant communities were recorded in the survey area. Five of the vegetation communities were *Eucalyptus* Woodlands, one a Mixed Shrubland and two Chenopod Shrublands. None of the vegetation communities described in the survey area are classified as Threatened Ecological Communities. Communities NE1, NE2, NE3 and NE5 (*Eucalyptus* woodlands) are considered to be Locally Significant due to the presence of the Priority species, *Eucalyptus websteriana* subsp. *norsemanica* and *Eremophila purpurascens*.
 - The condition of the vegetation within the study area was good to very good based on the presence of one introduced (weed) species and low disturbance.
- A flora and vegetation survey was undertaken by Mattiske in April 2005 of the proposed Tailings Dam area (Mattiske 2005). The key findings comprised of (Mattiske 2005):
 - A total of 32 plant families, 63 genera and 134 plant taxa (including subspecies and varieties) were recorded within the survey area. Dominant families included Chenopodiaceae, Mimosaceae, Myrtaceae and Myoporaceae. There were two introduced (weed) species present and few annual or Asteraceae (daisy) and Poaceae (grass) species were recorded due to the paucity of annual species as a result of the timing of the survey (Mattiske 2005).
 - No Threatened species were found. One Priority One *Acacia dorsenna* and two Priority Three *Eremophila purpurascens* and *Eucalyptus brockwayi* were found (these species have the same status as of 2021) (Mattiske 2005).
 - A total of seventeen plant communities were recorded within the survey area. Eleven of the communities were *Eucalyptus* Woodlands, three Shrublands, one Casuarina Woodland and two are Chenopod Shrublands. Although several of these communities were restricted in area, none of the communities were restricted to the survey area and no TEC were present (Mattiske 2005).

The above mentioned pre-2020 surveys provide regional background flora and vegetation information for the Green Lantern Project area.

2.4.2 Detailed Surveys 2020

2.4.2.1 Overview

An overview of the detailed surveys undertaken for the NGP which includes the Green Lantern area is provided in Table 2 and a summary of the results is provided in Table 3.

Flora and vegetation surveys were completed in accordance with:

- Environmental Factor Guideline: Flora and vegetation (Environmental Protection Authority (EPA) 2016a).
- Technical Guidance: Flora and vegetation surveys for environmental impact assessment (EPA 2016b).

Overall, Mattiske (2020a) found the vegetation of the NGP survey areas to be common at statewide and regional levels and the presence of Priority listed flora species is of local importance.

Table 2: Overview of Flora and Vegetation Studies for the NGP

Proposed Project Area	Year	Consultant	Study Title
<u>Desktop</u> - all NGP areas. <u>Field survey</u> - Gladstone, North Royal, Gladstone-North Royal Haul Roads, Jimberlana Pipeline and Scotia (NB: Scotia included the Green Lantern area).	Autumn 2020	Mattiske Consulting Pty Ltd (Mattiske)	Flora and Vegetation Assessment, Norseman Gold Project, Norseman, WA, July 2020 (Mattiske 2020a) (Appendix 2).
<u>Field survey</u> - Camp, Cobbler, Gladstone extensions, North Royal extension, OK, Scotia extensions (NB: Scotia Extensions included the Green Lantern area), Slippers and TSF.	Spring 2020	Mattiske Consulting Pty Ltd (Mattiske)	Flora and Vegetation Assessment – Spring 2020, Norseman Gold Project, Norseman, WA, December 2020 (Mattiske 2020b) (Appendix 3).
<u>Desktop</u> - Scotia area. <u>Field survey</u> - 248 ha area, consisting of salt flats and littoral vegetation.	Spring 2020	Biota Environmental Sciences (Biota)	Norseman Gold (Scotia) Reconnaissance Flora and Vegetation Survey (Biota 2020) (Appendix 4).

Table 3: Results Summary of Flora and Vegetation Studies for the NGP

Survey	No. Quadrats	Dominant Genera and Families	Vegetation Communities and Condition	Conservation Significant Taxa and Communities	Introduced Species
Autumn 2020 (Matiske 2020a): <ul style="list-style-type: none"> • Northern area: <ul style="list-style-type: none"> – Gladstone – North Royal – Gladstone-North Royal – Haul Roads – Jimberlana Pipeline • Southern area: <ul style="list-style-type: none"> – Scotia (NB: Scotia included the Green Lantern area). • Opportunistic records. 	<ul style="list-style-type: none"> • 61 quadrats in the northern survey areas. • 40 quadrats in the southern survey area. 	<ul style="list-style-type: none"> • A total of 804 vascular plant taxa, representative of 260 genera and 115 families, with the most common families being Myrtaceae, Fabaceae and Asteraceae, and the most common genera being <i>Eucalyptus</i>, <i>Acacia</i> and <i>Eremophila</i>. • Species accumulation analysis shows that approximately 73% of taxa potentially present in the survey areas were recorded during the field survey. 	<ul style="list-style-type: none"> • Eighteen vegetation communities were defined and mapped: twelve Eucalypt woodland communities, two other woodland communities and four shrubland communities. Two of the shrubland communities, dominated by salt-tolerant species, formed almost 25% of the Northern survey areas, reflecting the significant areas of salt lake in these areas. • Approximately 93 % of the sites with a recorded condition ranking were assessed as being in Pristine or Excellent condition. The vegetation condition in the Scotia survey area is generally better than that in the Northern areas, although both areas have very little disturbance within the areas of native vegetation. 	<p>Threatened Species</p> <ul style="list-style-type: none"> • One Threatened species, <i>Davesia microcarpa</i> (T), was previously recorded within the survey areas, with the most recent record from 2001. • Three sites, two along Jimberlana pipeline and one where the North Royal pipeline meets the Eyre Highway, where <i>Davesia microcarpa</i> (T) was previously found were traversed, with one dead plant recorded at two of the locations. • No live Threatened species were recorded. <p>Priority Species</p> <ul style="list-style-type: none"> • <i>Calandrinia lefroyensis</i> (P1) and <i>Acacia kerryana</i> (P2), were recorded in the GEV and Jimberlana Pipeline survey areas, respectively. • <i>Eremophila parvifolia</i> ?subsp. <i>parvifolia</i> (P4), which was recorded throughout the four Northern survey areas, was unable to be confidently identified to a sub-species level. This species was treated with a precautionary approach as the P4 subspecies. <p>Threatened and Priority Ecological Communities</p> <ul style="list-style-type: none"> • No Threatened Ecological Communities (TEC) were recorded. 	<p>Two introduced species, *<i>Asphodelus fistulosus</i> (Onion Weed) and *<i>Gazania linearis</i>, were recorded in very small numbers at one site each. Under the Department of Parks and Wildlife Weed Prioritisation Process, *<i>Gazania linearis</i> is considered to be one of the 17 Goldfields Region priority alert weeds.</p>

Survey	No. Quadrats	Dominant Genera and Families	Vegetation Communities and Condition	Conservation Significant Taxa and Communities	Introduced Species
				<ul style="list-style-type: none"> No Priority Ecological Communities (PEC) were recorded in the study area. One PEC (<i>Allocasuarina globosa</i> assemblages on greenstone rock'), supporting the Threatened flora species <i>Allocasuarina globosa</i> (T) is known to occur south of Norseman and is located 12 km north of the Scotia survey area (note that Scotia is approximately 30 km southeast of the Norseman township). Note there are no Threatened or priority flora species or TEC/PECs located within the Green Lantern Project Purpose Permit boundary. 	
<p>Spring 2020 (Mattiske 2020b):</p> <ul style="list-style-type: none"> Hills Area: <ul style="list-style-type: none"> Cobbler Scotia extensions (NB: Scotia Extensions included the Green Lantern area). Flats Area: <ul style="list-style-type: none"> Camp North Royal extension OK 	<ul style="list-style-type: none"> 48 quadrats in the 'Hills' area. 31 Quadrats in the 'Flats' area. 	<ul style="list-style-type: none"> A total of 168 vascular plant taxa, representative of 85 genera and 40 families, were recorded. In the Hills area, 145 taxa were recorded and in the Flats area, 100 taxa. The most common families overall, and within each of the Hills and Flats areas, were Myrtaceae, Chenopodiaceae, and Scrophulariaceae, and the most common genera were Eucalyptus, Eremophila and Acacia. Species accumulation analysis shows that approximately 70% in the Hills area and 65% in the Flats area of taxa potentially present in the survey areas were recorded during the field survey. 	<ul style="list-style-type: none"> Nine vegetation communities were mapped across the Hills survey areas: five Eucalyptus woodland communities, four shrubland communities as well as cleared land and salt lakes. Two Eucalyptus woodland communities made up most of the vegetation of the Hills survey area. Approximately 57% of the survey sites were assessed as being in Pristine condition and 43% in Excellent condition. The vegetation condition in the Hills area is generally better than that in the Flats areas, although both areas have very little disturbance within the areas of native vegetation. The east- 	<p>Threatened Species</p> <ul style="list-style-type: none"> No threatened flora species were recorded. <p>Priority Species</p> <ul style="list-style-type: none"> Eight priority flora species were recorded. i.e., <ul style="list-style-type: none"> <i>Allocasuarina eriochlamys</i> subsp. <i>grossa</i> (P3), <i>Eremophila purpurascens</i> (P3), <i>Eucalyptus cockswayi</i> (P3), <i>Eucalyptus websteriana</i> subsp. <i>norsemanica</i> (P1), <i>Goodenia laevis</i> subsp. <i>laevis</i> (P3), <i>Melaleuca coccinea</i> (P3), <i>Micromyrtus papillosa</i> (P1) and <i>Philothea apiculata</i> (P1). All of these taxa were found within the Hills survey areas; 	<p>Five introduced species, *<i>Asphodelus fistulosus</i> (Onion Weed), *<i>Carrichtera annua</i> (Ward's weed), *<i>Gazania linearis</i>, *<i>Salvia verbenaca</i> (Wild sage) and *<i>Sonchus oleraceus</i> (Common sowthistle) were recorded.</p>

Survey	No. Quadrats	Dominant Genera and Families	Vegetation Communities and Condition	Conservation Significant Taxa and Communities	Introduced Species
<ul style="list-style-type: none"> – Gladstone extensions – Slippers – TSF 			<p>facing hillslope at Cobbler had been burnt within the previous year; quadrats were moved slightly to avoid burnt vegetation.</p>	<p>one taxon was also recorded in the TSF and Camp areas.</p> <ul style="list-style-type: none"> • The shrub <i>Eremophila parvifolia?subsp. parvifolia</i> (P4), collected in Autumn as a potential priority species, was re-collected in spring and re-identified as the non-priority listed subspecies <i>Eremophila parvifolia ?subsp. auricampi</i>. <p>Threatened and Priority Ecological Communities</p> <ul style="list-style-type: none"> • No TECs or PECs were recorded. 	
Spring 2020 (Scotia) (Biota 2020)	10 quadrats.	<ul style="list-style-type: none"> • 136 native vascular flora taxa, 68 genera and 41 families. 	<ul style="list-style-type: none"> • Seven vegetation types were identified within the study area comprising: <ul style="list-style-type: none"> – A mosaic of five different Eucalyptus open forest vegetation types was recorded on plains surrounding the lake. – The Melaleuca shrubland vegetation type occurred along the salt lake margins, with three small depressions of samphire shrubland scattered through the site. • Two other units not assessed as vegetation types were also identified and mapped; these were the non-vegetation bed of the salt lake and cleared ravel roads and tracks. • Approximately 150 ha, or 60.73% of the study area was comprised of 'Pristine' vegetation. 	<p>Threatened Species</p> <ul style="list-style-type: none"> • No Threatened species. <p>Priority Species</p> <ul style="list-style-type: none"> • One P3 i.e., <i>Eremophila purpurascens</i> was recorded at two separate locations in the E5 vegetation type. • One potential P1 species i.e., <i>Lepidosperma ?lyonsii</i> was not able to be confirmed through the formal identification process as the taxonomic revision for the genus is not yet complete. A small population of this species was found within the MS vegetation type along the central western edge of the study area. <p>Threatened and Priority Ecological Communities</p> <ul style="list-style-type: none"> • No TECs or PECs were recorded. 	One introduced flora species (* <i>Pentameris airoides</i>).

Survey	No. Quadrats	Dominant Genera and Families	Vegetation Communities and Condition	Conservation Significant Taxa and Communities	Introduced Species
			<ul style="list-style-type: none"> • Less than 5% of the study area was rated as 'Excellent' (the E5 vegetation type) due to the presence of the weed species <i>Pentameris airoides</i>. • Less than 1% was rated as 'Completely Degraded' and comprised cleared roads and tracks. • The non-vegetated salt lake bed, covering just over a third of the study area, was not assigned a condition rating due to it being naturally devoid of vegetation. 		

2.4.2.2 Impact Assessment

Conservation Significant Flora Species

Records of *Eremophila purpurascens* (P3) were found during the Scotia and Green Lantern survey as shown in Figure 5, however these records are not located within the proposed Green Lantern site layout and will not be impacted (Figure 5).

One Priority Ecological Community (PEC) '*Allocasuarina globosa* assemblages on greenstone rock', supporting the Threatened flora species *Allocasuarina globosa* (T) is located 12 km north of the Scotia and Green Lantern survey area however this will not be impacted (note that Scotia and Green Lantern are located approximately 30 km southeast of the Norseman township).



An overview of the locations of Threatened and Priority flora for the PPA is shown in Figure 6.




Vegetation Communities

The NGP area lies within the Coolgardie 3 – Eastern Goldfields Subregion of the Coolgardie Bioregion within the Southwestern Interzone botanical district (Cowan 2001). The majority of the vegetation in the area comprises *Eucalyptus* woodlands, often over *Eremophila* species and/or chenopod shrublands, and *Triodia* species grasslands with mallees.

Vegetation communities of the Green Lantern survey area is shown in Table 4 (Mattiske 2020a and b).

Table 4: Vegetation Communities of the Green Lantern Survey Area

Vegetation Community (Mattiske 2020a and b)	Vegetation Type (Mattiske 2020a and b)	Photo (Mattiske 2020a and b)	Proposed Clearing of Native Vegetation (ha)	Total Mapped by Mattiske (2020a and b) (ha)	% Vegetation Community to be Impacted
SL - Salt lake or non-vegetated lake bed.	-	-	0	812.6	0%
S1 - Shrubland of <i>Allocasuarina</i> spp., <i>Acacia neurophylla</i> subsp. <i>neurophylla</i> , <i>Melaleuca ?hamata</i> , <i>Dodonaea microzyga</i> var. <i>acrolobata</i> and <i>Cryptandra</i> spp. over mixed <i>Asteraceae</i> sp. and <i>Lepidosperma</i> sp. on red-brown clayey loam and ironstone outcropping on upper slopes and ridges.	Shrubland		19.1	60.7	31.5%
S3 - Open woodland of <i>Eucalyptus ?salicola</i> over open shrubland of <i>Bossiaea barbarae</i> , <i>Acacia assimilis</i> subsp. <i>assimilis</i> and <i>Melaleuca lanceolata</i> over <i>Lepidosperma</i> sp. on pale orange sand flats on salt lake margins.	Open Woodland		0.04	0.2	20%

Vegetation Community (Mattiske 2020a and b)	Vegetation Type (Mattiske 2020a and b)	Photo (Mattiske 2020a and b)	Proposed Clearing of Native Vegetation (ha)	Total Mapped by Mattiske (2020a and b) (ha)	% Vegetation Community to be Impacted
W2 - Woodland to open woodland of <i>Eucalyptus flocktoniae</i> , <i>E. urna</i> , <i>E. lesouefii</i> and <i>E. dundasii</i> over sparse shrubland of <i>Melaleuca sheathiana</i> , <i>Eremophila scoparia</i> , <i>Scaevola spinescens</i> , <i>Beyeria sulcata</i> and <i>Exocarpos aphyllus</i> over isolated shrubs of <i>Olearia muelleri</i> on orange-red to brown clayey loam on flats and slopes.	Woodland / Open Woodland		88.2	869.5	10.2%
W3 - Open woodland of <i>Eucalyptus longicornis</i> or <i>E. delicata</i> over open shrubland of <i>Melaleuca sheathiana</i> and <i>Cratystylis conocephala</i> over mixed sparse chenopod shrubland on pale brown clayey loam flats.	Open Woodland		150.0	275.5	54.5%
W4 - Open woodland of <i>Eucalyptus torquata</i> over <i>Melaleuca sheathiana</i> , <i>Dodonaea microzyga</i> , <i>Alyxia buxifolia</i> , <i>Beyeria spp.</i> and <i>Eremophila spp.</i> over <i>Scaevola spinescens</i> and <i>Ptilotus obovatus</i> on red-brown clayey loam with surface rocks on slopes and ridges.	Open Woodland		19.0	216.9	8.8%


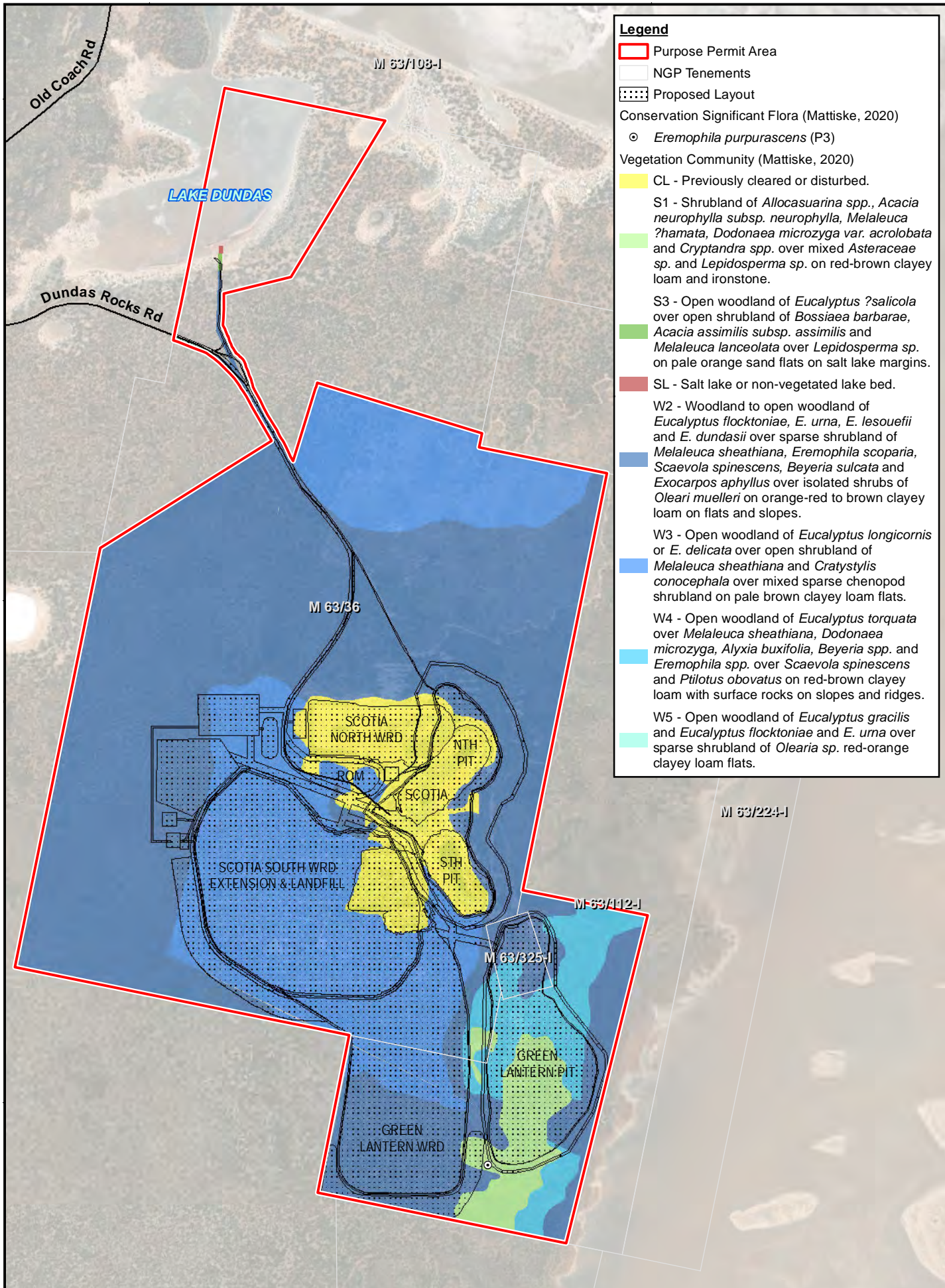
Vegetation Community (Mattiske 2020a and b)	Vegetation Type (Mattiske 2020a and b)	Photo (Mattiske 2020a and b)	Proposed Clearing of Native Vegetation (ha)	Total Mapped by Mattiske (2020a and b) (ha)	% Vegetation Community to be Impacted
W5 - Open woodland of <i>Eucalyptus gracilis</i> , <i>E. flocktoniae</i> and <i>E. urna</i> over sparse shrubland of <i>Olearia</i> spp. on red-orange clayey loam and sandy clay flats.	Open Woodland		0.43	9.8	4.4%
Total			276.8	2,245.2	-

Figure 5: Green Lantern Vegetation Communities and Conservation Significant Flora

Legend

- Purpose Permit Area
 - NGP Tenements
 - Proposed Layout
- Conservation Significant Flora (Matiske, 2020)
- ⊙ *Eremophila purpurascens* (P3)
- Vegetation Community (Matiske, 2020)
- CL - Previously cleared or disturbed.
 - S1 - Shrubland of *Allocasuarina* spp., *Acacia neurophylla* subsp. *neurophylla*, *Melaleuca ?hamata*, *Dodonaea microzyga* var. *acrolobata* and *Cryptandra* spp. over mixed Asteraceae sp. and *Lepidosperma* sp. on red-brown clayey loam and ironstone.
 - S3 - Open woodland of *Eucalyptus ?salicola* over open shrubland of *Bossiaea barbarae*, *Acacia assimilis* subsp. *assimilis* and *Melaleuca lanceolata* over *Lepidosperma* sp. on pale orange sand flats on salt lake margins.
 - SL - Salt lake or non-vegetated lake bed.
 - W2 - Woodland to open woodland of *Eucalyptus flocktoniae*, *E. urna*, *E. lesouefii* and *E. dundasii* over sparse shrubland of *Melaleuca sheathiana*, *Eremophila scoparia*, *Scaevola spinescens*, *Beyeria sulcata* and *Exocarpos aphyllus* over isolated shrubs of *Oleari muelleri* on orange-red to brown clayey loam on flats and slopes.
 - W3 - Open woodland of *Eucalyptus longicornis* or *E. delicata* over open shrubland of *Melaleuca sheathiana* and *Cratystylis conocephala* over mixed sparse chenopod shrubland on pale brown clayey loam flats.
 - W4 - Open woodland of *Eucalyptus torquata* over *Melaleuca sheathiana*, *Dodonaea microzyga*, *Alyxia buxifolia*, *Beyeria* spp. and *Eremophila* spp. over *Scaevola spinescens* and *Ptilotus obovatus* on red-brown clayey loam with surface rocks on slopes and ridges.
 - W5 - Open woodland of *Eucalyptus gracilis* and *Eucalyptus flocktoniae* and *E. urna* over sparse shrubland of *Olearia* sp. red-orange clayey loam flats.



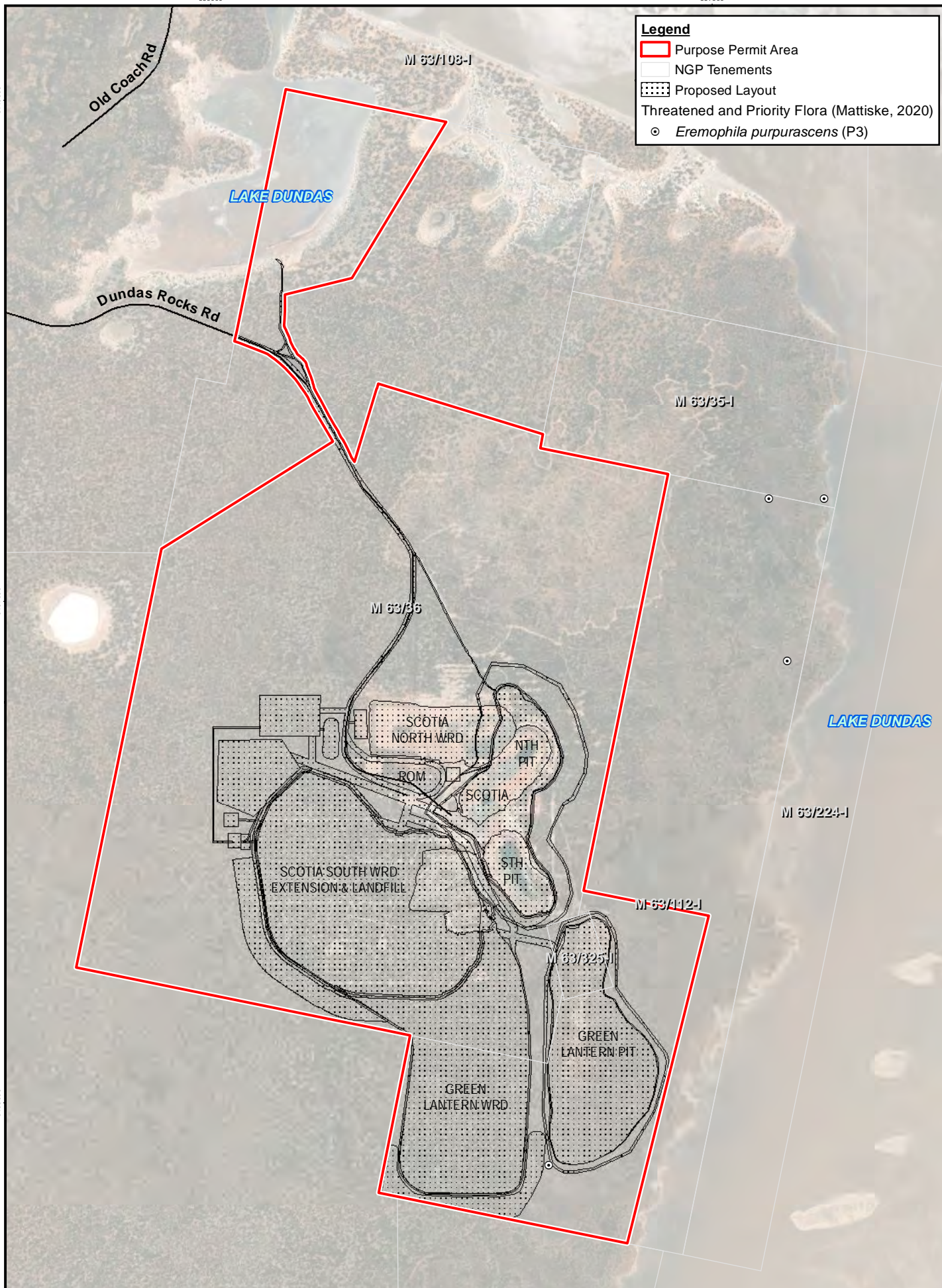
Date: 14/02/2022
 Scale: 1:25,000 @ A4
 Projection: GDA 1994 MGA Zone 51
 Tenements - DMIRS Ortho - Open Source

Pantoro South Pty Ltd
 Norseman Gold Project
 Green Lantern Clearing Permit

Figure 5
 Scotia & Green Lantern
 Vegetation Communities &
 Conservation Significant Flora



Figure 6: Overview – Threatened and Priority Flora



Legend

- Purpose Permit Area
- NGP Tenements
- Proposed Layout
- Threatened and Priority Flora (Mattiske, 2020)
- Eremophila purpurascens* (P3)

Date: 14/02/2022
 Scale: 1:25,000 @ A4
 Projection: GDA 1994 MGA Zone 51
 Tenements - DMIRS Ortho - Open Source

Pantoro South Pty Ltd
 Norseman Gold Project
 Green Lantern Clearing Permit

Figure 6
 Scotia & Green Lantern
 Threatened and Priority Flora



2.4.3 Weeds

The Mattiske (2020a) study recorded two introduced species within the entire NGP autumn survey area (the NGP includes Scotia and Green Lantern as well as other Project areas) i.e., **Asphodelus fistulosus* (Onion Weed) and **Gazania linearis*, in very small numbers at one site each.

The Mattiske (2020b) study recorded five introduced weed species within the entire NGP spring survey area (the NGP includes Scotia and Green Lantern as well as other Project areas) i.e., **Asphodelus fistulosus* (Onion Weed), **Carrichtera annua* (Ward's weed), **Gazania linearis*, **Salvia verbenaca* (Wild sage) and **Sonchus oleraceus* (Common sowthistle).

The Biota (2020) study recorded one introduced weed species (**Pentameris airoides*) within the Scotia area.

Under the Department of Parks and Wildlife Weed Prioritisation Process, **Gazania linearis* is considered to be one of the 17 Goldfields Region priority alert weeds (Mattiske 2020a). None of these species are Weeds of National Significance (DAWE 2020b).

The declared pest status and control/keeping category pursuant to section 22 of the *Biosecurity and Agriculture Management Act 2007* (BAM Act) for all of the above-mentioned weed species is (DPIRD 2020b):

- Permitted - s11 (Permitted organisms must satisfy any applicable import requirements when imported. They may be subject to an import permit if they are potential carriers of high-risk organisms). Not assigned to any control category for a local government area at this time.

No weeds were recorded within the Purpose Permit boundary of Green Lantern.

2.4.4 Great Western Woodlands

The NGP (which includes the Green Lantern Project) falls within the Great Western Woodlands (GWW). The GWW are the largest remaining intact Mediterranean-climate woodland which covers almost 16 million hectares in size and extends between the edge of the Western Australian Wheatbelt in the west, to Kalgoorlie-Boulder in the north, the inland deserts to the northeast and the Nullarbor Plain to the east (DEC 2010). The GWW is an internationally significant area of biological richness. The vegetation of the area is predominantly woodland communities, but also includes shrubland and mallee vegetation (DEC 2010). It supports approximately 20% of Australia's known flora and is a centre of Eucalyptus species diversity, with over 160 species of Eucalyptus found in the area (DEC 2010).

2.5 Terrestrial Vertebrate Fauna and Habitat

2.5.1 Basic Survey 2020

2.5.1.1 Overview

Western Wildlife was engaged to complete a basic vertebrate fauna survey and targeted Malleefowl survey (Appendix 5) (Western Wildlife 2021). A desktop and field survey was carried out in June 2020 for NGP areas totalling 4,180.2 ha and this included the Scotia and Green Lantern Project areas (Table 5). After the basic survey was completed, the survey area was extended into adjacent areas of the NGP. These additional areas were subject to a desktop survey, including habitat mapping, in January 2021. The survey was undertaken in accordance with:

- Environmental Factor Guideline - Terrestrial Fauna (EPA 2016c).
- Technical Guidance - Terrestrial vertebrate fauna surveys for environmental impact assessment (EPA 2020).

Eight fauna habitats were identified across the NGP areas and the survey area extent for each habitat is shown in Table 5:

- Eucalypt woodland on rocky hills.
- Eucalypt woodland on plains.
- Mallee woodland over spinifex.
- Shrubland on rocky hills.
- Shrubland on sandy lake edges.
- Gypsum dunes.
- Chenopod shrubland.
- Salt lake.

The habitats present are common in the region. Habitats that are less common in the region, such as granite outcrops or freshwater wetlands, were absent from the NGP area. Although all habitats have importance in supporting native fauna, the habitats of the NGP area are unlikely to be of particular significance as ecological linkages, refugia or supporting important populations of conservation significant vertebrate fauna (Western Wildlife 2021).

Table 5: Survey Area Extent of Fauna Habitats (Western Wildlife 2021)

Survey Area	Area of Each Habitat (ha)									
	Cleared	Chenopod shrubland	Eucalypt woodland on plains	Eucalypt woodland on rocky hills	Gypsum dunes	Mallee woodland over spinifex	Salt lake	Shrubland on rocky hills	Shrubland on sandy lake edge	Total
North Royal	195.27	13.96	151.51	34.87	-	-	1.97	-	8.87	406.45
Gladstone	110.64	316.44	194.43	64.53	132.52	31.75	424.04	-	156.41	1,430.76
North Royal – Gladstone Haul Road	20.69	-	-	5.99	-	2.43	-	-	-	29.11
Cobbler	8.71	14.89	28.20	46.48	-	-	363.44	14.53	-	476.25
TSF4	79.09	-	4.09	112.96	-	-	-	20.37	-	216.51
OK	38.51	-	-	81.82	-	-	-	-	-	120.34
Camp	10.24	-	-	4.60	-	-	-	-	-	14.84
Maybell	7.72	9.11	211.09	49.28	-	-	9.83	25.30	-	312.33
Scotia (includes Green Lantern)	70.62	8.41	917.22	128.88	-	-	11.41	36.92	0.17	1,173.62
Total (ha)	541.50	362.81	1,506.53	529.39	132.52	34.18	810.70	97.12	165.45	4,180.20

The faunal assemblage of the NGP area is likely to be largely intact, as the NGP area is situated within a larger tract of native vegetation. Many of the species that occur are widely distributed through semi-arid Australia. The predicted faunal assemblage includes up to seven frogs, 64 reptiles, 150 birds, 25 native mammals and eight introduced mammals. The observed assemblage on this survey included no frogs or reptiles, 46 birds and five introduced mammals.

Fifteen conservation significant fauna potentially occur in the NGP area (however none occur within the Scotia and Green Lantern survey areas); these comprise of (Western Wildlife 2021):

- Three Threatened species:
 - Curlew Sandpiper (*Calidris ferruginea*) – Environment Protection and Biodiversity Conservation Act (EPBC Act) (Critically Endangered and Migratory, Biodiversity Conservation Act 2016 (BC Act) (Critically Endangered).
 - Chuditch (*Dasyurus geoffroi*) – EPBC Act (Vulnerable), BC Act (Vulnerable).
 - Malleefowl (*Leipoa ocellata*) – EPBC Act (Vulnerable), BC Act (Vulnerable).
- Six Migratory species:
 - Common Sandpiper (*Actitis hypoleucos*) – EPBC Act (Migratory), BC Act (Migratory).
 - Sharp-tailed Sandpiper (*Calidris acuminata*) – EPBC Act (Migratory), BC Act (Migratory).
 - Common Greenshank (*Tringa nebularia*) – EPBC Act (Migratory), BC Act (Migratory).
 - Red-necked Stint – (*Calidris ruficollis*) – EPBC Act (Migratory), BC Act (Migratory).
 - Pectoral Sandpiper (*Calidris melanotos*) – EPBC Act (Migratory), BC Act (Migratory).

- Fork-tailed Swift (*Apus pacificus*) – EPBC Act (Migratory), BC Act (Migratory).
- One Specially Protected species:
 - Peregrine Falcon (*Falco peregrinus*) – BC Act (Other Specially Protected).
- Five Priority species:
 - Lake Cronin Snake (*Paroplocephalus atriceps*) – Priority 3.
 - Hooded Plover (*Thinornis cucullata*) – Priority 4.
 - Inland Western Rosella (*Platycercus icterotis xanthagenys*) – Priority 4.
 - Central Long-eared Bat (*Nyctophilus major tor*) – Priority 3.
 - Western Brush Wallaby (*Notamacropus irma*) – Priority 4.

A summary of the above listed conservation significant fauna is provided in Table 6 and is further described below (Western Wildlife 2021):

- The Curlew Sandpiper may occur but is unlikely to be a regular visitor as it favours coastal environments.
- The Chuditch may occur in woodlands and shrublands in low densities, but there are very few records of this species in the region.
- The Malleefowl is known to occur in the region and may occur. However, no evidence of the Malleefowl was recorded in the NGP area despite 153 km of transects walked, and dense shrubby habitats suitable for nesting were uncommon in the NGP area (Figure 7, Western Wildlife 2021).
- Although Migratory shorebirds may occur on occasion, the salt lake habitat of the NGP area is unlikely to support nationally or internationally significant numbers of any species. The Fork-tailed Swift is a Migratory species that is thought to be almost entirely aerial when visiting Australia, so the NGP area is not likely to provide important habitat for this species (Western Wildlife 2021).
- The Peregrine Falcon is likely to occur as a foraging visitor and may breed in abandoned open pits (Western Wildlife 2021).
- The Lake Cronin Snake has a low likelihood of occurrence despite suitable habitat being present, as there are few records in the region and the NGP area is north of its current known range.
- The Hooded Plover is known to occur on Lake Dundas, and is likely to occur in salt lake habitats, at least on occasion.
- The Inland Western Rosella (*Platycercus icterotis xanthagenys*) was recorded during this fauna survey however it was not found within the Green Lantern site layout. It is likely to occur in eucalypt woodlands and shrublands as a breeding resident, breeding in tree hollows (Table 6).
- The Central Long-eared Bat is known to occur in the region and is likely to occur in eucalypt woodlands.
- The Western Brush Wallaby may occur in woodland and shrubland habitats, but the NGP areas represent the extreme eastern edge of this species range (Western Wildlife 2021).

Table 6: Summary of Conservation Significant Vertebrate Fauna (Western Wildlife 2021)

Species	Status*				Likelihood of Occurrence	Habitat							Notes
	EPBC Act**	BC Act***	DBCA Priority	Locally Significant		Eucalypt Woodland on Rocky Hills	Eucalypt Woodland on Plains	Mallee Woodland over Spinifex	Shrubland on Rocky Hills	Shrubland on Salt Lake Edges	Gypsum Dunes	Chenopod Shrubland	
REPTILES													
<i>Paroplocephalus atriceps</i> Lake Cronin Snake			P3		Very Low		X						Although the habitats present are potentially suitable, its distribution is not currently known to extend as far north as the study areas.
BIRDS													
<i>Calidris ferruginea</i> Curlew Sandpiper	Cr	Cr			Moderate							X	Although it may occur on occasion, this species is not likely to be present in significant numbers.
<i>Leipoa ocellata</i> Malleefowl	Vu	Vu			Moderate	X	X		X				This species is known to occur in the region, but no evidence of its presence was recorded during the field survey despite extensive searching.
<i>Falco peregrinus</i> Peregrine Falcon		OS			High	X	X	X		X	X	X	Although likely to occur, foraging in most open habitats, the study area is unlikely to be of particular significance to this species.
<i>Actitis hypoleucos</i> Common Sandpiper	Mi	Mi			High							X	Although likely to occur on occasion, this species is not likely to be present in significant numbers.
<i>Calidris acuminata</i> Sharp-tailed Sandpiper	Mi	Mi			High							X	Although likely to occur on occasion, this species is not likely to be present in significant numbers.

Species	Status*				Likelihood of Occurrence	Habitat							Notes	
	EPBC Act**	BC Act***	DBCA Priority	Locally Significant		Eucalypt Woodland on Rocky Hills	Eucalypt Woodland on Plains	Mallee Woodland over Spinifex	Shrubland on Rocky Hills	Shrubland on Salt Lake Edges	Gypsum Dunes	Chenopod Shrubland		Salt Lake
<i>Tringa nebularia</i> Common Greenshank	Mi	Mi			High								X	Although likely to occur on occasion, this species is not likely to be present in significant numbers.
<i>Calidris ruficollis</i> Red-necked Stint	Mi	Mi			High								X	Although likely to occur on occasion, this species is not likely to be present in significant numbers.
<i>Calidris melanotos</i> Pectoral Sandpiper	Mi	Mi			Low								X	This species may occur but prefers vegetated freshwater wetlands.
<i>Apus pacificus</i> Fork-tailed Swift	Mi	Mi			Moderate									This species is largely aerial in Australia, and although it may overfly the area the terrestrial habitats of the study area are not likely to be important for this species.
<i>Thinornis cucullata</i> Hooded Plover			P4		High								X	Known to occur on Lake Dundas, this species is likely to occur in the study area, at least on occasion.
<i>Platycercus icterotis xanthagenys</i> Inland Western Rosella			P4		Known to occur	X	X		X					This species was recorded in the OK study area during the 2020 field survey and is likely to be a breeding resident.
MAMMALS														
<i>Dasyurus geoffroii</i> Chuditch	Vu	Vu			Low	X	X		X					Although the habitats present are suitable, there are few records of this species in the region.

Species	Status*				Likelihood of Occurrence	Habitat							Notes	
	EPBC Act**	BC Act***	DBCA Priority	Locally Significant		Eucalypt Woodland on Rocky Hills	Eucalypt Woodland on Plains	Mallee Woodland over Spinifex	Shrubland on Rocky Hills	Shrubland on Salt Lake Edges	Gypsum Dunes	Chenopod Shrubland		Salt Lake
<i>Nyctophilus major</i> tor Central Long-eared Bat			P3		Moderate	X	X							This species is known to occur in the region and its favoured woodland habitats are present.
<i>Notamacropus irma</i> Western Brush Wallaby			P4		Low	X	X		X					This species may occur at low densities in the region, although it is likely to be at the very eastern limit of its distribution in the vicinity of the study areas.

*Key to Status: Mig = Migratory, En = Endangered, Vu = Vulnerable, OS = Other Specially Protected Fauna, P = Priority, LS = locally significant (Western Wildlife 2021).

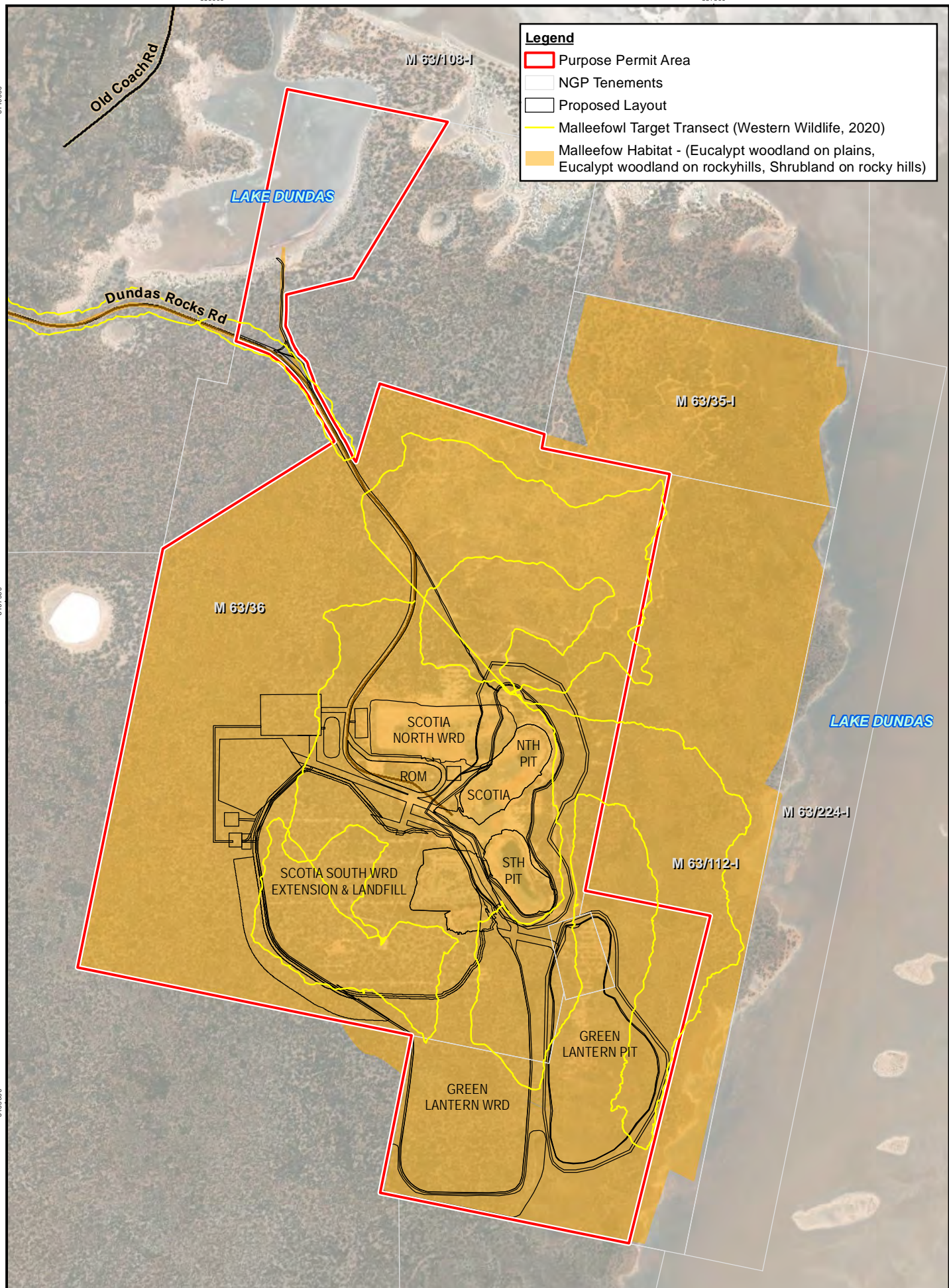
** EPBC Act - *Environment Protection and Biodiversity Conservation Act 1999*.

*** BC Act - *Biodiversity Conservation Act 2016*.

Figure 7: Overview – Targeted Malleefowl Search

Legend

- Purpose Permit Area
- NGP Tenements
- Proposed Layout
- Malleefowl Target Transect (Western Wildlife, 2020)
- Malleefowl Habitat - (Eucalypt woodland on plains, Eucalypt woodland on rocky hills, Shrubland on rocky hills)



Date: 14/02/2022
 Scale: 1:25,000 @ A4
 Projection: GDA 1994 MGA Zone 51
 Tenements - DMIRS Ortho - Open Source

Pantoro South Pty Ltd
 Norseman Gold Project
 Green Lantern Clearing Permit

Figure 7
 Scotia & Green Lantern
 Targeted Malleefowl Search



2.5.1.2 Impact Assessment





Conservation Significant Fauna Species

No conservation significant fauna was identified within the vicinity of the Green Lantern survey area (Figure 8).

Fauna Habitats

Fauna habitats of the survey areas are described in Table 7 and shown in Figure 8.

Table 7: Fauna Habitats of the Survey Area

Fauna Habitat	Fauna Habitat Type (Western Wildlife 2021)	Photo (Western Wildlife 2021)	Proposed Clearing of Fauna Habitat (ha)	Total Mapped by Western Wildlife (2021) (ha)	% Fauna Habitat to be Impacted
Salt lake	The bare lakebeds of Lake Cowan and Lake Dundas lack vegetation.		0	812.1	0%
Shrubland on lake edges	Open shrubland of Sticky Hopbush (<i>Dodonaea viscosa</i>), Currant Bush (<i>Scaevola spinescens</i>), <i>Eremophila</i> sp. and mixed chenopods, sometimes with scattered Rottnest Island Pine (<i>Callitris preisii</i>).		0.04	169.0	0.03%
Eucalypt woodland on plains	Woodland of Merrit (<i>Eucalyptus flocktoniae</i>), Red Morrel (<i>Eucalyptus longicornis</i>), Gimlet (<i>Eucalyptus salubris</i>), Dundas Blackbutt (<i>Eucalyptus dundasii</i>), Mallett (<i>Eucalyptus prolixa</i>) and Goldfields Blackbutt (<i>Eucalyptus lesouefii</i>).		235.9	1,553.2	15.2%
Eucalypt woodland on rocky hills	Woodland of Coral Gum (<i>Eucalyptus torquata</i>) over shrubs such as Boree (<i>Melaleuca sheathiana</i>), Brilliant Hopbush (<i>Dodonaea microzyga</i>) and Sea Box (<i>Alyxia buxifolia</i>).		20.1	611.1	3.3%


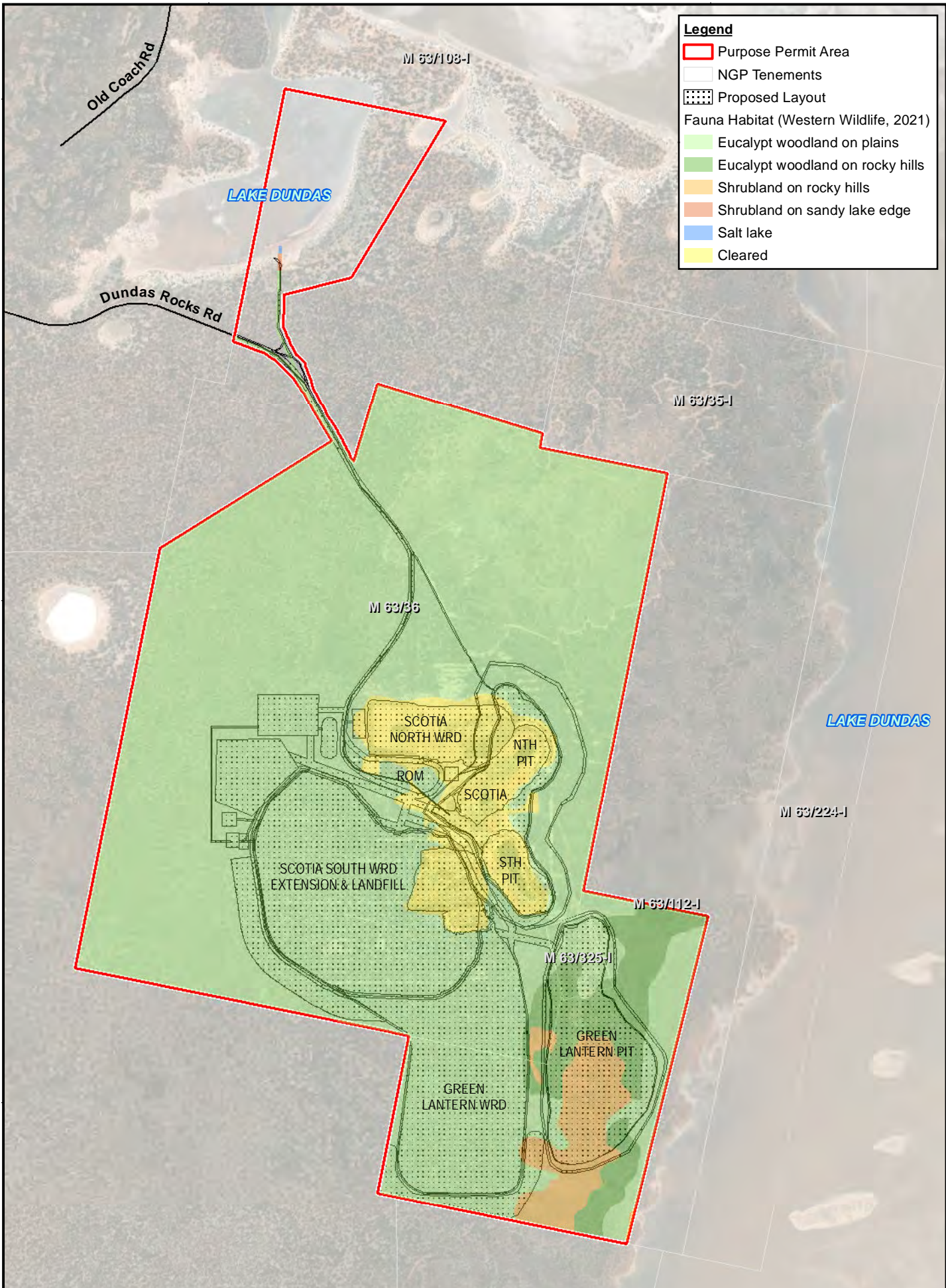
Fauna Habitat	Fauna Habitat Type (Western Wildlife 2021)	Photo (Western Wildlife 2021)	Proposed Clearing of Fauna Habitat (ha)	Total Mapped by Western Wildlife (2021) (ha)	% Fauna Habitat to be Impacted
Shrubland on rocky hills	Shrubland of sheoaks (<i>Allocasuarina acutivalvis</i> or <i>Allocasuarina campestris</i>), <i>Grevillea nematophylla</i> and/or <i>Acacia neurophylla</i> .		19.1	97.2	19.7%
Total			275.2	3,242.6	-

Figure 8: Green Lantern Fauna Habitats and Conservation Significant Fauna



Legend

- Purpose Permit Area
- NGP Tenements
- Proposed Layout
- Fauna Habitat (Western Wildlife, 2021)
- Eucalypt woodland on plains
- Eucalypt woodland on rocky hills
- Shrubland on rocky hills
- Shrubland on sandy lake edge
- Salt lake
- Cleared

Date: 14/02/2022
 Scale: 1:25,000 @ A4
 Projection: GDA 1994 MGA Zone 51
 Tenements - DMIRS Ortho - Open Source

Pantoro South Pty Ltd
 Norseman Gold Project
 Green Lantern Clearing Permit

Figure 8
 Scotia & Green Lantern
 Fauna Habitat



2.5.2 Introduced Species

Eight introduced species were identified as having the potential to occur in the Project area; these include the House Mouse (*Mus musculus*), Black Rat (*Rattus rattus*), Dog (*Canis familiaris familiaris*), Fox (*Vulpes vulpes*), Cat (*Felis catus*), Dromedary Camel (*Camelus dromedarius*), European Rabbit (*Oryctolagus cuniculus*) and Feral Goat (*Capra hircus*).

2.6 Heritage and Social Setting

2.6.1 Land Use and Community

The town of Norseman is located adjacent to the NGP. Norseman is the last major town in Western Australia before heading east across the Nullarbor Plain. According to the Australian Bureau of Statistics (ABS), Norseman has a population of 581 people and of this, 75 people are of Aboriginal and/or Torres Strait Islander People descent (ABS 2016).

The Norseman area is in a well-established mining region (Goldfields), with a number of other mines of various ages and phases (some operating, some in care and maintenance, and some abandoned) in the surrounding area. On final relinquishment of the NGP tenements, the land is expected to revert to vacant Crown land (Pantoro 2020). As the land is within a prospective mineralised area however, part or all of it is likely to remain under some form of mining tenure indefinitely, with any outstanding liability transferred to future tenement holders (Pantoro 2020).

Other than mining, key land uses include residential, recreation and passing tourism in the vicinity of the Norseman township with some pastoralism (cattle and sheep grazing), forest and nature reserves in the broader region (Pantoro 2020). The surrounding areas comprise native bushland and salt lake ecosystems, forming part of the Great Western Woodlands (GWW). The GWW cover a 16 million hectare swath of woodlands and heathlands interspersed with salt lakes. It remains a largely intact ecosystem predominantly located on public lands, however only small portions of the area are currently under protection.

The post mining land use will be re-establishment of native ecosystems (Pantoro 2020). Due to the proximity to the Norseman township, a key focus will be on the protection of public safety, with all potential hazards either removed or isolated (Pantoro 2020). The amenity of the community is also a key consideration, with post mining landforms designed to be compatible with their surroundings as far as practicable.

As part of stakeholder engagement, Pantoro will ensure that the post-mining land use is further defined and agreed with key stakeholders.

2.6.2 Aboriginal Heritage

A number of Aboriginal heritage surveys have been completed for the NGP area, dating back to the 1990s, which provide an understanding of the location of heritage sites (both archaeological and ethnographic). These include:

- Smith, M. (1994). *Aboriginal Sites in Ngadju Country. Requested by the MURNKURNI Aboriginal Women's Corporation now part of Ngadju Bugarla Mirning Wamu Wamu Aboriginal Corporation*. A Report for the National Estate Programme.
- Archae-aus – Gifford, P. and Veitch, B. (April 1997). *Preliminary Advice on an Aboriginal Heritage Survey of the Proposed Lady Miller Mine Project area near Norseman Western Australia for Central Norseman Gold Corporation Pty Ltd*.
- Archae-aus - Gifford, P. and Veitch, B. (May 1997). *Preliminary Advice on an Aboriginal Ethnographic Assessment and an Archaeological Field Inspection of the Central Norseman Gold Exploration Leases near Norseman, Western Australia*.
- Gleason, J. (December 1999). *Report of an Aboriginal Heritage Field Inspection (Ngadju People) of Central Norseman Gold Corporation and St. Ives Gold Buldania Tenements Near Norseman, Western Australia*.
- Glendenning, W. (February 2005). *A Report of an Ethnographic Survey of a Proposed Mineral Exploration Program at Norseman (prepared for Croesus Mining NL)*.
- Barret, R. (September 2009). *Results of an Ethnographic Survey for Norseman Gold - Fraser Range Survey – Ngadju Component. A Report Prepared for Norseman Gold and the Goldfields Land and Sea Council on behalf of the Ngadju People*.

- JCHMC Pty Ltd. (September 2020). *Site Visit Central Norseman Gold Pty Ltd (Pantoro) M63/659*. A Report Prepared for Ngadju Native Title Aboriginal Corporation.

From this, Archaeaus – Gifford, P. and Veitch, B. (April 1997) and Gleason, J. (December 1999) include M63/36, M63/112-I and M63/325-I. No Aboriginal heritage sites are known to occur within M63/36, M63/112-I and M63/325-I. These survey reports are classified as confidential and provision of these reports will be considered upon request.

A search of the Aboriginal Heritage Inquiry System (AHIS) (DPLH 2020) on 23 October 2020 and 9 December 2021 found no registered Aboriginal heritage sites within M63/36, M63/112-I and M63/325-I.

One 'other heritage place' named 'Horse Rocks' (Place ID: 2923), described as 'artefacts/scatter, camp, water source' (DPLH 2020), is situated outside of M63/36 towards the northwest of the tenement and will not be impacted by mining activities.

Proposed activities within this application will not have any effect on Aboriginal heritage sites.

Pantoro have liaised with the Ngadju Native Title Aboriginal Corporation (NNTAC) to discuss proposed mining activities within the Scotia and Green Lantern areas. Pantoro maintains regular consultation with the NNTAC to ensure that the greater NGP will not result in an impact to registered Aboriginal heritage sites. Pantoro will continue to work closely with the NNTAC throughout the life of mine to ensure ongoing compliance with the *Aboriginal Heritage Act 1972*.

2.6.3 European Heritage

Traces of alluvial gold were first discovered in the Dundas area by Mr Moir of Fanny's Creek in 1890 and the Dundas Field was proclaimed in 1893. In 1894, Laurie Sinclair was prospecting just north of Dundas and discovered the rich Norseman reef which according to legend, he named after his horse (Shire of Dundas 2017).

The town of Norseman was gazetted in 1895 and replaced Dundas as the major township in the area. With continuation of mining around Norseman, the town expanded with establishment of a post office, banks, newspapers, churches, general stores and other infrastructure and a rail link between Norseman and Coolgardie was established in 1909 (Shire of Dundas 2017).

Western Mining began operations at Norseman in 1935 providing electricity to the town and facilitating development of roads and extension of the water pipeline from Coolgardie to Norseman. The history of Norseman is intrinsically linked to its mining heritage (Shire of Dundas 2017).

The Australian Heritage Database (AHD) was searched on 22 September 2020 for the Norseman area which included the Scotia and Green Lantern Project areas. From this, the only place currently nominated for National Heritage listing in the Norseman area is the Great Western Woodlands (GWW) of Western Australia. The GWW is nominated as possibly the largest remaining intact area of temperate woodlands left on Earth covering an area of more than 16 million hectares including NGP tenements. There are three other natural areas in the Norseman area that are registered as heritage places on the Register of the National Estate, these comprise of:

- **Binaronca Rock Nature Reserve** – located along the Coolgardie-Esperance Highway near Higginsville, approximately 60 km south of Coolgardie and 9.5 km south of the small settlement of Widgiemooltha in Western Australia. It shows important and particularly clear exposures of the Binneringie Dyke, one of the world's largest basic dyke intrusions. It is the site of important geological research and part of ongoing study of basic intrusions in the Yilgarn Block (DAWE 2020).
- **Dundas Area** – located along the Eyre Highway, approximately 30 km southeast of Norseman in Western Australia. It is representative of the southern part of the eastern goldfields and has important wilderness values. Recommended as a possible National Park or Nature Reserve (DAWE 2020).
- **Peak Charles National Park** – located along the Coogardie-Esperance Highway, 40km west of Salmon Gums and 85 km south-west of Norseman, comprising Reserve 36004. Peak Charles is an area of over 39,000 ha in the eastern part of the wheatbelt region in an area that is rich in endemic species at a national scale.

The State Inherit database was searched on 22 September 2020 for the Norseman area which included the Scotia and Green Lantern Project areas. From this, 58 heritage places were listed including 3 state registered places. The three state registered places are comprised of:

- **Holy Trinity Church** – 100 Angove Street, Norseman. Constructed 1898 to 1968.
- **Norseman Post Office** – 82 Prinsep Street, Norseman. Constructed 1897 to 1959.
- **Doctors House (fmr)** – 66 Talbot Street, Norseman. Constructed 1939, 1960s (destroyed by fire 2008).

It is expected the proposed activities in this Clearing Permit will not have any effect on European heritage listed places.

3. PROPOSED LAND CLEARING

As outlined in Section 1.1, this NVCP (Purpose Permit) application is for the development of Green Lantern which forms part of the larger NGP (Figure 4).

This application requests approval to progressively clear a combined total of 340.9 ha of native vegetation within a PPA of 918.7 ha. An active clearing permit exists for Scotia ((CPS 9466/1, valid from 5 March 2022 to 4 March 2027) which covers mine components pertaining to Scotia on M63/36. Due to the use of common infrastructure for both Projects, the PPA boundaries for this Green Lantern application and CPS 9466/1 overlap.

The proposed clearing of native vegetation is to allow for proposed mining of an open pit, construction and expansion of WRDs and construction of supporting infrastructure at Green Lantern. Supporting infrastructure includes (but is not limited to), topsoil and growth medium stockpiles, pipelines, roads and abandonment bunds.

Progressive clearing of native vegetation will be undertaken as required commencing Quarter 1 (2022) as soon as approval is received and will be undertaken in accordance with the approved associated Mining Proposal for the Project (Table 1). The life of mine of the Project is approximately 2029.

A GIS shapefile in GDA94 is provided with submission of this application.

4. ASSESSMENT OF CLEARING PRINCIPLES

Clearing applications are assessed against 10 principles as outlined in Schedule 5 of the EP Act (Table 8). These principles aim to ensure that all potential impacts resulting from the removal of native vegetation can be assessed in an integrated way and applied to all lands throughout Western Australia. The principles address the four main environmental areas of biodiversity significance, land degradation, conservation estate and ground and surface water quality.

Information regarding the potential impact of clearing for mining activities on each of these principles for the Project area is provided in Table 8.

Table 8: Native Vegetation Clearing Principles

Clearing Principle		Assessment
Biodiversity Significance	a). Native vegetation should not be cleared if it comprises a high level of biological diversity.	<ul style="list-style-type: none"> The area proposed to be cleared is located within the Coolgardie 3 – Eastern Goldfields Subregion of the Coolgardie Bioregion within the Southwestern Interzone botanical district (Cowan 2001). The subregion is extensive, measuring over 5.06 million hectares, with the proposed clearing amounting to 340.9 ha, representing <0.007% of the sub-region. Vegetation communities of the Project are considered common and widespread in the subregion. No live Threatened (T) Flora pursuant to Part 2, Division 1, Subdivision 2 of the <i>Biodiversity Conservation Act 2016</i> (BC Act) and as listed by DBCA, or pursuant to section 179 of the EPBC Act or listed by the Department of Agriculture, Water and the Environment (DAWE), were identified during the flora assessment. <i>Eremophila purpurascens</i> (P3) was recorded during the surveys, however this species will not be impacted by the proposed Project. No Threatened Ecological Communities (TEC) were recorded. No Priority Ecological Communities (PEC) were recorded in the study area. One PEC '<i>Allocasuarina globosa</i> assemblages on greenstone rock', supporting the Threatened flora species <i>Allocasuarina globosa</i> (T) is located 12 km north of the Scotia and Green Lantern survey area however this will not be impacted (note that Scotia and Green Lantern are located approximately 30 km southeast of the Norseman township). Given the above, the vegetation proposed to be cleared does not comprise a high level of biological diversity. The proposed clearing, therefore, is not likely to be at variance to this Principle.
	b). Native vegetation should not be cleared if it comprises the whole or part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.	<ul style="list-style-type: none"> The area proposed to be cleared is located within the Coolgardie 3 – Eastern Goldfields Subregion of the Coolgardie Bioregion within the Southwestern Interzone botanical district (Cowan 2001). The subregion is extensive, measuring over 5.06 million hectares, with the proposed clearing amounting to 340.9 ha, representing <0.007% of the sub-region. Eight fauna habitats were identified in the greater NGP area. Fauna habitats of the Project are considered common and widespread in the subregion and unlikely to function as ecological linkages or refugia. No conservation significant fauna species occur within the Green Lantern survey area. Given the above, the vegetation proposed to be cleared does not comprise the whole or a part of, or is necessary for the maintenance of, a significant habitat for native fauna. The clearing as proposed is therefore not at variance to this Principle.
	c). Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.	<ul style="list-style-type: none"> As stated above in Principle (a), <i>Eremophila purpurascens</i> (P3) was recorded during the surveys, however this species will not be impacted by the proposed Project. The clearing as proposed is therefore not at variance to this Principle.

Clearing Principle		Assessment
	d). Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a TEC.	<ul style="list-style-type: none"> No Threatened Ecological Communities (TECs) were recorded during surveys of the Green Lantern Project area. The clearing as proposed is therefore not at variance to this Principle.
	e). Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.	<ul style="list-style-type: none"> No remnant vegetation occurs within the Green Lantern Project area. The clearing of vegetation as proposed is therefore not at variance to this principle.
	f). Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.	<ul style="list-style-type: none"> No watercourses or wetlands are located within the proposed clearing area. Lake Dundas is the closest salt lake associated with the Green Lantern Project. Lake Dundas is not listed on the Directory of Important Wetlands of Australia (Environment Australia 2001). Although local drainage is towards Lake Dundas, there are no major river systems within the vicinity of the Green Lantern deposit and much of the runoff from local catchments reports to the lake by a combination of shallow sheetflow and channelised flow via minor creeks and watercourses. For the majority of the year, drainage systems are dry. No vegetation groups are classed as riparian in the proposed clearing area. The clearing of vegetation as proposed is therefore not at variance to this principle.
Land Degradation	g). Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.	<ul style="list-style-type: none"> The proposed area of native vegetation clearing is 340.9 ha and will not cause any appreciable land degradation. The nearby Scotia Project contains existing disturbance from historic operations and supporting infrastructure used for the Green Lantern Project will be mostly located at Scotia. All disturbed areas will be rehabilitated at the completion of operations in accordance with the Mine Closure Plan, or progressively throughout operations where it is practical to do so. Six weed species were identified throughout the Project areas (refer to section 2.4.3). Under the Department of Parks and Wildlife Weed Prioritisation Process, *<i>Gazania linearis</i> is considered to be one of the 17 Goldfields Region priority alert weeds (Mattiske 2020a). None of these species are Weeds of National Significance (DAWE 2020b). Vehicle hygiene practices will be implemented to prevent the introduction and spread of weeds. Soils are predominantly calcareous earths. Slopes range from up to 25% for the southern tenements. The size and progressive nature of the clearing is unlikely to increase water and wind erosion. Increases in salinity, water logging, soil acidity and nutrient export are all unlikely to occur as a result of implementation of the Projects. The clearing of vegetation as proposed is therefore not at variance to this principle.

Clearing Principle		Assessment
Conservation Estate	h). Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.	<ul style="list-style-type: none"> The NGP is located within the Great Western Woodlands (GWW) nominated for National Heritage listing. Clearing activities are unlikely to have an impact on the environmental values of the GWW as the extent of clearing is a small percentage of the GWW, the majority of Project areas have experienced previous disturbance through historical mining activities, operations will be completed in accordance with strict environmental management procedures including internal Ground Disturbance Permits, rehabilitation will be completed at the end of operations, or progressively throughout operation where it is practical to do so. There are three heritage places on the Register of the National Estate (i.e., Binaronca Rock Nature Reserve, Dundas Area and Peak Charles National Park) however these will not be impacted by the proposed Projects. The clearing of vegetation as proposed is therefore not at variance to this principle.
Ground and Surface Water Quality	i). Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.	<ul style="list-style-type: none"> There are no major river systems in the vicinity of the NGP deposits. Lake Dundas is the closest salt lake associated with the Green Lantern Project. Clearing of vegetation around tributaries of Lake Dundas has the potential to result in increased sediment loads. This will be minimised through installation of sediment control structures at locations where high sediment loads are anticipated or observed. The proposed clearing is unlikely to cause deterioration in the quality of any surface water. The groundwater within the Project is largely hypersaline and is consistent with the surrounding region. Given this, the proposed clearing is unlikely to cause deterioration in the quality of any groundwater. There are no groundwater dependent vegetation units within the disturbance area. The clearing of vegetation as proposed is therefore not at variance to this principle.
	j). Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence of flooding.	<ul style="list-style-type: none"> The NGP is located in a relatively flat to slightly undulating area which may on occasion be at risk of flooding following short intense rainfall events. All the watercourses and drainages in the immediate vicinity of the Project are ephemeral and for the majority of the year, the drainage systems are dry. However, flows will occur periodically during high rainfall events. Some localised increase in surface runoff may occur where vegetation is cleared. However, the impact is unlikely to be detectable in the context of the range of the natural variability of runoff. Any minor effects will be short term as the majority of the area cleared will be revegetated on completion of operations in accordance with the Mine Closure Plan. Stormwater management controls e.g., v-drains, bunds and berms will be constructed as necessary to direct rainfall away from open excavations. Flood protection infrastructure has been designed based on analysis of sub-catchment characteristics to ensure appropriately sized structures are built. The clearing of native vegetation is unlikely to cause or exacerbate the incidence of flooding. The clearing of vegetation as proposed is therefore not at variance to this principle.

5. ENVIRONMENTAL MANAGEMENT MEASURES

In respect to the control and management of clearing and ground disturbance activities, the following shall be implemented:

- All proposed operations will be carried out in accordance with the provisions of the *Aboriginal Heritage Act 1972*.
- No impact to Aboriginal heritage sites as a result of ground disturbance and clearing.
- Disturbance will be minimised through careful design of site layout.
- Clearing activities will be managed to ensure clearing is strictly limited to that necessary for the operations.
- Ground disturbance and clearing is restricted to approved areas, amounts and limits.
- Implementation and adherence to the NVCP and valid exemptions.
- All Threatened and Priority flora and fauna species will be avoided.
- Include GIS check of vegetation communities, fauna habitat, Threatened and Priority flora and fauna species and Aboriginal heritage sites before approving the internal site Disturbance Permit.
- Inclusion of the relevant clearing approval (e.g., CPS number) on the internal site Disturbance Permit.
- Prior to clearing, the area will be demarcated.
- Stockpiles of growth medium (topsoil) will be stored at no greater than 2 m in height and will be protected from vehicular traffic and stormwater flows. Growth medium will be used to rehabilitate disturbed areas as soon as practicable.
- Post-clearing survey of ground disturbance.
- All vehicles and other equipment should be free of weed seeds and soil prior to mobilisation to site.
- Vehicles and other equipment will travel on designed access routes and mining infrastructure areas.
- Personnel will be required to adhere to speed limits and drive to road/weather conditions to minimise the risk of fauna injuries due to traffic.
- Annual review of disturbance areas and reporting in accordance with the NVCP, Mining Rehabilitation Fund (MRF) and Annual Environmental Report (AER) requirements.
- Disturbed areas will be rehabilitated progressively where possible and in accordance with the Mine Closure Plan.
- All personnel to complete the site induction which outlines strategies to protect the environment.

6. REHABILITATION

Rehabilitation is the return of disturbed land to a safe, stable, productive, non-polluting and self-sustaining condition in consideration of beneficial uses of the land. Appropriate rehabilitation will ensure that the long-term impacts of mining in the area are minimised.

Rehabilitation will be undertaken in accordance with the Mine Closure Plan and Pantoro will comply with all tenement conditions.

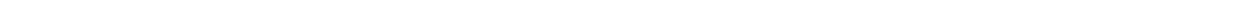
7. REFERENCES

- Australian Bureau of Statistics (ABS). 2016. *Norseman 2016 Census*. URL: https://quickstats.censusdata.abs.gov.au/census_services/getproduct/census/2016/quickstat/SSC51117 Accessed 22 September 2020.
- Archae-aus – Gifford, P. and Veitch, B. April 1997. *Preliminary Advice on an Aboriginal Heritage Survey of the Proposed Lady Miller Mine Project area near Norseman Western Australia for Central Norseman Gold Corporation Pty Ltd*.
- Archae-aus - Gifford, P. and Veitch, B. May 1997. *Preliminary Advice on an Aboriginal Ethnographic Assessment and an Archaeological Field Inspection of the Central Norseman Gold Exploration Leases near Norseman, Western Australia*.
- Barret, R. September 2009. *Results of an Ethnographic Survey for Norseman Gold - Fraser Range Survey – Ngadju Component. A Report Prepared for Norseman Gold and the Goldfields Land and Sea Council on behalf of the Ngadju People*.
- Beard, J. S. 1990. *Plant Life of Western Australia*. Kangaroo Press, Kenthurst, NSW.
- Biota Environmental Sciences. 2020. *Norseman Gold (Scotia) Reconnaissance Flora and Vegetation Survey*. An unpublished report prepared for Pantoro South.
- Bureau of Meteorology (BoM). 2020. *Climate of Norseman Aero (Station 012009)*. URL: http://www.bom.gov.au/climate/averages/tables/cw_012009.shtml Accessed 24 September 2020.
- Blueprint Environmental Strategies (Blueprint). 2021. *Soil Assessment – Norseman Gold Project*. An unpublished report prepared for Pantoro South Pty Ltd.
- Cowan, M., Graham, G. and McKenzie, N. (2001). *Coolgardie 2 (COO2 – Southern Cross subregion) In; The Biodiversity Audit of Western Australia*. Eds McKenzie, N.L., May, J.E. and McKenna, S. Department of Conservation and Land Management, Perth.
- Department of Agriculture and Food. 2006. *Soil-landscapes of Western Australia's Rangelands and Arid Interior, P. Tille, Government of Western Australia*.
- Department of Agriculture, Water and the Environment (DAWE). 2020a. *Australian Heritage Database*. URL: <http://www.environment.gov.au/cgi-bin/ahdb/search.pl> Accessed 22 September 2020.
- Department of Agriculture, Water and the Environment (DAWE). 2020b. *Weeds of National Significance*. URL: <http://www.environment.gov.au/biodiversity/invasive/weeds/weeds/lists/wons.html>. Accessed 6 March 2020.
- Department of Biodiversity, Conservation and Attractions (DBCA). 2020. *NatureMap*. URL: <https://naturemap.dbca.wa.gov.au/>
- Department of Biodiversity, Conservation and Attractions (DBCA). 2021. *Florabase*. URL: <https://florabase.dpaw.wa.gov.au/>
- Department of Environment and Conservation (DEC). 2010. *A Biodiversity and Cultural Conservation Strategy for the Great Western Woodlands, Government of Western Australia*. URL: <https://www.dpaw.wa.gov.au/management/off-reserve-conservation/the-great-westernwoodlands> Accessed 22 September 2020.
- Department of Environment and Energy (DoEE). 2020. *Protected Matters Search Tool*. URL: <http://www.environment.gov.au/webgis-framework/apps/pmst/pmst.jsf> Accessed 18 September 2020.
- Department of Parks and Wildlife (DPaW) (2013). *A Biodiversity Audit of Western Australia's 53 Biogeographic Subregions in 2002*. Available at: <https://www.dpaw.wa.gov.au/about-us/scienceand-research/biological-surveys/117-a-biodiversity-audit-of-wa>.

- Department of Primary Industries and Regional Development (DPIRD). 2020a. *Dominant Soil Groups - Highest Probability (DPIRD-077)*. URL: https://services.slip.wa.gov.au/public/services/SLIP_Public_Services/Geology_and_Soils_Map/MapServer/WMServer Accessed 16 September 2020.
- Department of Primary Industries and Regional Development (DPIRD). 2020b. *Western Australian Organism List*. Government of Western Australia. URL: <https://www.agric.wa.gov.au/organisms> Accessed 6 March 2020.
- Department of Planning, Lands and Heritage (DPLH). 2020. *Aboriginal Heritage Inquiry System (AHIS)*. URL: <https://espatial.dplh.wa.gov.au/AHIS/index.html?viewer=AHIS> Accessed 15 September 2020.
- Environmental Protection Authority (EPA). 2016a. *Environmental Factor Guideline: Flora and Vegetation*. Environmental Protection Authority, Western Australia.
- Environmental Protection Authority (EPA). 2016b. *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment*. Environmental Protection Authority, Western Australia.
- Environmental Protection Authority (EPA). 2016c. *Environmental Factor Guideline – Terrestrial Fauna*. EPA, Western Australia.
- Environmental Protection Authority (EPA). 2020. *Technical Guidance – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment*. EPA, Western Australia.
- Environment Australia. 2001. *A Directory of Important Wetlands in Australia, Third Edition*. Commonwealth of Australia. URL: <http://www.environment.gov.au/cgi-bin/wetlands/list.pl>
- Gleason, J. December 1999. *Report of an Aboriginal Heritage Field Inspection (Ngadju People) of Central Norseman Gold Corporation and St. Ives Gold Buldania Tenements Near Norseman, Western Australia*.
- Glendenning, W. February 2005. *A Report of an Ethnographic Survey of a Proposed Mineral Exploration Program at Norseman (prepared for Croesus Mining NL)*.
- Hall and McKenzie. (1993). *The Biological Survey of the Eastern Goldfields of Western Australia, Part 9, Norseman – Balladonia Study Area*. Records of the Western Australian Museum Supplement Number 42.
- Heritage Council, State Heritage Office. 2020. *InHerit Database*. Available: URL: <http://inherit.stateheritage.wa.gov.au/Public/>. Accessed 22 September 2020.
- Invertebrate Solutions. 2020a. *Survey for Short Range Endemic Fauna for the Pantoro South Norseman Gold Project, Norseman, Western Australia*. An unpublished report prepared for Pantoro Limited.
- JCHMC Pty Ltd. September 2020. *Site Visit Central Norseman Gold Pty Ltd (Pantoro) M63/659. A Report Prepared for Ngadju Native Title Aboriginal Corporation*.
- Landcare Services Pty Ltd (Landcare Services). 1995. *Baseline Vegetation Survey (Phase I), Central Norseman Gold Corporation Ltd, Norseman, Western Australia*. Prepared for Western Mining Corporation.
- Landcare Services Pty Ltd (Landcare Services). 1996. *Baseline Flora and Vegetation Survey (Phase II), Norseman WA*. Prepared for Central Norseman Gold Corp. Ltd.
- Landcare Services Pty Ltd (Landcare Services). 1997. *Baseline Flora Survey (Phase III), Norseman WA*. Prepared for Central Norseman Gold Corp. Ltd.
- Landgate. 2017. *Interactive Maps: Map Viewer*. URL: <https://www0.landgate.wa.gov.au/maps-and-imagery/interactive-maps/map-viewer/how-to-use-map-viewer-plus#%20Government%20of%20Western%20Australia>. Accessed 22 September 2020.
- Mattiske Consulting Pty Ltd (Mattiske). 2001. *Flora and Vegetation Survey, Gladstone and Daisy Project Areas, Norseman*. An unpublished report prepared for Central Norseman Gold Corporation Pty Ltd.
- Mattiske Consulting Pty Ltd (Mattiske). 2002. *Flora and Vegetation Survey Proposed Mining Area Cobbler-Norseman*. An unpublished report prepared for Croesus Mining NL.

- Mattiske Consulting Pty Ltd (Mattiske). 2005. *Flora, Vegetation and Vertebrate Fauna Survey on Proposed Tailings Dam Area*. An unpublished report prepared for Croesus Mining NL.
- Mattiske Consulting Pty Ltd. (2020a). *Flora and Vegetation Assessment, Norseman Gold Project, Norseman WA*. An unpublished report prepared for Pantoro Ltd.
- Mattiske Consulting Pty Ltd. (2020b). *Flora and Vegetation Assessment – Spring 2020, Norseman Gold Project, Norseman WA*. An unpublished report prepared for Pantoro Ltd.
- Native Vegetation Solutions (NVS). 2020. *Targeted Threatened Flora Search of the Maybell and Lord Percy Project Areas – November 2019*. An unpublished report prepared for Pantoro Ltd.
- Native Vegetation Solutions (NVS). 2021. *Targeted Threatened Flora Search of the Cobbler Project Area – April 2021*. An unpublished report prepared for Pantoro Ltd.
- Native Vegetation Solutions (NVS). 2021a. *Targeted Threatened Flora Search of the Cobbler Project Area – May 2021*. An unpublished report prepared for Pantoro Ltd.
- Pantoro South Pty Ltd. 2020. *Norseman Gold Project, Site Wide Mine Closure Plan*.
- Schoknecht, N. 2002. *Soil Groups of Western Australia. Resource Management Technical Report 246*. Department of Agriculture, South Perth.
- Shire of Dundas (2017). *Norseman History*. Available at: <http://www.dundas.wa.gov.au/norseman-history.aspx>
- Smith, M. 1994. *Aboriginal Sites in Ngadju Country. Requested by the MURNKURNI Aboriginal Women's Corporation now part of Ngadju Bugarla Mirning Wamu Wamu Aboriginal Corporation. A Report for the National Estate Programme*.
- Tille, P. J. (2006). *Soil-landscapes of Western Australia's rangelands and arid interior*. Department of Agriculture and Food, Western Australia, Perth. Report 313.
- Western Wildlife. 2021. *Norseman Gold Project: Basic Vertebrate Fauna Survey and Targeted Malleefowl Survey 2020*. An unpublished report prepared for Pantoro Limited.

APPENDICES



**APPENDIX 1: CNGC-PANTORO LETTER OF
AUTHORITY**





31 May 2019

The Executive Director
Environment Division
Department of Mines, Industry Regulation and
Safety
Mineral House
100 Plain Street
EAST PERTH WA 6004

Central Norseman Gold
Corporation Pty Ltd
ABN 48 005 482 860

PO Box 56
Norseman 6443

Tel : 0890399800
Fax: 0890399803

Dear Sir/Madam

NORSEMAN GOLD PROJECT – Refer attached tenement list

Central Norseman Gold Corporation Pty Ltd ('CNGC') is the 100% holder of the tenements associated with the Norseman Gold Project. In May 2019, Pantoro South Pty Ltd ('PSPL') entered into a purchase and 50/50 unincorporated joint venture agreement with CNGPL ('JV Agreement'). PSPL and CNGC are to be tenants in common in respect to the tenements and PSPL has management control of the tenements.

CNGC acknowledges that PSPL will be lodging Programs of Work (POW's), Clearing Permit Applications, Mining Proposals and Mine Closure Plans with the Department of Mines, Industry Regulation & Safety ('DMIRS') for tenements associated with the Norseman Gold Project, prior to the tenement equity being transferred pursuant to the terms of the JV Agreement.

CNGC hereby consents to PSPL undertaking exploration and mining programs on the tenements listed above, subject to compliance by PSPL with all statutory requirements.

CNGC hereby confirm that PSPL are authorised and responsible for the submission and management of any POW's, Clearing Permit Applications, Mining Proposals and Mine Closure Plans submitted in respect to these Norseman Gold Project tenements, and requests that the department provides PSPL with the assistance and consideration necessary for the grant of such permits.

Yours sincerely

Kevin Maloney
Chairman & CEO

Attachment 1 – Tenement List

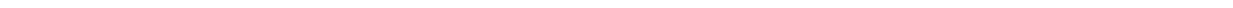
Tenement number	Holder	Shares
E63/1640	Central Norseman Gold Corporation Pty Ltd	100
E63/1641	Central Norseman Gold Corporation Pty Ltd	100
E63/1642	Central Norseman Gold Corporation Pty Ltd	100
L63/0012	Central Norseman Gold Corporation Pty Ltd	96
L63/0013	Central Norseman Gold Corporation Pty Ltd	96
L63/0014	Central Norseman Gold Corporation Pty Ltd	96
L63/0017	Central Norseman Gold Corporation Pty Ltd	96
L63/0019	Central Norseman Gold Corporation Pty Ltd	96
L63/0032	Central Norseman Gold Corporation Pty Ltd	96
L63/0034	Central Norseman Gold Corporation Pty Ltd	96
L63/0035	Central Norseman Gold Corporation Pty Ltd	96
L63/0036	Central Norseman Gold Corporation Pty Ltd	96
L63/0037	Central Norseman Gold Corporation Pty Ltd	96
L63/0038	Central Norseman Gold Corporation Pty Ltd	96
L63/0039	Central Norseman Gold Corporation Pty Ltd	96
L63/0040	Central Norseman Gold Corporation Pty Ltd	96
L63/0041	Central Norseman Gold Corporation Pty Ltd	96
M63/0009	Central Norseman Gold Corporation Pty Ltd	96
M63/0011	Central Norseman Gold Corporation Pty Ltd	96
M63/0013	Central Norseman Gold Corporation Pty Ltd	96
M63/0014	Central Norseman Gold Corporation Pty Ltd	96
M63/0015	Central Norseman Gold Corporation Pty Ltd	96
M63/0026	Central Norseman Gold Corporation Pty Ltd	96
M63/0029	Central Norseman Gold Corporation Pty Ltd	100
M63/0035	Central Norseman Gold Corporation Pty Ltd	96
M63/0036	Central Norseman Gold Corporation Pty Ltd	96
M63/0040	Central Norseman Gold Corporation Pty Ltd	96
M63/0041	Central Norseman Gold Corporation Pty Ltd	96
M63/0042	Central Norseman Gold Corporation Pty Ltd	96
M63/0043	Central Norseman Gold Corporation Pty Ltd	96
M63/0044	Central Norseman Gold Corporation Pty Ltd	96
M63/0045	Central Norseman Gold Corporation Pty Ltd	96
M63/0046	Central Norseman Gold Corporation Pty Ltd	96
M63/0047	Central Norseman Gold Corporation Pty Ltd	96

Tenement number	Holder	Shares
M63/0048	Central Norseman Gold Corporation Pty Ltd	96
M63/0049	Central Norseman Gold Corporation Pty Ltd	96
M63/0050	Central Norseman Gold Corporation Pty Ltd	100
M63/0051	Central Norseman Gold Corporation Pty Ltd	100
M63/0052	Central Norseman Gold Corporation Pty Ltd	100
M63/0053	Central Norseman Gold Corporation Pty Ltd	100
M63/0054	Central Norseman Gold Corporation Pty Ltd	100
M63/0055	Central Norseman Gold Corporation Pty Ltd	96
M63/0056	Central Norseman Gold Corporation Pty Ltd	96
M63/0057	Central Norseman Gold Corporation Pty Ltd	96
M63/0058	Central Norseman Gold Corporation Pty Ltd	96
M63/0059	Central Norseman Gold Corporation Pty Ltd	96
M63/0060	Central Norseman Gold Corporation Pty Ltd	100
M63/0061	Central Norseman Gold Corporation Pty Ltd	96
M63/0062	Central Norseman Gold Corporation Pty Ltd	96
M63/0063	Central Norseman Gold Corporation Pty Ltd	100
M63/0064	Central Norseman Gold Corporation Pty Ltd	100
M63/0065	Central Norseman Gold Corporation Pty Ltd	100
M63/0066	Central Norseman Gold Corporation Pty Ltd	100
M63/0067	Central Norseman Gold Corporation Pty Ltd	100
M63/0068	Central Norseman Gold Corporation Pty Ltd	96
M63/0069	Central Norseman Gold Corporation Pty Ltd	96
M63/0088	Central Norseman Gold Corporation Pty Ltd	96
M63/0096	Central Norseman Gold Corporation Pty Ltd	96
M63/0099	Central Norseman Gold Corporation Pty Ltd	96
M63/0100	Central Norseman Gold Corporation Pty Ltd	96
M63/0105	Central Norseman Gold Corporation Pty Ltd	96
M63/0108	Central Norseman Gold Corporation Pty Ltd	96
M63/0110	Central Norseman Gold Corporation Pty Ltd	96
M63/0112	Central Norseman Gold Corporation Pty Ltd	100
M63/0114	Central Norseman Gold Corporation Pty Ltd	96
M63/0115	Central Norseman Gold Corporation Pty Ltd	96
M63/0116	Central Norseman Gold Corporation Pty Ltd	96
M63/0118	Central Norseman Gold Corporation Pty Ltd	96
M63/0119	Central Norseman Gold Corporation Pty Ltd	96
M63/0120	Central Norseman Gold Corporation Pty Ltd	96

Tenement number	Holder	Shares
M63/0122	Central Norseman Gold Corporation Pty Ltd	96
M63/0125	Central Norseman Gold Corporation Pty Ltd	96
M63/0126	Central Norseman Gold Corporation Pty Ltd	96
M63/0127	Central Norseman Gold Corporation Pty Ltd	96
M63/0128	Central Norseman Gold Corporation Pty Ltd	96
M63/0129	Central Norseman Gold Corporation Pty Ltd	96
M63/0130	Central Norseman Gold Corporation Pty Ltd	96
M63/0133	Central Norseman Gold Corporation Pty Ltd	100
M63/0134	Central Norseman Gold Corporation Pty Ltd	96
M63/0136	Central Norseman Gold Corporation Pty Ltd	96
M63/0137	Central Norseman Gold Corporation Pty Ltd	96
M63/0138	Central Norseman Gold Corporation Pty Ltd	96
M63/0140	Central Norseman Gold Corporation Pty Ltd	100
M63/0141	Central Norseman Gold Corporation Pty Ltd	96
M63/0142	Central Norseman Gold Corporation Pty Ltd	96
M63/0145	Central Norseman Gold Corporation Pty Ltd	100
M63/0152	Central Norseman Gold Corporation Pty Ltd	96
M63/0155	Central Norseman Gold Corporation Pty Ltd	100
M63/0156	Central Norseman Gold Corporation Pty Ltd	100
M63/0160	Central Norseman Gold Corporation Pty Ltd	96
M63/0164	Central Norseman Gold Corporation Pty Ltd	96
M63/0173	Central Norseman Gold Corporation Pty Ltd	100
M63/0174	Central Norseman Gold Corporation Pty Ltd	96
M63/0178	Central Norseman Gold Corporation Pty Ltd	96
M63/0180	Central Norseman Gold Corporation Pty Ltd	96
M63/0182	Central Norseman Gold Corporation Pty Ltd	96
M63/0184	Central Norseman Gold Corporation Pty Ltd	96
M63/0187	Central Norseman Gold Corporation Pty Ltd	96
M63/0189	Central Norseman Gold Corporation Pty Ltd	96
M63/0190	Central Norseman Gold Corporation Pty Ltd	96
M63/0207	Central Norseman Gold Corporation Pty Ltd	100
M63/0213	Central Norseman Gold Corporation Pty Ltd	100
M63/0214	Central Norseman Gold Corporation Pty Ltd	96
M63/0218	Central Norseman Gold Corporation Pty Ltd	96
M63/0219	Central Norseman Gold Corporation Pty Ltd	96
M63/0220	Central Norseman Gold Corporation Pty Ltd	100

Tenement number	Holder	Shares
M63/0224	Central Norseman Gold Corporation Pty Ltd	96
M63/0233	Central Norseman Gold Corporation Pty Ltd	100
M63/0257	Central Norseman Gold Corporation Pty Ltd	96
M63/0258	Central Norseman Gold Corporation Pty Ltd	96
M63/0259	Central Norseman Gold Corporation Pty Ltd	96
M63/0265	Central Norseman Gold Corporation Pty Ltd	100
M63/0272	Central Norseman Gold Corporation Pty Ltd	96
M63/0273	Central Norseman Gold Corporation Pty Ltd	100
M63/0274	Central Norseman Gold Corporation Pty Ltd	96
M63/0275	Central Norseman Gold Corporation Pty Ltd	96
M63/0315	Central Norseman Gold Corporation Pty Ltd	96
M63/0316	Central Norseman Gold Corporation Pty Ltd	96
M63/0325	Central Norseman Gold Corporation Pty Ltd	96
M63/0326	Central Norseman Gold Corporation Pty Ltd	96
M63/0327	Central Norseman Gold Corporation Pty Ltd	96
M63/0526	Central Norseman Gold Corporation Pty Ltd	96
P63/1391	Central Norseman Gold Corporation Pty Ltd	100
P63/1392	Central Norseman Gold Corporation Pty Ltd	100
P63/1393	Central Norseman Gold Corporation Pty Ltd	100
P63/1779	Central Norseman Gold Corporation Pty Ltd	100
P63/1835	Central Norseman Gold Corporation Pty Ltd	100
P63/1836	Central Norseman Gold Corporation Pty Ltd	100
P63/1837	Central Norseman Gold Corporation Pty Ltd	100
P63/2003	Central Norseman Gold Corporation Pty Ltd	100
P63/2004	Central Norseman Gold Corporation Pty Ltd	100
P63/2010	Central Norseman Gold Corporation Pty Ltd	100
P63/2089	Central Norseman Gold Corporation Pty Ltd	100

**APPENDIX 2: FLORA AND VEGETATION
ASSESSMENT - AUTUMN (MATTISKE 2020A)**



FLORA & VEGETATION ASSESSMENT
NORSEMAN GOLD PROJECT, NORSEMAN, WA



Prepared By



Mattiske Consulting Pty Ltd

Prepared For
Pantoro Ltd

Date
July 2020



DOCUMENT STATUS				
DOCUMENT REFERENCE: CNG2001/007/20				
VERSION	TYPE	AUTHOR/S	REVIEWER/S	DATE DISTRIBUTED
V1	Internal review	J. Wescombe/ E. Chetwin/ L. Taaffe	E.M. Mattiske	-
V2	Draft for client	E. Chetwin	E.M. Mattiske	10/6/2020
V3	Draft for client	E.M. Mattiske	E.M. Mattiske	21/07/2020
Final	Final	E.M. Mattiske	E.M. Mattiske	30/07/2020



(ACN 063 507 175, ABN 39 063 507 175)

PO Box 437
Kalamunda WA 6926
Phone: +61 8 9257 1625
Email: admin@mattiske.com.au

Photo Cover: Vegetation in the Scotia survey area at the western edge of Lake Dundas, Autumn 2020

COPYRIGHT AND DISCLAIMER

Copyright

The information contained in this report is the property of Mattiske Consulting Pty Ltd. The use or copying of the whole or any part of this report without the written permission of Mattiske Consulting Pty Ltd is not permitted.

Disclaimer

This report has been prepared on behalf of and for the exclusive use of Pantoro Ltd, and is subject to and issued in accordance with the agreement between Pantoro Ltd and Mattiske Consulting Pty Ltd. This report is based on the scope of services defined by Pantoro Ltd, the budgetary and time constraints imposed by Pantoro Ltd, and the methods consistent with the preceding.

Mattiske Consulting Pty Ltd has utilised information and data supplied by Pantoro Ltd (and its agents), and sourced from government databases, literature, departments and agencies in the preparation of this report. Mattiske Consulting Pty Ltd has compiled this report on the basis that any supplied or sourced information and data was accurate at the time of publication. Mattiske Consulting Pty Ltd accepts no liability or responsibility whatsoever for the use of, or reliance upon, the whole or any part of this report by any third party.

TABLE OF CONTENTS

	Page
EXECUTIVE SUMMARY	1
1. INTRODUCTION	3
1.1. Location and Scope of Project	3
1.2. Environmental Legislation and Guidelines	3
2. OBJECTIVES	8
3. METHODS	9
3.1. Desktop Assessment	9
3.2. Field Survey	9
3.3. Survey Timing	10
3.4. Analysis of Site Data	10
3.5. Vegetation Descriptions	11
3.6. Survey Limitations	11
4. DESKTOP ASSESSMENT RESULTS	13
4.1. Regional Context	13
4.2. Managed Lands	13
4.3. Climate	16
4.4. Geology, Soils and Topography	16
4.5. Regional Vegetation	18
4.6. Great Western Woodlands	23
4.7. Previous Surveys	24
4.8. Potential Flora	24
4.8.1. Potential Threatened and Priority Flora	24
4.8.2. Potential Introduced (Weed) Species and Declared Pest (Plant) Organisms	25
4.9. Potential Threatened and Priority Ecological Communities	26
5. FIELD SURVEY RESULTS	29
5.1. Flora	29
5.1.1. Threatened and Priority Flora	32
5.1.2. Other Significant Flora	36
5.1.3. Introduced (Weed) Species and Declared Pest (Plant) Organisms	37
5.2. Vegetation	37
5.2.1. Statistical Analysis	37
5.2.2. Vegetation Communities	38
5.2.3. Threatened and Priority Ecological Communities	43
5.2.4. Vegetation Condition	48
6. DISCUSSION	49
6.1. Flora	49
6.2. Vegetation	49
6.2.1. Eucalypt woodlands	50
6.2.2. Other vegetation communities	51
6.2.3. Species Richness	51
6.2.4. Comparison with previous mapping	51
6.3. Local and regional context and impact	52
7. CONCLUSION	53
8. ACKNOWLEDGEMENTS	55
9. PERSONNEL	55
10. REFERENCES	56

TABLES

1:	Tenements occurring in each Project survey area
2:	Potential limitations affecting the conclusions made in this report
3:	Extent of Land Systems intersecting the Norseman Gold Project survey area
4:	Extent of pre-European vegetation associations intersecting the Norseman Gold Project survey areas
5:	Location and extent of priority species within the Norseman Gold Project survey areas
6	Location and extent of the <i>Lepidosperma</i> species (currently under taxonomic review) within the Norseman Gold Project survey areas
7:	Taxa recorded within the Norseman Gold Project survey area in 2019 representing an extension to currently known distributions
8:	Vegetation communities in the Northern survey areas
9:	Vegetation communities in the Scotia survey area
10:	Vegetation Condition by Vegetation Community in the Northern and Scotia survey areas

FIGURES

1:	Locality
2.1-2.2:	Tenements
3.1-3.2:	Managed Lands & Reserves
4:	Climate
5:	Soil landscape provinces and zones
6.1-6.2:	Land Systems
7.1-7.2:	Pre-European Vegetation
8.1-8.2:	DBCA Threatened and Priority Species and Ecological Communities
9.1-9.2:	Survey Site Locations and Tracks, Autumn 2020, with Previous Mattiske Consulting Pty Ltd Vegetation Mapping
10.1- 10.2:	Average randomised Species Accumulation Curves for the Northern and Scotia survey areas, Autumn 2020
11.1- 11.2:	Dendrograms for the Northern and Scotia survey areas
12.1- 12.2:	Vegetation Mapping, Northern survey area, Autumn 2020
13.1- 13.2:	Vegetation Mapping, Scotia survey area, Autumn 2020

PLATES

- 1: *Calandrinia lefroyensis* (P1) (Photo: E. Chetwin)
- 2: *Acacia kerryana* (P2) habit (Photo: E. Chetwin)
- 3: *Eremophila parvifolia* subsp. *parvifolia* (P4) (WAH 1998-)

APPENDICES

- A1: Threatened and priority flora definitions
- A2: Threatened and priority ecological community definitions
- A3: Categories and control measures of declared pest (plant) organisms in Western Australia
- A4: Other definitions
- A5: NVIS structural formation terminology
- A6: Definition of vegetation condition scale for the South West and Interzone Botanical Provinces
- B: Summary of previous surveys in the Norseman area
- C: Vascular plant species with the potential to occur in the Norseman Gold Project survey areas
- D: Assessment of threatened and priority flora potentially present within the Norseman Gold Project survey areas
- E: Survey site locations, Autumn 2020
- F: Vascular plant species recorded by Survey Site, Autumn 2020
- G: Summary of Vegetation Communities in the Northern survey areas, Autumn 2020
- H: Summary of Vegetation Communities in the Scotia survey area, Autumn 2020

LIST OF ABBREVIATIONS

BAM Act:	<i>Biosecurity and Agriculture Management Act 2007 (WA)</i>
BC Act:	<i>Biodiversity Conservation Act 2016 (WA)</i>
BOM:	Bureau of Meteorology
CLUSTER:	Hierarchical clustering
DAWE	Department of Agriculture, Water and the Environment
DEC:	Department of Environment and Conservation
DBCA:	Department of Biodiversity, Conservation and Attractions
DPaW:	Department of Parks and Wildlife (now under DBCA)
DPIRD:	Department of Primary Industries and Regional Development (includes Agriculture and Food)
EP Act:	<i>Environmental Protection Act 1986 (WA)</i>
EPA:	Environmental Protection Authority
EPBC Act:	<i>Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)</i>
IBRA:	Interim Biogeographical Regionalisation for Australia
MCPL:	Mattiske Consulting Pty Ltd
NVIS:	National Vegetation Information System
Pantoro:	Pantoro Limited
PEC:	Priority Ecological Community
PRIMER:	Plymouth Routines in Multivariate Ecological Research
SIMPER:	Similarity percentages
SIMPROF:	Similarity profile
TEC:	Threatened Ecological Community
WAH:	Western Australian Herbarium (PERTH)

EXECUTIVE SUMMARY

Mattiske Consulting Pty Ltd (Mattiske) was commissioned in March 2020 by Pantoro Limited (Pantoro) to undertake a flora and vegetation assessment of the Norseman Gold Project areas located around Norseman, WA. This report outlines the methodology and results from a desktop assessment of flora and vegetation of the entire Norseman Gold Project area, performed in March 2020. A detailed flora and vegetation field survey of five smaller survey areas (Gladstone, North Royal, Gladstone-North Royal Haul Roads, Jimberlana Pipeline and Scotia) was carried out from 29th March to 3rd April 2020. This report describes the methodology and results of that survey, and discusses their significance.

The main findings of the desktop study were:

- The Norseman Gold Project area lies within the *Coolgardie 3 – Eastern Goldfields* Subregion of the Coolgardie Bioregion, and more specifically, falls within the Great Western Woodlands.
- The majority of the vegetation in the area comprises *Eucalyptus* woodlands, often over *Eremophila* species and/or chenopod shrublands, and *Triodia* species grasslands with mallees in some places.
- A total of 804 vascular plant taxa, representative of 260 genera and 115 families, were found to have the potential to occur within the study areas, with the most common families being Myrtaceae, Fabaceae and Asteraceae, and the most common genera being *Eucalyptus*, *Acacia* and *Eremophila*. Forty-two introduced species had the potential to occur within the Norseman Gold Project area, four of which are Declared Pest species.
- Three Threatened flora species had the possibility of occurring in the Norseman Gold Project area. *Daviesia microcarpa* (T) and *Eucalyptus platydisca* (T) were assessed as having a High likelihood of occurrence in the North study areas. One Priority ecological (**'Allocasuarina globosa assemblages on greenstone rock'**), supporting the other Threatened flora species *Allocasuarina globosa* (T) is known to occur south of Norseman, and has a potential to occur in the Scotia survey area.
- A total of 37 Priority flora species, including eleven Priority 1, five Priority 2, seventeen Priority 3 and four Priority 4 flora species, were assessed as having the potential to occur within the Norseman Gold Project study areas.
- No Threatened ecological communities were found to have the potential to occur in the Norseman Gold Project area.

The field survey found the following, recorded in 61 quadrats in the Northern survey areas (Gladstone, North Royal, Gladstone-North Royal Haul Roads and Jimberlana Pipeline) and 40 quadrats in the Scotia survey area, plus several opportunistic records:

- In the Northern survey areas, 138 vascular plant taxa were recorded, representative of 60 genera and 33 families. The most common families were Myrtaceae, Chenopodiaceae, Fabaceae and Scrophulariaceae, and the most common genera were *Eucalyptus*, *Eremophila* and *Acacia*.
- In the Scotia survey area, 101 vascular plant taxa were recorded, representative of 50 genera and 31 families. Most taxa were part of the Myrtaceae, Fabaceae and Chenopodiaceae families. The most common genera were *Eucalyptus*, *Acacia* and *Eremophila*.
- Species accumulation analysis shows that approximately 73% of taxa potentially present in the survey areas were recorded during the field survey.
- No live threatened flora species were recorded within the five Norseman Gold Project survey areas; however, sites where *Davesia microcarpa* (T) was previously recorded within the survey areas were visited, with no alive specimens recorded in the current survey.
- Two priority flora species, *Calandrinia lefroyensis* (P1) and *Acacia kerryana* (P2), were recorded in the Gladstone and Jimberlana Pipeline survey areas, respectively. *Eremophila parvifolia* ?subsp. *parvifolia* (P4), which was recorded throughout the four Northern survey areas, was unable to be confidently identified to a sub-species level as a fruiting specimen is required. This species is treated with a precautionary approach as the Priority 4 subspecies.
- Eleven taxa, including three potential identifications, recorded within the survey areas represent extensions to their current known distributions based on known data. Three of the taxa are

ranked as being Moderate range extensions and one as High and due to lack of lowering and fruiting material could not be confirmed.

- Two introduced (weed) species, **Asphodelus fistulosus* (Onion Weed) and **Gazania linearis*, were recorded in very small numbers at one site each. Under the Department of Parks and Wildlife Weed Prioritisation Process, **Gazania linearis* is considered to be one of the 17 Goldfields Region priority alert weeds and therefore the locations should be reported to the local regional office of the Department of Biodiversity, Conservation and Attractions.
- In the Northern survey areas, a total of 18 vegetation communities were defined and mapped: twelve Eucalypt woodland communities, two other woodland communities and four shrubland communities. Two of the shrubland communities, dominated by salt-tolerant species, formed almost 25 % of the Northern survey areas, reflecting the significant areas of salt lake in these areas.
- Nine vegetation communities were defined in the Scotia survey area: five Eucalypt woodland communities and four shrubland communities. Three Eucalypt woodland communities made up almost 85 % of the Scotia survey area.
- No Threatened or Priority ecological communities were recorded as occurring in the Norseman Gold survey areas.
- Approximately 93 % of the sites with a recorded condition ranking were assessed as being in Pristine or Excellent condition. The vegetation condition in the Scotia survey area is generally better than that in the Northern areas, although both areas have very little disturbance within the areas of native vegetation.
- Average species richness in the vegetation communities of the Scotia survey was greater than in the Northern survey areas, but values varied more widely in the Northern areas.
- The vegetation communities defined within both the Northern and Scotia survey areas are consistent with the Pre-European vegetation associations of the area, are typical of the regional vegetation of the Great Western Woodlands, and show the same gradation from salt lake vegetation with low chenopod shrublands on salt lake fringes into woodlands with mixed *Eucalyptus* species as noted for the area in earlier regional studies. The communities are all very similar to those mapped in previous local surveys in the area.

As the vegetation of the Norseman Gold Project survey areas is common at statewide and regional levels, clearing should not have significant detrimental effects at those levels. However, the presence of Priority listed flora species within the survey areas is of local importance with regard to clearing of vegetation.

1. INTRODUCTION

Mattiske Consulting Pty Ltd was commissioned in March 2020 by Pantoro Limited (Pantoro) to undertake a flora and vegetation assessment of the Norseman Gold Project areas.

1.1. Location and Scope of Project

The Norseman Gold Project lies within the Coolgardie Botanical District of the Southwestern Interzone (Beard 1990), surrounding the town of Norseman, Western Australia (Figure 1) and within the Coolgardie 3-Eastern Goldfields subregion of the Coolgardie Bioregion within the Southwestern Interzone botanical district (Cowan 2001). The overall Norseman Gold Project area consists of seven smaller areas: Gladstone, North Royal, Gladstone-North Royal Haul Roads, Jemberlana Pipeline, Cobbler, OK, TSF 4, Maybell, and Scotia. The tenements that underlie each of the smaller survey areas are presented in Table 1 and Figure 2.

This report outlines the methodology and results from a desktop assessment of flora and vegetation of the entire Norseman Gold Project area. For the purposes of this report, and to be consistent with the detailed field survey (see next paragraph), this assessment was divided into two study areas; **'North'** (including Gladstone, North Royal, Gladstone-North Royal Haul Roads, Jemberlana Pipeline, Cobbler, OK, TSF 4 and surrounds) and **'South' (Maybell, Scotia and surrounds)**.

A detailed flora and vegetation field survey was carried out from 29th March to 3rd April 2020 in five of the smaller areas listed above. This report describes the methodology and results of that survey, and discusses their significance. The results, in terms of flora recorded and vegetation communities mapped, are grouped in two larger survey **areas: 'Scotia' (comprising Scotia and its haul road only) and 'Northern'** (Gladstone, North Royal, Gladstone-North Royal Haul Roads and Jemberlana Pipeline).

1.2. Environmental Legislation and Guidelines

The following key Commonwealth (federal) legislation relevant to this survey is the:

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The following key Western Australian (state) legislation relevant to this survey include the:

- *Biodiversity Conservation Act 2016* (BC Act);
- *Biosecurity and Agriculture Management Act 2007* (BAM Act); and
- *Environmental Protection Act 1986* (EP Act);

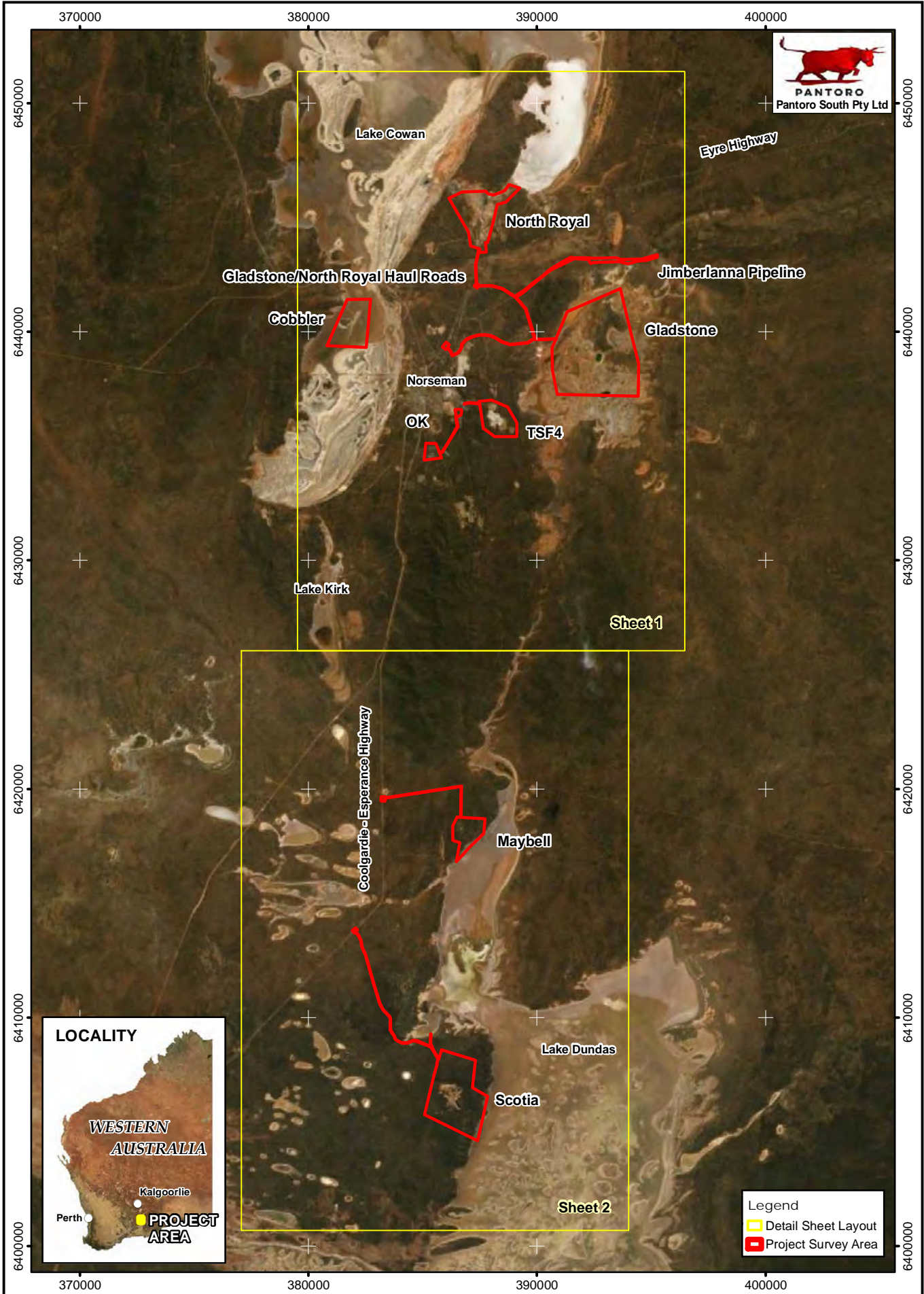
Furthermore, key Western Australian guidelines relevant to this survey are the:

- *Environmental Factor Guideline: Flora and Vegetation* (Environmental Protection Authority [EPA] 2016a); and
- *Technical Guidance – Flora and vegetation surveys for environmental impact assessment* (EPA 2016b).


Definitions of flora and vegetation terminology commonly used throughout this report are provided in Appendix A1-6.

Table 1: Tenements underlying each survey area

SURVEY AREA	TENEMENT	SURVEY AREA	TENEMENT
Cobbler	M 63/44	Maybell	L 63/56
	M 63/218		L 63/74
M 63/259	M 63/119-I		
Gladstone	M 63/42		M 63/138
	M 63/43		M 63/204-I
	M 63/275		M 63/515-I
	M 63/659		P 63/2035
	P 63/1392		P 63/2037
	P 63/1393		P 63/2095
	Untitled Land		P 63/2156
Gladstone-North Royal Haul Roads	L 63/17	North Royal	P 63/2162
	L 63/32		L 63/32
	L 63/40		M 63/11
	M 63/13		M 63/29
	M 63/14	M 63/155	
	M 63/42	OK	M 63/156
	M 63/133-I		M 63/15
	M 63/140-I	Scotia	M 63/68-I
	M 63/142		E 63/1914
	M 63/155		L 63/19
M 63/156	M 63/35-I		
P 63/2003	M 63/36		
Jimberlana Pipeline	E 63/1042-I		M 63/108-I
	L 63/12		M 63/112-I
	L 63/13	M 63/224-I	
	L 63/17	M 63/325-I	
	L 63/36	P 63/2119	
	L 63/37	Untitled Land	
	L 63/39	TSF4	M 63/15
	L 63/40		M 63/133-I
	M 63/140-I		
P 63/2157			
P 63/2158			



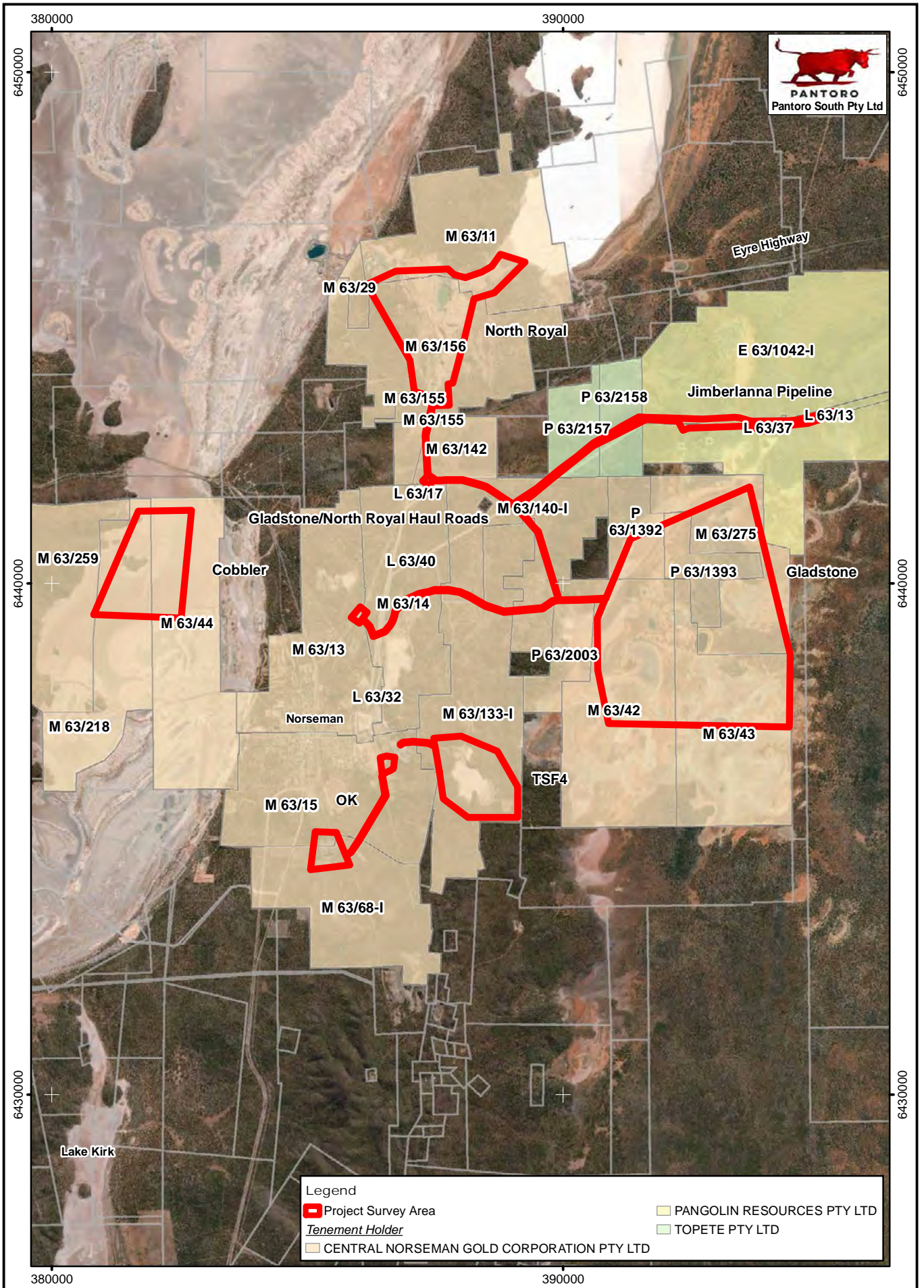
Notes: Image: DigitalGlobe (27/11/2016)


 Scale: 1:125,000
 MGA94 (Zone 50)
 CAD Ref: a2764_f01_01
 Date: March 2020


Mattiske Consulting Pty Ltd
 28 Central Road, Kalamunda WA 6076 - Tel: 9257 1625 - Fax: 9257 1640
 Author: E M Mattiske MCPL Ref: CNG2001/007/20
 Drawn: CAD Resources - www.cadresources.com.au
 Tel: (08) 9246 3242 - Fax (08) 9246 3202

Norseman Gold Project Locality

Figure: **1**



Legend

- Project Survey Area
- PANGOLIN RESOURCES PTY LTD
- TOPETE PTY LTD
- Tenement Holder*
CENTRAL NORSEMAN GOLD CORPORATION PTY LTD

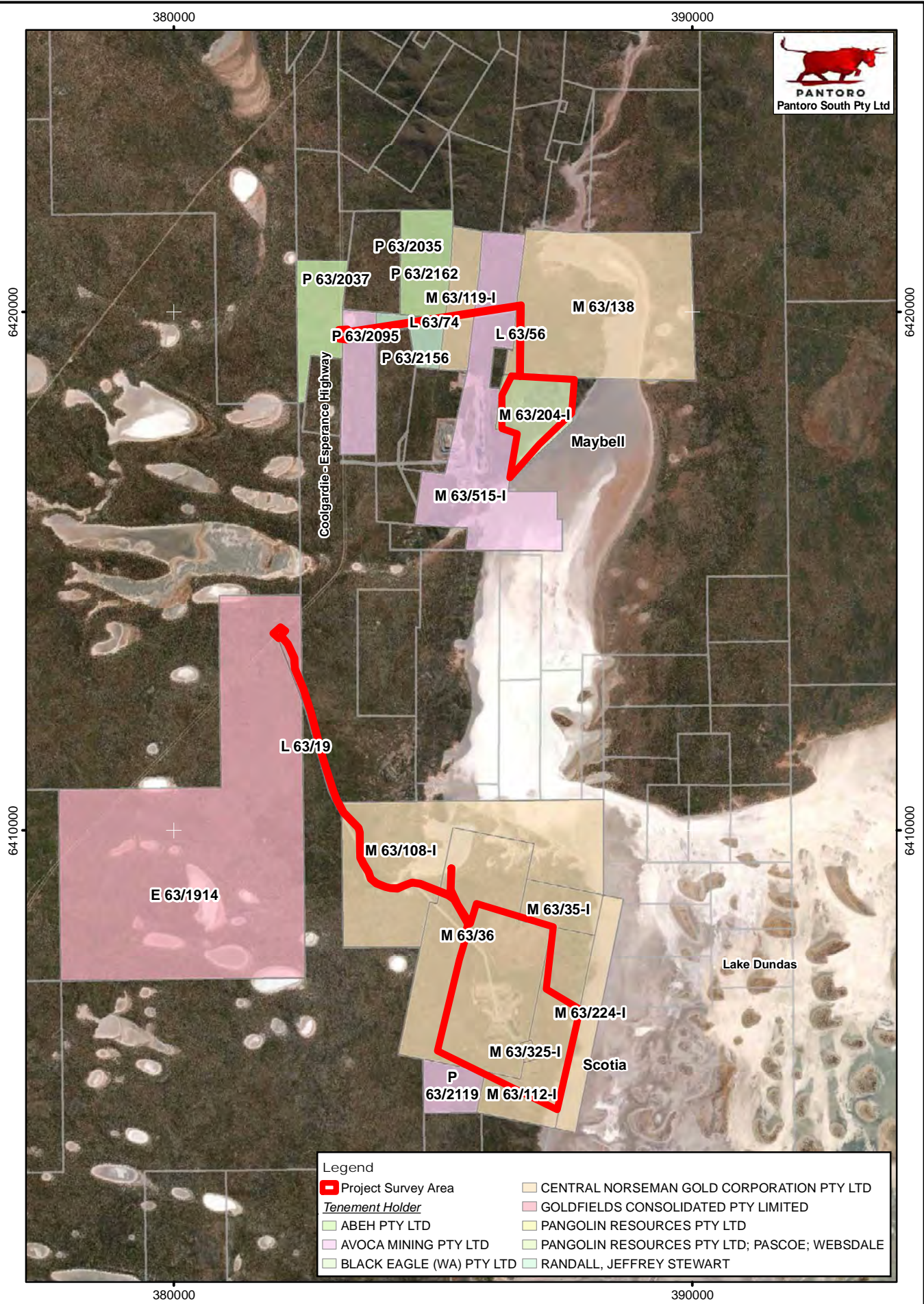
Notes: Image: DigitalGlobe (27/11/2016), Tenements: DMIRS (11/2/2020)

Scale: 1:125,000
 MGA94 (Zone 50)
 CAD Ref: a2764_f01_02
 Date: March 2020

Mattiske Consulting Pty Ltd
 28 Central Road, Kalamunda WA 6076 - Tel: 9257 1625 - Fax: 9257 1640
 Author: E M Mattiske MCPL Ref: CNG2001/00720
 Drawn: CAD Resources - www.cadresources.com.au
 Tel: (08) 9246 3242 - Fax (08) 9246 3202

Norseman Gold Project
Tenements
 Sheet 1 of 2

Figure:
2.1



Legend	
	Project Survey Area
<u>Tenement Holder</u>	
	ABEH PTY LTD
	AVOCA MINING PTY LTD
	BLACK EAGLE (WA) PTY LTD
	CENTRAL NORSEMAN GOLD CORPORATION PTY LTD
	GOLDFIELDS CONSOLIDATED PTY LIMITED
	PANGOLIN RESOURCES PTY LTD
	PANGOLIN RESOURCES PTY LTD; PASCOE; WEBSDALE
	RANDALL, JEFFREY STEWART

Notes: Image: DigitalGlobe (27/11/2016), Tenements: DMIRS (11/2/2020)

Scale: 1:125,000
 MGA94 (Zone 50)
 CAD Ref: a2764_f01_02
 Date: March 2020

28 Central Road, Kalamunda WA 6076 - Tel: 9257 1625 - Fax: 9257 1640
 Author: E M Mattiske MCPL Ref: CNG2001/007/20
 Drawn: CAD Resources ~ www.cadresources.com.au
 Tel: (08) 9246 3242 - Fax (08) 9246 3202

Norseman Gold Project
Tenements
Sheet 2 of 2

Figure:
2.2

2. OBJECTIVES

The objective of this survey was to undertake a flora and vegetation assessment of the Norseman Gold Project survey areas, including to:

- Complete a desktop study of the flora and vegetation of the greater Norseman Gold Project area, with an emphasis on threatened and priority flora, and threatened and priority ecological communities;
- Review the historical literature of the greater Norseman Gold Project area;
- Undertake a detailed field survey of five of the Norseman Gold Project survey areas, and collect and identify the vascular plant species present;
- Review the conservation status of the vascular plant species recorded by reference to current literature and listings by the Department of Biodiversity, Conservation and Attractions (DBCA) and plant collections held at the Western Australian State Herbarium (WAH), and listed by the Department of Agriculture, Water and the Environment (DAWE) under the EPBC Act;
- Define and map the vegetation communities in the five Norseman Gold Project survey areas;
- Define and map the location of any threatened and priority flora located within the five Norseman Gold Project survey areas;
- Define any management issues related to flora and vegetation values;
- Provide recommendations on the local and regional significance of the vegetation communities; and
- Prepare a report summarising the findings.

3. METHODS

3.1. Desktop Assessment

A desktop assessment was conducted using FloraBase (WAH 1998-) and NatureMap (DBCA 2007-) databases, to identify the possible occurrence of threatened and priority flora and threatened and priority ecological communities within the Norseman Gold Project area.

The NatureMap search was conducted separately for two parts of the Norseman Gold Project area; North (Gladstone, Gladstone-North Royal Haul Roads, Jemberlana Pipeline, North Royal, Cobbler, OK and TSF 4 survey areas) and South (Maybell and Scotia survey areas). Search parameters used were a 10 km radius 'by circle' at the following points:

North: 32° 09' 42" S, 121° 48' 25" E.

South: 32° 24' 51" S, 121° 46' 37" E.

The aforementioned coordinates were also used in the *EPBC Act Protected Matters Search Tool* (DAWE 2015).

In addition, historical documentation and vegetation mapping of the region, principally that of Beard (1970, 1975, 1990), which provide extensive resource material for the floristics and vegetation of the greater Norseman Gold Project area, was reviewed.

Previous flora and vegetation surveys from the Norseman area (Botanica Consulting 2010; GHD Pty Ltd 2009, 2010a, 2010b; Goldfields Environmental Management Pty Ltd 1989; Landcare Services Pty Ltd 1995, 1996, 1997; Marianna Partners Environmental Services 1996; Mattiske Consulting 2001a, 2001b, 2002, 2005, 2013a, 2013b; Native Vegetation Solutions 2019; Outback Ecology 2003; Paul Armstrong & Associates 2004; Rally Revegetation and Environmental Services 2004, 2005; Umwelt Australia Pty Ltd 2016) were reviewed to identify the occurrence of threatened and priority flora likely to be found within the Norseman Gold Project survey areas and vegetation communities mapped in those areas (Appendix B).

The NatureMap (DBCA 2007-) database search, along with the records of previous surveys, was also used to help compile a list of all flora taxa that could possibly occur in the study area (Appendix C).

The Threatened and Priority Flora (DBCA 2020b) and WAH Flora (WAH 2020) databases were searched by CAD Resources for records of threatened and priority flora in the survey areas. The likelihood of occurrence of any threatened and priority flora within both the North and South Norseman Gold Project study areas was assessed on the basis of: proximity of previous records to the current survey areas, age of the record, and size of the recorded population (Appendix D).

3.2. Field Survey

A detailed field assessment of the flora and vegetation of five of the Norseman Gold Project survey areas was undertaken by four botanists from Mattiske Consulting Pty Ltd, from the 30th March 2020 to the 3rd April 2020 ("**Autumn 2020**"), in accordance with methods outlined in *Technical Guidance – Flora and vegetation surveys for environmental impact assessment* (EPA 2016b). All botanists held valid collection licences to collect flora for scientific purposes, issued under the BC Act.

The geographic co-ordinates defining the Norseman Gold Project survey areas were supplied by Pantoro. The areas to be surveyed in Autumn 2020 in the Northern survey area were Gladstone, Gladstone-North Royal Haul Roads, Jemberlana Pipeline and North Royal (and its pipeline); in the Scotia (southern) survey area they were Scotia and its associated haul road. Aerial photographic maps of the Norseman Gold

Project survey areas were prepared and supplied by CAD Resources. Survey sites were selected prior to the field survey using aerial photographic maps and locations modified in the field where observation or availability of time deemed changes to be necessary. A total of 101 survey sites, 61 in the Northern survey areas and 40 in the Scotia area, were selected to sample all vegetation types, with replication, within the Norseman Gold Project survey area.

Survey sites consisted of un-marked 20 x 20 metre quadrats. The GPS location of the northwest corner of each quadrat was recorded and a photo taken from that point looking to the southeast.

Flora and vegetation were described and sampled systematically at each survey site, and additional opportunistic collections were undertaken wherever previously unrecorded plants were observed. At each quadrat the following floristic and environmental parameters were recorded:

- GPS location (GDA94 datum, zone 51);
- Local site topography;
- Soil type and colour;
- Outcropping rocks and their type;
- Percentage litter cover and percentage bare ground;
- Approximate time since fire;
- Vegetation condition (based on Keighery 1994); and
- For each vascular plant species, the average height and the percentage cover (of both alive and dead material) over the survey site.

The location of any plant or population of plants thought to potentially be a Threatened or Priority taxon was recorded, along with the height of the plant (or average height of the population), the area which the **population occupied, the plant or population's condition**, and its reproductive status. Photographs were taken to aid in identification.

All plant specimens collected during the field surveys were dried and processed in accordance with the requirements of the WAH. The plant species were identified based on taxonomic literature and through comparison with pressed specimens housed at the WAH. Where appropriate, plant taxonomists with specialist skills were consulted. Nomenclature of the species recorded is in accordance with the WAH (1998-).

3.3. Survey Timing

According to the *Technical guidance – Flora and vegetation surveys for environmental impact assessment* (EPA 2016b), the primary survey timing for the Southwestern Interzone is Spring (September-November). The rainfall for the three months prior to the Autumn survey (67.2 mm for January-March 2020 against 92.7 mm as the long-term average for those months) and the 12 months (221.8 mm for the previous 12 months against 291.6 mm for the annual long-term average) was below average (Bureau of Meteorology [BOM] 2020).

3.4. Analysis of Site Data

A species accumulation curve for each of the Northern and Scotia survey areas, based on accumulated species versus sites surveyed was prepared to provide an indication of the level of adequacy of the survey effort (*EstimateS* – Colwell 2013). As the number of survey sites increases, and correspondingly the size of the area surveyed increases, there should be a diminishing number of new species recorded. At some point, the number of new species recorded becomes essentially asymptotic. The asymptotic value was

determined using Michaelis-Menten modelling and provided an incidence-based coverage estimator of species richness (Chao 2004). When the number of new species being recorded for survey effort expended approaches this asymptotic value, the survey effort can be considered to be adequate.

Plymouth Routines in Multivariate Ecological Research v7 (PRIMER) statistical analysis software was used to analyse species-by-site data and discriminate survey sites on the basis of their species composition (Clarke and Gorley 2015). The data were split into Northern and Scotia survey areas, with a very similar treatment in both areas. To down-weight the relative contributions of quantitatively dominant species, a fourth root transformation was applied to the data set. Introduced species, annual species, specimens not identified to species level and singletons (species recorded at a single quadrat and not forming a dominant structural component, i.e. <5 % foliage cover) were excluded from the data set prior to analysis. Taxa which were identified to the subspecies and variety levels were revised to the specific level to reduce the tendency to create further statistical variation in the analysis that was considered unwarranted. Two *Eucalyptus* species forming a dominant structural vegetation component were grouped for analysis in the Scotia survey area; *Eucalyptus flocktoniae* and *Eucalyptus urna* were combined to '*Eucalyptus flocktoniae* complex'. This is due to the two species being easily confused during identification, as juvenile material is required to form a confident identification. Computation of similarity matrices was based on the Bray-Curtis similarity measure. Data were analysed using a series of multivariate analysis routines including Similarity Profile (SIMPROF), Hierarchical Clustering (CLUSTER) and Similarity Percentages (SIMPER). Results were used to inform and support interpretation of aerial photography, quadrat data and delineation of individual plant communities.

Previous vegetation mapping by Mattiske Consulting Pty Ltd in the Gladstone and Gladstone-North Royal Haul Roads survey areas (Mattiske Consulting Pty Ltd 2001a) was used to guide interpretation of vegetation communities in the parts of those areas not surveyed during the Autumn 2020 survey. Whilst the original data were not available, the vegetation community descriptions were used in a qualitative manner. Some of the areas included in the 2001 survey were resurveyed in Autumn 2020 in order to provide verification of the earlier work. Immediately to the south of the Gladstone-North Royal Haul Roads survey area, Mattiske Consulting Pty Ltd carried out vegetation mapping over a proposed tailings dam area (Mattiske Consulting Pty Ltd 2005). This previous work was used qualitatively to assist with mapping in the Gladstone-North Royal Haul Roads survey area. North of the Scotia survey area, Mattiske Consulting Pty Ltd had carried out vegetation mapping over the Mt Henry mine and surrounds (Mattiske Consulting Pty Ltd 2013a, 2013b). This work was also used qualitatively to assist with mapping in the Scotia area.

3.5. Vegetation Descriptions

Vegetation descriptions were based on Alpin's (1979) modification of the vegetation classification system of Specht (1970), to align with the National Vegetation Information System (NVIS) (see Appendix A5). Vegetation communities were described at the association level of the NVIS classification framework, as defined by the Executive Steering Committee for Australian Vegetation Information (2003). Vegetation condition of each of the mapping sites was assessed as per the criteria developed by Keighery (1994) (see Appendix A6).

3.6. Survey Limitations

A general assessment was made of the current survey against a range of factors that may have limited the outcomes and conclusions of this report (Table 2).

Table 2: Potential limitations affecting the conclusions made in this report

POTENTIAL SURVEY LIMITATION	IMPACT ON CURRENT SURVEY
Availability of contextual information at a regional and local scale	Not a limitation: Historical studies including Beard's work (1970, 1975, 1990) and Keighery, Newbey & Hall (1993), covering flora and vegetation of the region, were reviewed. The results of twenty-one previous field surveys (1989-2019) in the greater Norseman Gold Project area, including six performed by Mattiske Consulting Pty Ltd (2001-2013), were analysed (Appendix B).
Competency/experience of team carrying out survey; experience in the bioregion surveyed	Not a limitation: Two of the team were experienced Botanists, one with experience in the southern part of the Coolgardie IBRA region, and the other having worked in the southern part of the Murchison IBRA region. The other two team members had some experience in the wider area of Western Australia. Mattiske Consulting Pty Ltd has carried out several surveys in the Norseman area (2001-2013).
Proportion of flora collected and identification issues	Minor limitation: The species accumulation curves for each of the Northern and Scotia survey areas (Figures 10.1-10.2) show that 73 % of taxa potentially present in each of the survey areas were recorded during this survey. In view of the extent of previous studies in different seasons, this was not seen as a limitation in 2020. Trees and mallees of the genus <i>Eucalyptus</i> (which often dominated the canopy) were an exception to this, as most were found with buds and fruit, making identification to species level possible.
Effort and extent of survey	Not a limitation: The survey was designed to be a reconnaissance assessment in degraded areas and a detailed flora and vegetation assessment in less disturbed environments. In view of the extent of previous studies in different seasons, this was not seen as a limitation in 2020. In most vegetation communities, three or more quadrats were surveyed in order to obtain statistically valid data. However, in total five communities contained only two quadrats each and eight communities contained only one quadrat. These thirteen communities were restricted in areal extent within the survey areas and thus it was not possible to survey more replicate sites (see section 5.2.1 for further detail). Although parts of the Gladstone-North Royal Haul Roads survey area and part of the Gladstone survey area were not surveyed at this time these areas had been covered by previous Mattiske Consulting Pty Ltd surveys (see Appendix B). Some parts of those previously mapped areas were re-surveyed at this time.
Access restrictions within survey area	Not a limitation: There were no restrictions to access encountered during the survey. Most sites could be reached by vehicle on pre-existing tracks followed by a short foot traverse. A small number of sites, particularly those in the east of the Scotia survey area, required walks of several km length to access.
Survey timing, rainfall, season of survey	Minor Limitation: As discussed in section 3.3, rainfall for 12 months prior to the Autumn survey was lower than average. In view of the extent of previous studies in the areas and nearby areas this was seen as a minor limitation.

Table 2: Potential limitations affecting the conclusions made in this report (continued)

POTENTIAL SURVEY LIMITATION	IMPACT ON CURRENT SURVEY
Disturbances (fire/flood/clearing)	Not a limitation: The vegetation at most survey sites was assessed as being Pristine or Excellent (Keighery 1994). However, some sites were adjacent to cleared areas, and a few areas (such as old tracks) had been cleared in the past. One site had been burnt around 6-10 years ago. These sites generally had a higher than usual number of weed species, a higher foliage cover of shrub species, and the Eucalypt species present were often juveniles.
Data and statistical analysis	Minor limitation: In view of lower rainfalls prior to the assessments, some plants were not flowering or fruiting at the time of the survey. This is seen as minor constraint in view of the extent of previous studies in the local and nearby areas. A significant number of vegetation communities (8 of 27) contained only one survey quadrat, and five another contained only two quadrats due to the restricted areal extent of some of the communities within the survey areas; and In some cases, taxa were combined to improve the robustness of the data (e.g. <i>Eucalyptus flocktoniae</i> complex – see section 3.4).

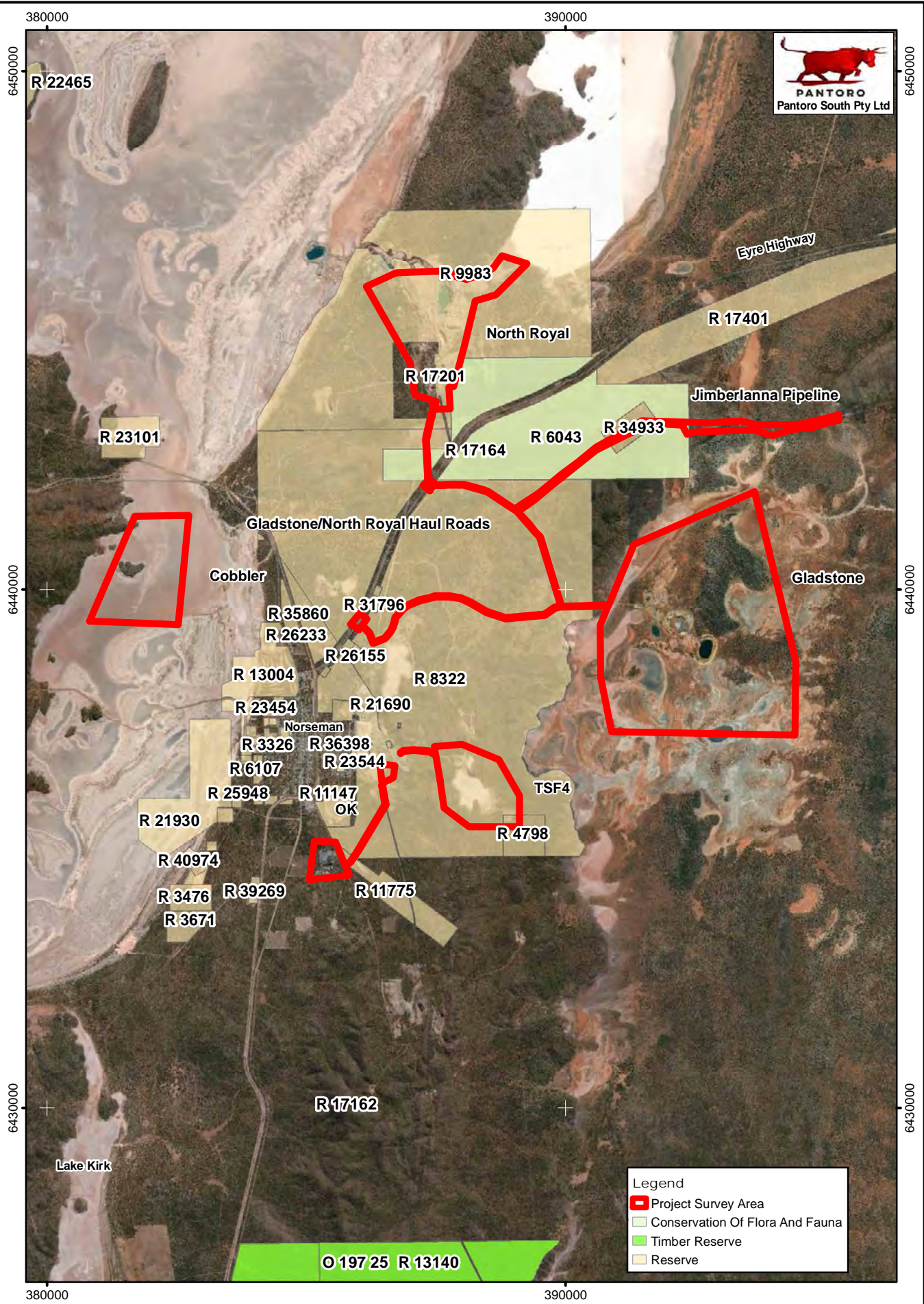
4. DESKTOP ASSESSMENT RESULTS

4.1. Regional Context

The Norseman Gold Project area lies within the Coolgardie Botanical District of the Southwestern Interzone (Beard 1990). The vegetation of Western Australia has been assigned to bioregions and subregions under the Interim Biogeographical Regionalisation for Australia (IBRA), with the survey area being within the *Coolgardie 3 – Eastern Goldfields* Subregion of the Coolgardie Bioregion (Cowan 2001). Geologically, the Norseman Gold Project survey area lies within the Yilgarn Block.

4.2. Managed Lands

There are a number of reserves in the area surrounding the Norseman Gold Project survey areas, presented in Figure 3. In the South, the 780,000 ha Class B Dundas Nature Reserve is located approximately 10 km east of the Scotia survey area. The southern border of the 2,610 ha Brockway Class C Forest Reserve (R 13140/O 19725) adjoins the northern section of the Maybell survey area (Figure 3). The Scotia Haul Road crosses water supply reserve R 4508. In the north, a former water supply reserve of 930 ha (R 6043) has been divested and converted to a Conservation Reserve. The latter encompasses Jimberlana Hill and covers parts of the Jimberlana Pipeline and North Royal pipeline survey areas. This reserve also includes a Main Roads Quarry (R 34933) and a Geodetic Infrastructure Reserve (R 17164). Reserve R 9983 (1954 ha) is reserved as common lands, and includes a small reserve (R 17201), covers part of the North Royal survey area. The TS4 and OK survey areas are covered by the common lands reserve R 8322 (3757 ha), and the rifle range reserve R 11775 (102 ha) intersects the OK haul road survey area.



Legend

- Project Survey Area
- Conservation Of Flora And Fauna
- Timber Reserve
- Reserve

Notes: Image: DigitalGlobe (27/11/2016), Managed Lands: DBCA, Reserves: Landgate

N
0 1.6 km
Scale: 1:125,000
MGA94 (Zone 50)

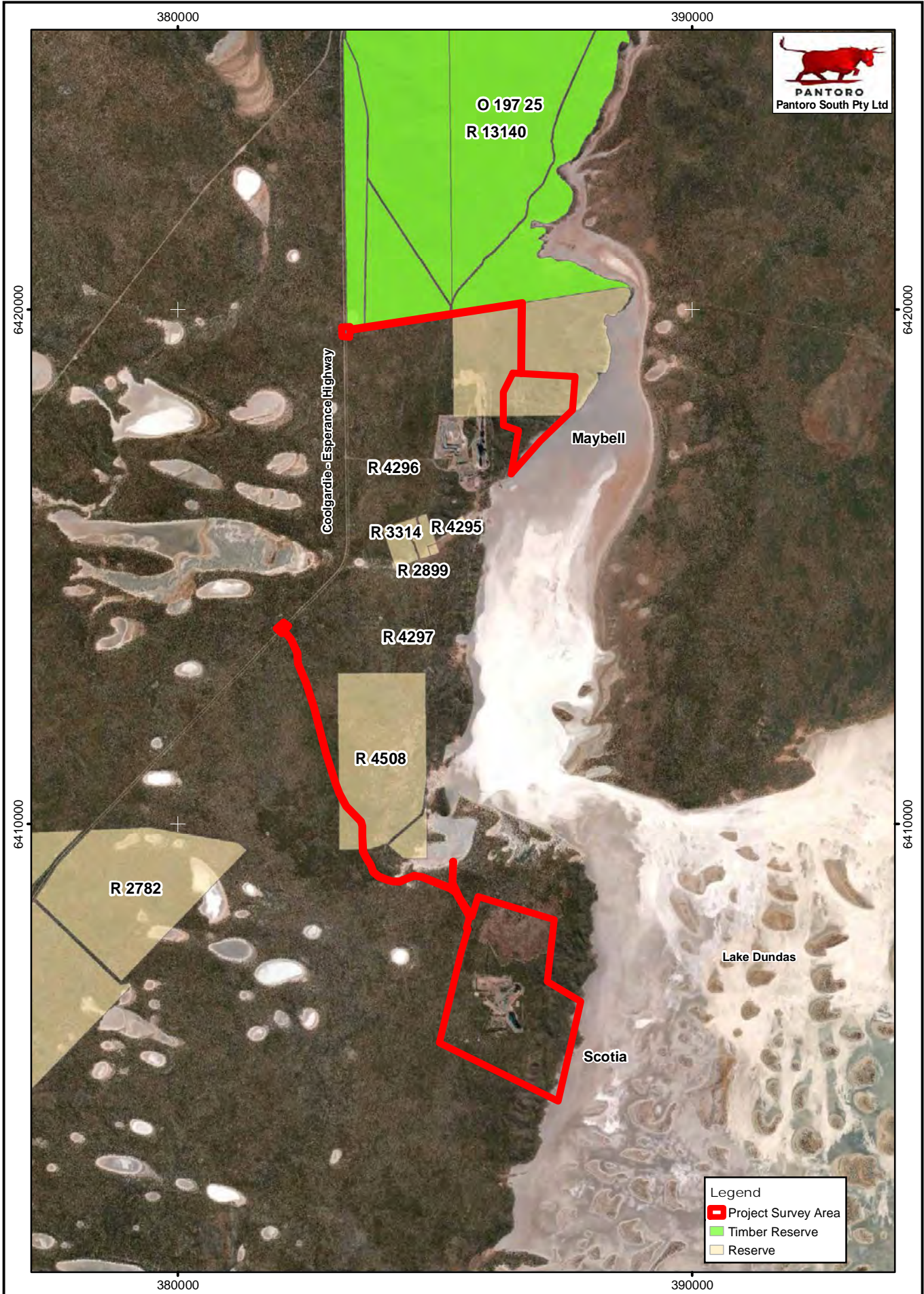
CAD Ref: a2764_f01_03
Date: March 2020

Rev: A A4

Mattiske Consulting Pty Ltd
28 Central Road, Kalamunda WA 6076 - Tel: 9257 1625 - Fax: 9257 1640
Author: E M Mattiske MCPL Ref: CNG2001/007/20
Drawn: CAD Resources - www.cadresources.com.au
Tel: (08) 9246 3242 - Fax (08) 9246 3202

**Norseman Gold Project
Managed Lands & Reserves
Sheet 1 of 2**

Figure:
3.1



Legend

- Project Survey Area
- Timber Reserve
- Reserve

Notes: Image: DigitalGlobe (27/11/2016), Managed Lands: DBCA, Reserves: Landgate

N

0 1.6 km

Scale: 1:125,000
MGA94 (Zone 50)

CAD Ref: a2764_f01_03
Date: March 2020

Rev: A | A4

Mattiske Consulting Pty Ltd

28 Central Road, Kalamunda WA 6076 - Tel: 9257 1625 - Fax: 9257 1640

Author: E M Mattiske | MCPL Ref: CNG2001/007/20

Drawn: CAD Resources - www.cadresources.com.au
Tel: (08) 9246 3242 - Fax (08) 9246 3202

**Norseman Gold Project
Managed Lands & Reserves
Sheet 2 of 2**

Figure:
3.2

4.3. Climate

The Coolgardie Botanical District has a typically arid non-seasonal to semi-arid Mediterranean climate, with annual rainfall between 200 and 300 mm (Beard 1990). Norseman Aero WA (012009) is the closest active BOM weather station to the survey area. Rainfall and temperature data from Norseman Aero WA (012009) (BOM 2020) are illustrated in Figure 4. Below average rainfall was received in the three months before the survey (for January to March 2020 rainfall was 67.2 mm compared to an average of 92.7 mm). Although the March 2020 rainfall was above average, January and February 2020 rainfall was well below average (BOM 2020).

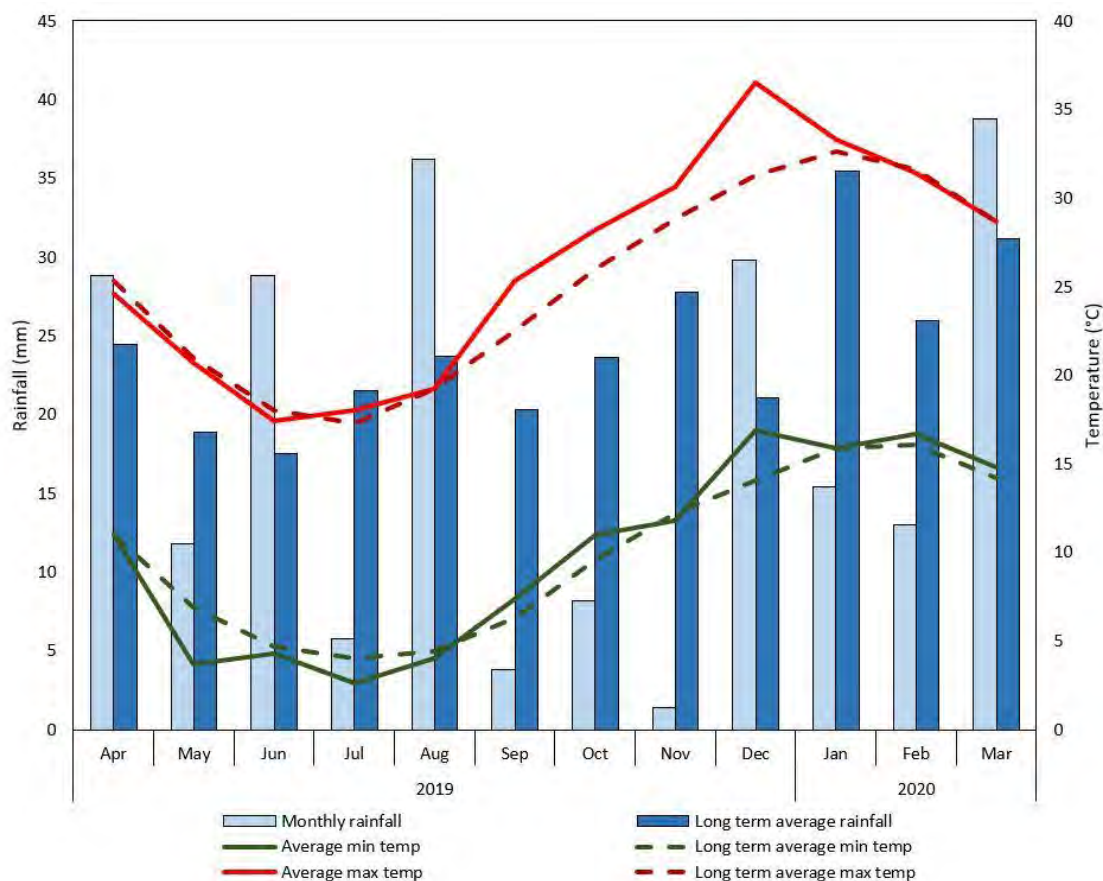


Figure 4: Rainfall and temperature data for Norseman Aero WA (012009)

Note: Long-term average monthly rainfall (2000-2020) and temperature (2000-2020) data, together with monthly rainfall and temperature data for the period of April 2019 to March 2020 (BOM 2020).

4.4. Geology, Soils and Topography

The geology of the area consists of Archaean greenstones and granite of the Yilgarn Block, and Proterozoic granite and gneiss of the Fraser Range Block (Beard 1990, Cowan 2001). The topography is of gently undulating plains, interrupted by occasional ranges of low hills and ridges of Archaean greenstones, playa lakes and sandplains in the west. A horst of Proterozoic basic granulite interrupts the undulating plains to the east (Beard 1990, Cowan 2001).

Soil-landscapes zones of Western Australia's rangelands and arid interior were defined by Tille (2006). The Norseman Gold Project survey area predominantly falls within the Kambalda Zone (265) of the

Kalgoorlie Province, although some of the southern survey areas are likely to cross into the northern section of the Salmon Gums Mallee Zone (246) of the Stirling Province (Tille 2006, Figure 5). The area is characterised by flat to undulating plains, hills, ranges, stony plains and salt lakes on greenstone and granite of the Yilgarn Craton (Tille 2006). Soils of the area include: Salt lake soils, red loamy earths, hardpan shallow loams, sandy duplexes and calcareous loamy earths. Calcareous earths are the predominant soil in the area, covering most of the plains and greenstone areas (Beard 1990, Cowan 2001, Tille 2006). Tille (2006) notes that the Stirling and Kalgoorlie Provinces grade into each other and that the boundary between the two reflects the change in terrain from Tertiary marine sediments supporting predominantly mallee vegetation with *Melaleuca* spp. understorey, to terrain formed by Aeolian deposits in the north that supports predominantly eucalypt woodland with halophytic understorey.

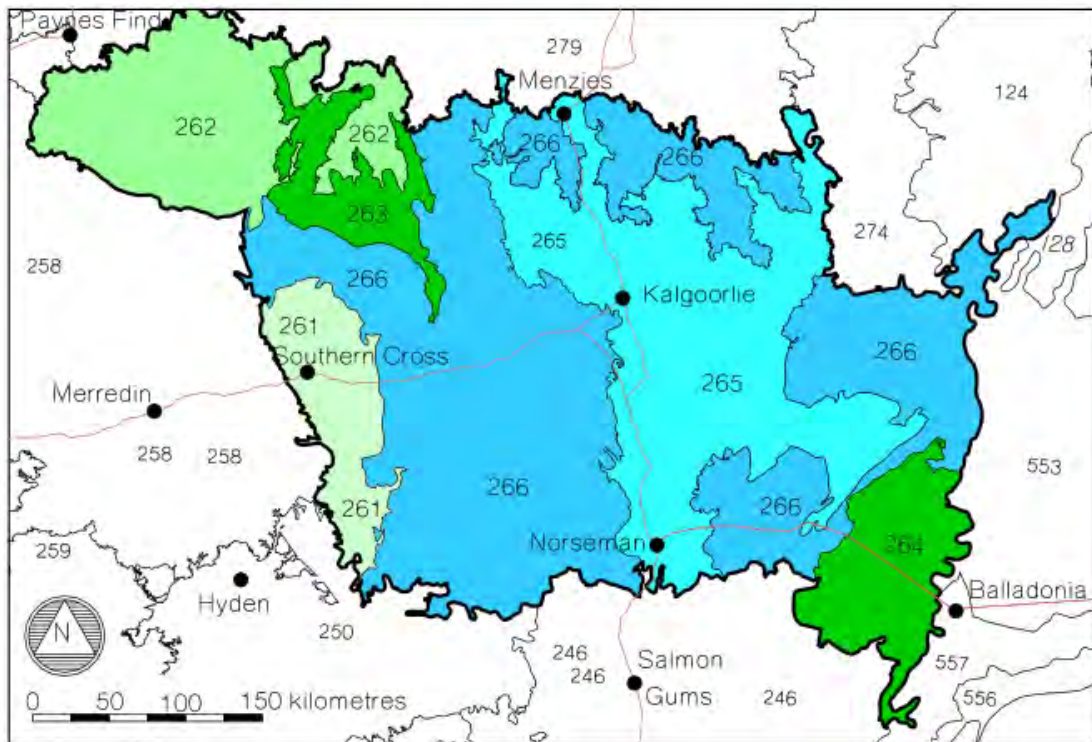


Figure 5: Soil-landscape zones of the WA rangelands and interior: Kalgoorlie Province (Tille 2006)

The Department of Primary Industries and Regional Development's (DPIRD) Land Systems present within the Norseman Gold Project survey area (Figure 6, Table 3) include:

1. SV2: Saline valleys with some dunes including barchan forms – salt lake channels, mostly devoid of true soils, and their fringing areas
2. DD14: Flat to undulating land with small valleys occasionally broken by low narrow rocky hills and ridges, or tors and bosses
3. BB5: Rocky ranges and hills of greenstones – basic igneous rocks
4. Lb10: Gently undulating plains with some granitic bosses and tors; acid clays common below surface

Table 3: Extent of Land Systems intersecting the Norseman Gold Project study areas

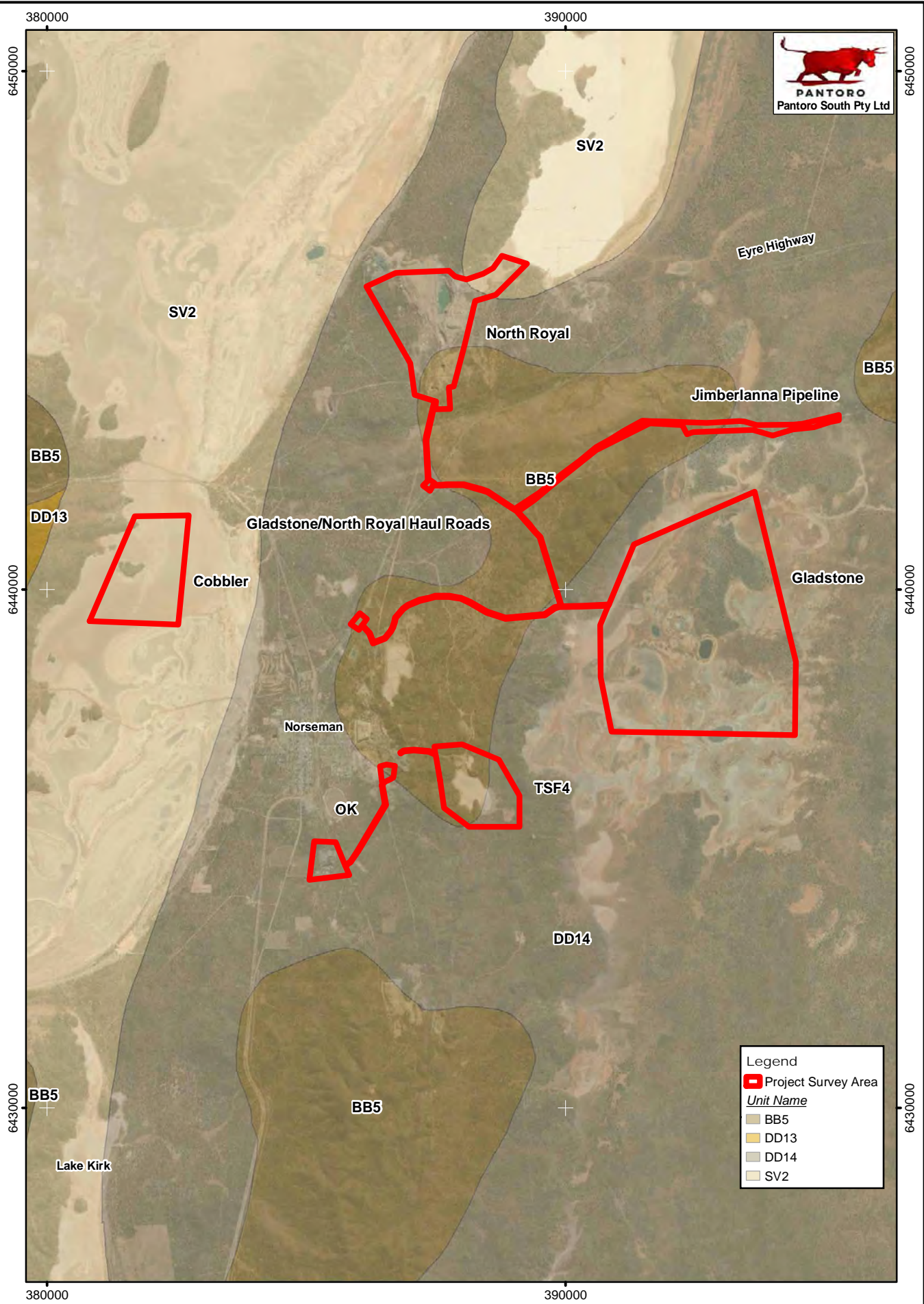
PROJECT SURVEY AREA	LAND SYSTEM	TOTAL STATEWIDE EXTENT (ha)	AREA OF INTERSECTION WITH THE SURVEY AREA (ha)	PROPORTION OF CURRENT EXTENT (%)
Cobbler	SV2	69941	284.5	0.41%
Gladstone	DD14	434972	1380.3	0.32%
Gladstone/North Royal Haul Road	BB5	145065	21.8	0.02%
	DD14	434972	7.3	0.00%
Jimberlana Pipeline	BB5	145065	37.1	0.03%
	DD14	434972	30.1	0.01%
Maybell	DD14	434972	128.1	0.03%
	SV2	69941	46.0	0.07%
North Royal	BB5	145065	64.6	0.05%
	DD14	434972	272.5	0.06%
	SV2	69941	42.8	0.06%
OK	BB5	145065	4.7	0.00%
	DD14	434972	47.9	0.01%
Scotia	BB5	145065	6.7	0.01%
	DD14	434972	10.9	0.00%
	Lb10	38417	470.0	1.22%
	SV2	87034	213.4	0.25%
TSF4	BB5	145065	123.3	0.09%
	DD14	434972	75.0	0.02%

4.5. Regional Vegetation

Beard (1990) described the vegetation of the Coolgardie Botanical District as predominantly Eucalypt woodland, becoming open and with saltbush-bluebush understorey on calcareous soils. *Allocasuarina* thickets and scrub-heath occur on sandplains and there are patches of shrub steppe adjoining the Great Victoria Desert (Beard 1990).

The Pre-European vegetation associations present within the Norseman Gold Project survey area (Figure 7, Table 4) include:

- 125.0: Bare areas - Salt lake, lagoon, clay pan
- 221.3: Succulent steppe/saltbush – *Grevillea* spp., *Atriplex* spp., *Maireana* spp. communities on alkaline soils
- 524.1: Medium Eucalypt woodland over *Eremophila* sparse shrubland over *Atriplex* mixed chenopod open shrubland - *Eucalyptus salubris*, *E. oleosa*, *E. dundasii*, *E. flocktoniae* over *Eremophila scoparia*, *E. interstans* over *Atriplex vesicaria*, *Maireana sedifolia*, *M. pyramidata*
- 110.0: Hummock grassland with scattered shrubs or mallee - *Triodia scariosa*, *Acacia* spp., *Grevillea* spp., *Eucalyptus* spp.
- 9.0: Medium Eucalypt woodland over *Eremophila* sparse shrubland - *Eucalyptus salubris*, *E. oleosa*, *E. torquata*, *E. lesouefii*, *E. clelandiorum* over *Eremophila scoparia*, *E. glabra*, *E. oldfieldii*
- 3106.0: Medium Eucalypt woodland - *Eucalyptus salubris*, *E. oleosa*, *E. salmonophloia*, *E. dundasii*



Legend

- Project Survey Area
- Unit Name*
- BB5
- DD13
- DD14
- SV2

Notes: Image: DigitalGlobe (27/11/2016), Land Systems: DPIRD

N

0 1.6 km

Scale: 1:100,000
MGA94 (Zone 50)

CAD Ref: a2764_f01_04
Date: March 2020

Rev: A | A4

Mattiske Consulting Pty Ltd

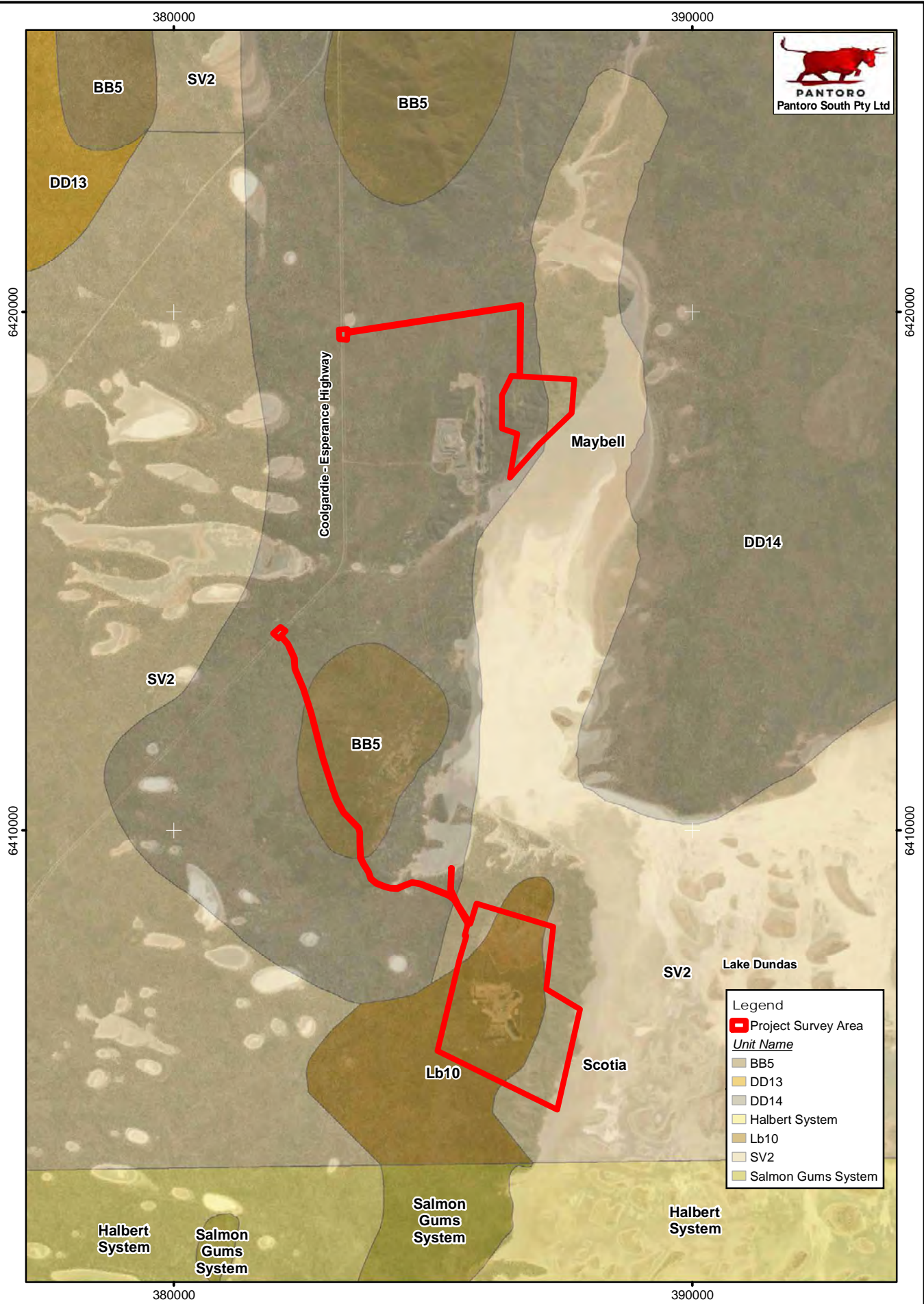
28 Central Road, Kalamunda WA 6076 - Tel: 9257 1625 - Fax: 9257 1640

Author: E M Mattiske | MCPL Ref: CNG2001/007/20

Drawn: CAD Resources - www.cadresources.com.au
Tel: (08) 9246 3242 - Fax (08) 9246 3202

**Norseman Gold Project
Land Systems
Sheet 1 of 2**

Figure:
6.1



Legend

- Project Survey Area
- Unit Name
- BB5
- DD13
- DD14
- Halbert System
- Lb10
- SV2
- Salmon Gums System

Notes: Image: DigitalGlobe (27/11/2016), Land Systems: DPIRD

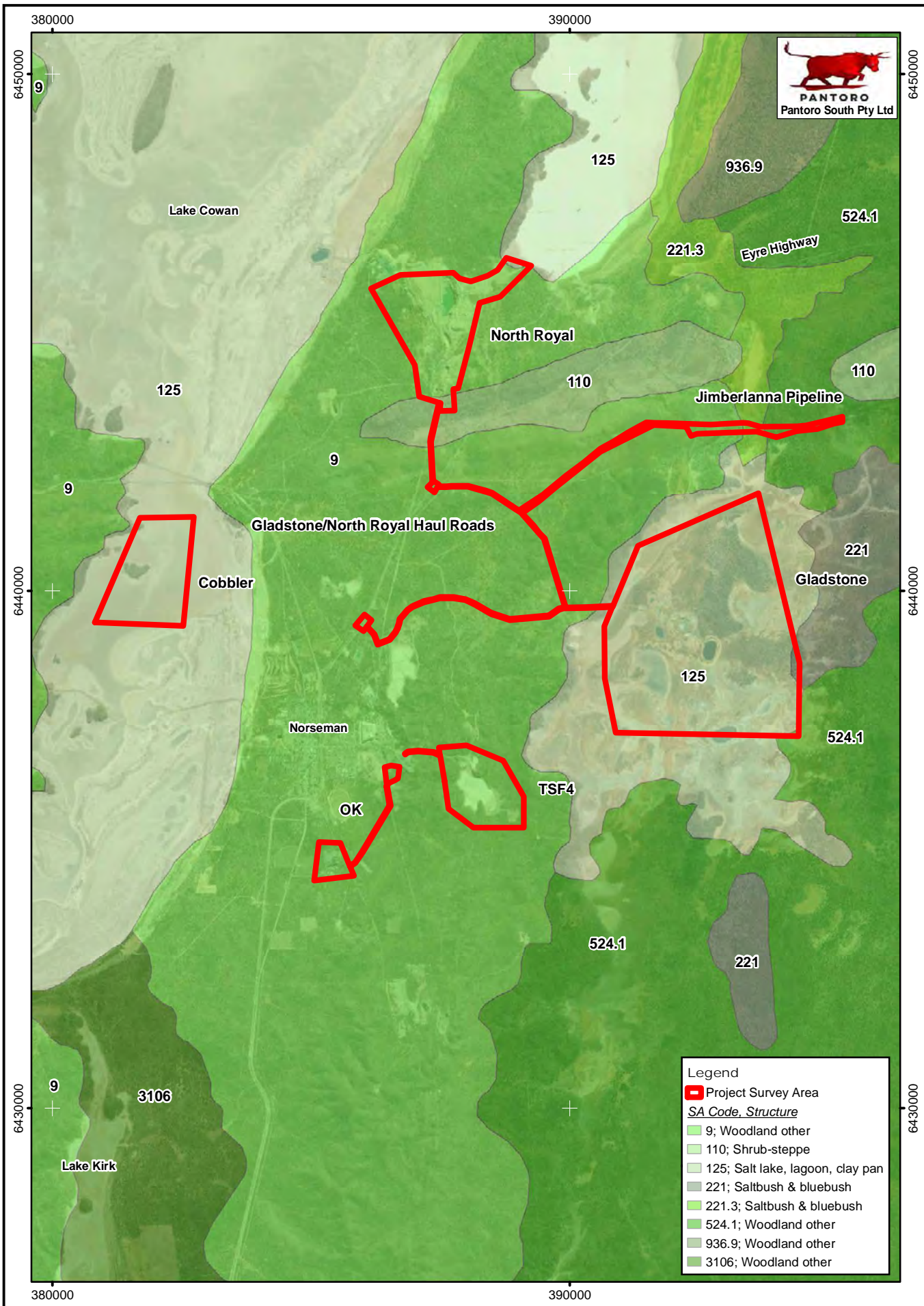
0 1.6 km
 Scale: 1:100,000
 MGA94 (Zone 50)

CAD Ref: a2764_f01_04
 Date: March 2020 Rev: A A4

Mattiske Consulting Pty Ltd
 28 Central Road, Kalamunda WA 6076 - Tel: 9257 1625 - Fax: 9257 1640
 Author: E M Mattiske MCPL Ref: CNG2001/007/20
 Drawn: CAD Resources - www.cadresources.com.au
 Tel: (08) 9246 3242 - Fax (08) 9246 3202

Norseman Gold Project Land Systems Sheet 2 of 2

Figure:
6.2



Legend	
	Project Survey Area
<u>SA Code, Structure</u>	
	9; Woodland other
	110; Shrub-steppe
	125; Salt lake, lagoon, clay pan
	221; Saltbush & bluebush
	221.3; Saltbush & bluebush
	524.1; Woodland other
	936.9; Woodland other
	3106; Woodland other

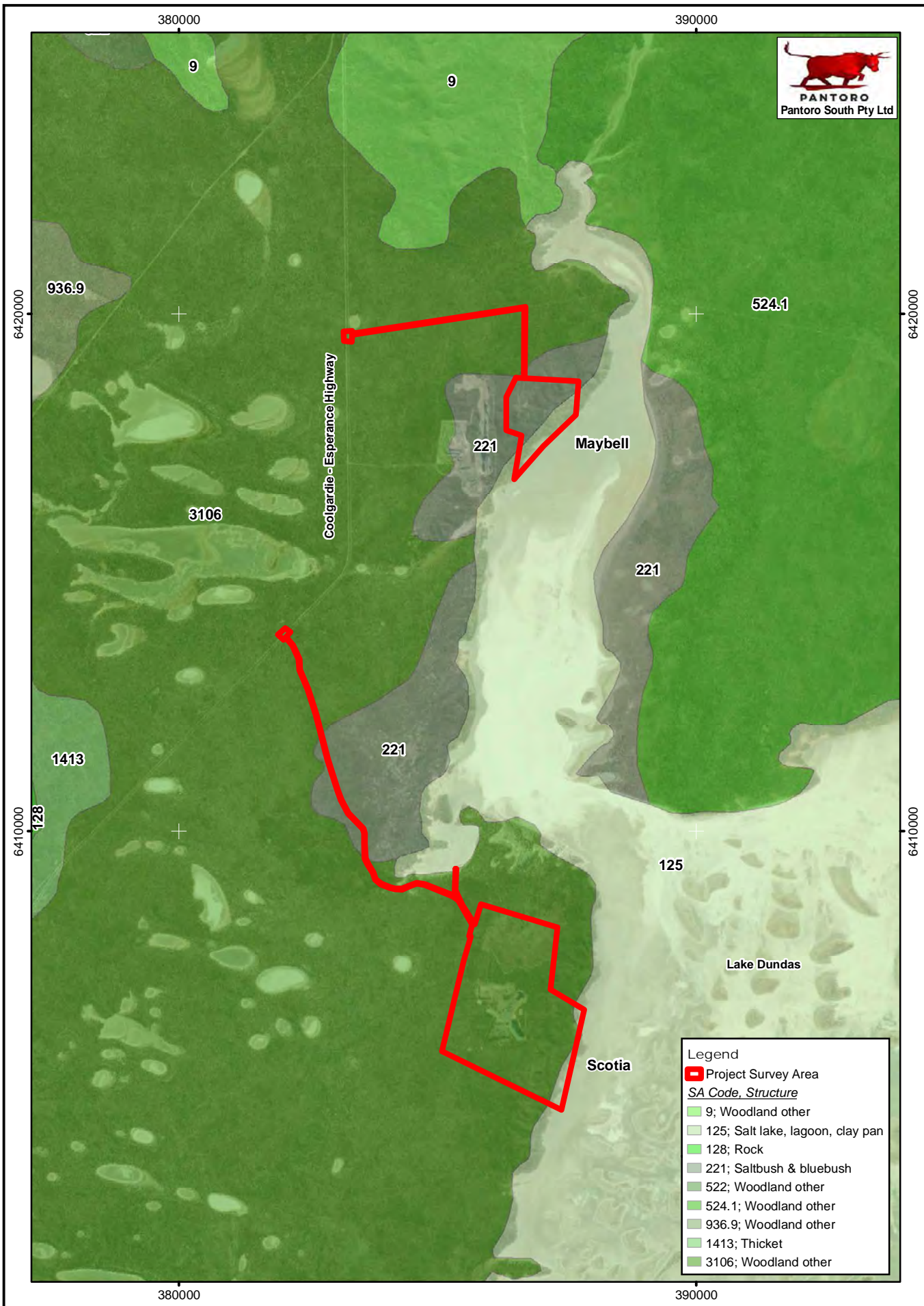
Notes: Image: DigitalGlobe (27/11/2016), Pre European Vegetation: DFRPD

0 1.6 km
 Scale: 1:100,000
 MGA94 (Zone 50)
 CAD Ref: a2764_f01_05
 Date: March 2020 Rev: B | A4

Mattiske Consulting Pty Ltd
 28 Central Road, Kalamunda WA 6076 - Tel: 9257 1625 - Fax: 9257 1640
 Author: E M Mattiske MCPL Ref: CNG2001/007/20
 Drawn: CAD Resources - www.cadresources.com.au
 Tel: (08) 9246 3242 - Fax (08) 9246 3202

Norseman Gold Project
Pre European Vegetation
Sheet 1 of 2

Figure:
7.1



Notes: Image: DigitalGlobe (27/11/2016), Pre European Vegetation: DPI/RD

N

0 1.6 km

Scale: 1:100,000
MGA94 (Zone 50)

CAD Ref: a2764_f01_05
Date: March 2020

Rev: B | A4

Mattiske Consulting Pty Ltd

28 Central Road, Kalamunda WA 6076 - Tel: 9257 1625 - Fax: 9257 1640

Author: E M Mattiske MCPL Ref: CNG2001/007/20

Drawn: CAD Resources - www.cadresources.com.au
Tel: (08) 9246 3242 - Fax (08) 9246 3202

Norseman Gold Project
Pre European Vegetation
Sheet 2 of 2

Figure:
7.2

More recently, the vegetation of Western Australia has been assigned to bioregions and subregions under the Interim Biogeographical Regionalisation for Australia (IBRA), with the Norseman Gold Project survey area falling within the *Coolgardie 3* (COO3 – Eastern Goldfields) subregion of the Coolgardie Region (DAWE 2020a). The *Coolgardie 3* subregion is rich in endemic *Acacia* spp. and the vegetation of the area is described as mallees, *Acacia* thickets and shrub heaths on sandplains. Diverse *Eucalyptus* woodlands occur on ranges, in valleys and around salt lakes. Salt lakes support dwarf shrublands of samphire (Cowan 2001).

Table 4: Extent of pre-European vegetation associations intersecting the Norseman Gold Project study areas

PROJECT SURVEY AREA	VEGETATION ASSOCIATION	STATE-WIDE PRE-EUROPEAN EXTENT (ha)	AREA OF INTERSECTION WITH THE SURVEY AREA	PROPORTION OF CURRENT EXTENT (%)
Cobbler	125.0	3494560	284.5	0.01%
Gladstone	125.0	3494560	1368.2	0.04%
	221.3	56313	9.8	0.02%
	524.1	21745	2.4	0.01%
Gladstone/North Royal Haul Road	110.0	361263	1.8	0.00%
	125.0	3494560	0.6	0.00%
	9.0	240437	26.8	0.01%
Jimberlana Pipeline	221.3	7710	6.1	0.08%
	524.1	21745	19.1	0.09%
	9.0	240437	42.0	0.02%
Maybell	125.0	3494560	55.0	0.00%
	221.3	56313	107.0	0.19%
	3106.0	52639	12.4	0.02%
North Royal	110.0	361263	9.5	0.00%
	125.0	3494560	5.2	0.00%
	9.0	240437	365.2	0.15%
OK	9.0	240437	52.5	0.02%
Scotia	125.0	3494560	30.2	0.00%
	221.3	56313	5.2	0.01%
	3106.0	52639	665.4	1.26%
TSF4	9.0	240437	198.4	0.08%

4.6. Great Western Woodlands

The Department of Environment and Conservation's [DEC] (2010) *A Biodiversity and Cultural Conservation Strategy for the Great Western Woodlands* outlines the issues and management responses to the protection of the internationally significant Great Western Woodlands. The purpose of the strategy is to provide a management approach to the protection of the environmental and cultural values of the Great Western Woodlands through coordination and integration of many management elements. The Great Western Woodlands are the largest remaining intact Mediterranean-climate woodland which covers almost 16 million hectares in size and extends between the edge of the Western Australian Wheatbelt in the west, to Kalgoorlie-Boulder in the north, the inland deserts to the north east and the Nullarbor Plain to the east

(DEC 2010). The Great Western Woodlands spans two botanic and climatic zones, the wetter south-west and the arid interzone (into which the Norseman Gold Project area falls), and is an internationally significant area of biological richness (DEC 2010). The vegetation of the area is predominantly woodland communities, but also includes shrubland and mallee vegetation. The Great Western Woodlands supports **approximately 20% of Australia's known flora and is a centre of *Eucalyptus* species diversity**, with over 160 species of *Eucalyptus* found in the area (DEC 2010).

4.7. Previous Surveys

Many flora and vegetation surveys have been conducted in and around Norseman, with one of the earliest maps being produced fifty years ago by Beard (Beard 1970) and the accompanying memoir in 1975 (Beard 1975). Many more surveys have been required recently by mining companies with activities in and around Norseman. The location, purpose, method and results of twenty-one field surveys carried out between 1989 and 2019 are reviewed and summarised in Appendix B. Six of the previous surveys listed here were conducted by Mattiske Consulting Pty Ltd (2001a, 2001b, 2002, 2005, 2013a, 2013b).

4.8. Potential Flora

A total of 804 vascular plant taxa, representative of 260 genera and 115 families, have the potential to occur within the Norseman Gold Project study areas (based on NatureMap (DBCA 2007-) & EPBC Act (DAWE 2015) search results and previous surveys in the area (Botanica Consulting 2010; GHD Pty Ltd 2009, 2010a, 2010b; Goldfields Environmental Management Pty Ltd 1989; Landcare Services Pty Ltd 1995, 1996, 1997; Marianna Partners Environmental Services 1996; Mattiske Consulting Pty Ltd 2001a, 2001b, 2002, 2005, 2013a, 2013b; Outback Ecology 2003; Paul Armstrong & Associates 2004; Rally Revegetation and Environmental Services 2004; Umwelt Australia Pty Ltd 2016), included in Appendix B). The most commonly represented families were Myrtaceae (111 taxa), Fabaceae (90 taxa) and Asteraceae (86 taxa). The most commonly represented genera were *Eucalyptus* (64 taxa), *Acacia* (51 taxa), *Eremophila* (32 taxa), *Melaleuca* (28 taxa) and *Maireana* (18 taxa).

A total of 591 vascular plant taxa, representative of 206 genera and 61 families, have the potential to occur within the Norseman Gold Project North study areas (based on NatureMap (DBCA 2007-) & EPBC Act (DAWE 2015) search results and previous surveys in the area (Goldfields Environmental Management Pty Ltd 1989; Landcare Services Pty Ltd 1995, 1996, 1997; Mattiske Consulting Pty Ltd 2001a, 2001b, 2002, 2005; Outback Ecology 2003; Rally Revegetation and Environmental Services 2004), included in Appendix B). The most commonly represented families were Myrtaceae (86 taxa), Chenopodiaceae (70 taxa) and Fabaceae (67 taxa). The most commonly represented genera were *Eucalyptus* (54 taxa), *Acacia* (34 taxa), *Eremophila* (29 taxa), *Melaleuca* (21 taxa) and *Maireana* (18 taxa).

A total of 515 vascular plant taxa, representative of 184 genera and 65 families, have the potential to occur within the Norseman Gold Project South study areas (based on NatureMap (DBCA 2007-) & EPBC Act (DAWE 2015) search results and previous surveys in the area (Botanica Consulting 2010; GHD Pty Ltd 2010b; Landcare Services Pty Ltd 1995, 1997; Marianna Partners Environmental Services 1996; Mattiske Consulting Pty Ltd 2013a, 2013b; Paul Armstrong & Associates 2004; Umwelt Australia Pty Ltd 2016), included in Appendix B). The most commonly represented families were Myrtaceae (82 taxa), Fabaceae (55 taxa) and Chenopodiaceae (55 taxa). The most commonly represented genera were *Eucalyptus* (47 taxa), *Acacia* (37 taxa), *Melaleuca* (22 taxa), *Eremophila* (21 taxa) and *Maireana* (15 taxa).

4.8.1. Potential Threatened and Priority Flora

Three Threatened flora species, *Allocasuarina globosa* (T), *Daviesia microcarpa* (T) and *Eucalyptus platydisca* (T), pursuant to Part 2, Division 1, Subdivision 2 of the BC Act and as listed by DBCA (2018a) have the possibility of occurring in the Norseman Gold Project survey area. All three of these species are pursuant to section 179 of the EPBC Act or listed by the DAWE (2020b). They all could possibly occur in

the Norseman Gold Project study areas (Appendix D), with both *Daviesia microcarpa* (T) and *Eucalyptus platydisca* (T) assessed as having a High likelihood of occurrence in the North study areas.

A total of 37 Priority flora species, including eleven Priority 1, five Priority 2, seventeen Priority 3 and four Priority 4 flora species, as listed by DBCA(2018b), have the potential to occur within the Norseman Gold Project study areas (Appendices C and D).

A total of 23 Priority flora species, including nine Priority 1, three Priority 2, eight Priority 3 and three Priority 4 flora species, as listed by DBCA (2018b), have the potential to occur within the Norseman Gold Project North study areas (Appendices C and D). Those species assessed as having a High likelihood of occurrence in the North study areas include the following species:

- Priority 1: *Bossiaea aurantiaca*, *Eucalyptus jimberlanica*, *Eucalyptus websteriana* subsp. *norsemanica*, *Grevillea phillipsiana* and *Micromyrtus papillosa*.
- Priority 3: *Eremophila purpurascens* and *Eucalyptus brockwayi*.

A total of 17 priority flora species, including four priority one, two priority two and 11 priority three flora species, as listed by DBCA (2018b), have the potential to occur within the Norseman Gold Project South study areas (Appendices C and D). Those species assessed as having a High likelihood of occurrence in the South study areas include the following species:

- Priority 1: *Eucalyptus jimberlanica* and *Philotheca apiculata*.
- Priority 3: *Allocasuarina eriochlamys* subsp. *grossa*, *Beyeria sulcata* var. *truncata*, *Eremophila purpurascens*, *Goodenia laevis* subsp. *laevis* and *Melaleuca coccinea*.

4.8.2. Potential Introduced (Weed) Species and Declared Pest (Plant) Organisms

Forty-two introduced species could potentially occur within the Norseman Gold Project study areas (based on NatureMap (DBCA 2007-) & EPBC Act (DAWE 2015) search results and previous surveys in the area (Botanica Consulting 2010; GHD Pty Ltd 2009, 2010a, 2010b; Goldfields Environmental Management Pty Ltd 1989; Landcare Services Pty Ltd 1995, 1996, 1997; Marianna Partners Environmental Services 1996; Mattiske Consulting Pty Ltd 2001a, 2001b, 2002, 2005, 2013a, 2013b; Outback Ecology 2003; Paul Armstrong & Associates 2004; Rally Revegetation and Environmental Services 2004; Umwelt Australia Pty Ltd 2016). Four of these species, *Ambrosia tenuifolia*, *Opuntia ficus-indica*, *Opuntia stricta* and *Tamarix aphylla* are declared pest organisms pursuant to section 22 of the BAM Act. In addition, *Opuntia* species and *Tamarix aphylla* are Weeds of National Significance (DAWE 2020c). None of these declared pest species have been recorded in the previous surveys summarised in this report (Appendix B); they were identified either by the NatureMap or EPBC Act searches.

Ambrosia tenuifolia has a declared pest organism control category of C1 Exclusion and keeping category of Prohibited for the whole of state (DPIRD 2020). A declared pest control category of C1 Exclusion requires organisms to be excluded from Western Australia. A declared pest keeping category of Prohibited requires the organism to only be kept under a permit for public display, education purposes or scientific research by entities approved by state authorities (DPIRD 2020).

Opuntia ficus-indica has a declared pest organism control category of C3 Management and keeping category of Exempt for the whole of state (DPIRD 2020). A declared pest control category of C3 Management requires the organisms should have management applied that would prevent or contain spread, reduce numbers or distribution or alleviate harmful impact of the organism (DPIRD 2020). A declared pest keeping category of Exempt requires no permits or conditions for keeping, although there may be other requirements under the *Biosecurity and Agriculture Management Act 2007*. Organisms in this category may also be regulated by legislation such as the *BC Act* administered by DBCA (DPIRD 2020).

Opuntia stricta has a declared pest organism control category of C3 Management and keeping category of Restricted for the whole of state (DPIRD 2020). A declared pest control category of C3 Management requires the organisms should have management applied that would prevent or contain spread, reduce numbers or distribution or alleviate harmful impact of the organism (DPIRD 2020). A declared pest keeping

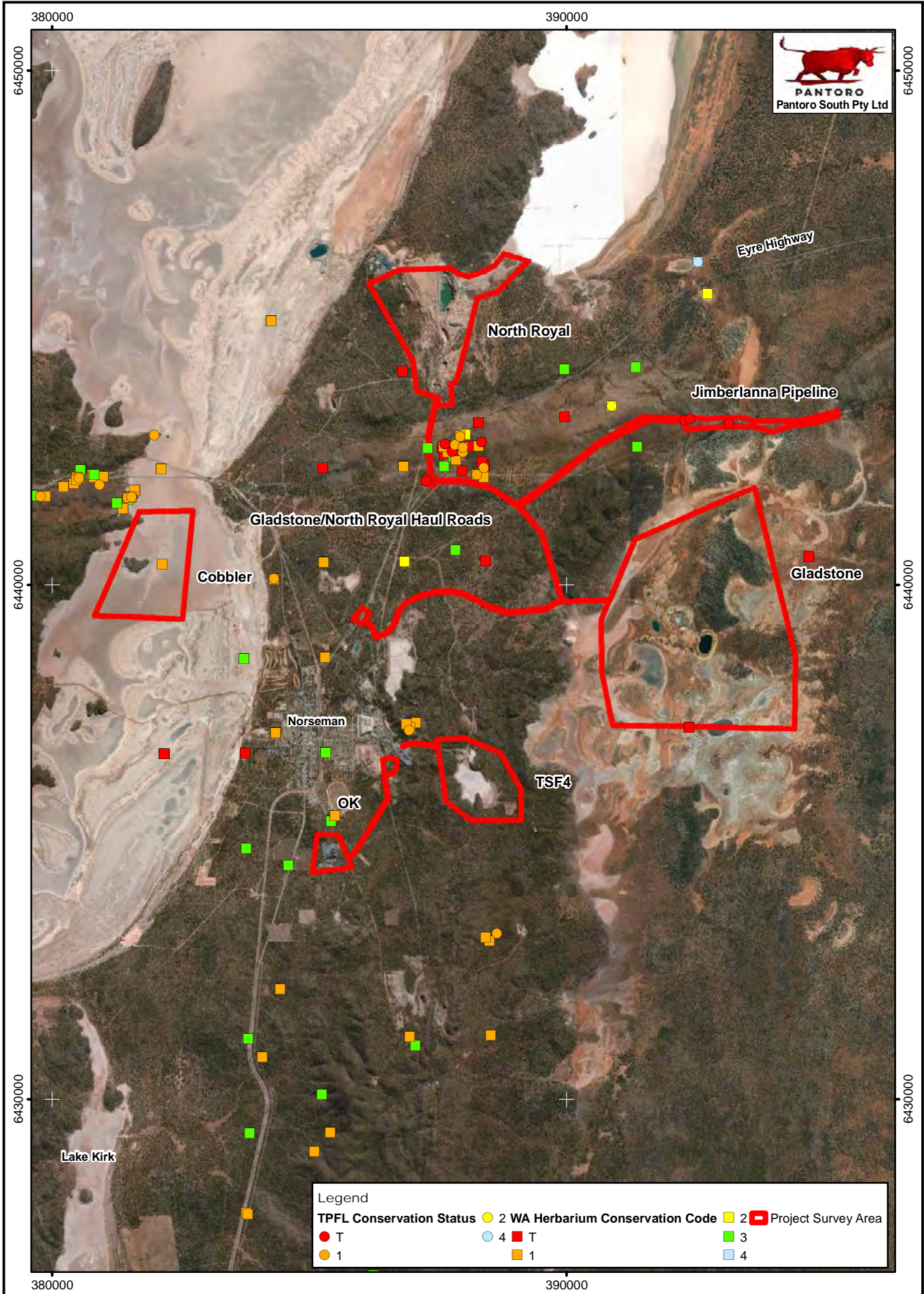
category of Restricted applies to organisms that can be kept under permit by private individuals as they have a relatively low risk of becoming a problem for primary industry, public safety or the environment (DPIRD 2020).

* *Tamarix aphylla* has a declared pest organism keeping category of Exempt for the whole of state (DPIRD 2020). A declared pest keeping category of Exempt requires no permits or conditions for keeping, although there may be other requirements under the *Biosecurity and Agriculture Management Act 2007*. Organisms in this category may also be regulated by legislation such as the *BC Act* administered by DBCA (DPIRD 2020).

4.9. Potential Threatened and Priority Ecological Communities

There are no threatened ecological communities (TECs) listed at Commonwealth level pursuant to sections 181 and 182 of the *EPBC Act* and listed by the DAWE (2020d) or at State level pursuant to Part 2, Division 2, Subdivision 1 of the *BC Act* and as listed by DBCA (2018c) with the potential to occur in the Norseman Gold Project study areas.

No priority ecological communities (PECs) as listed at State level by DBCA (2020a) have the potential to occur within any of the study areas of the Norseman Gold Project. The Priority 1 ecological community, 'Allocasuarina globosa assemblages on greenstone rock' (Esperance District) is listed at State level by DBCA (2020a) and occurs approximately 3 km north of the Maybell survey area (Figure 8). The assemblage is only known from near Norseman and in the Bremer Range (see Bremer Range vegetation complexes (P1)). It is described as *Allocasuarina* thickets on greenstone ridges of lateritic breakaways; *Acacia duriuscula*, *Allocasuarina globosa*, *Eucalyptus georgei* subsp. *georgei* and *Eucalyptus oleosa* thickets on greenstone ridges with skeletal soils (DBCA 2020a).



Legend

- | | | | | |
|---------------------------------|-----|---------------------------------------|-----|-----------------------|
| TPFL Conservation Status | ● 2 | WA Herbarium Conservation Code | ■ 2 | ■ Project Survey Area |
| ● T | ● 4 | ■ T | ■ 3 | |
| ● 1 | ■ 1 | ■ 4 | | |

Notes: Image: DigitalGlobe (27/11/2016), Flora: DBCA (18-0320FL)

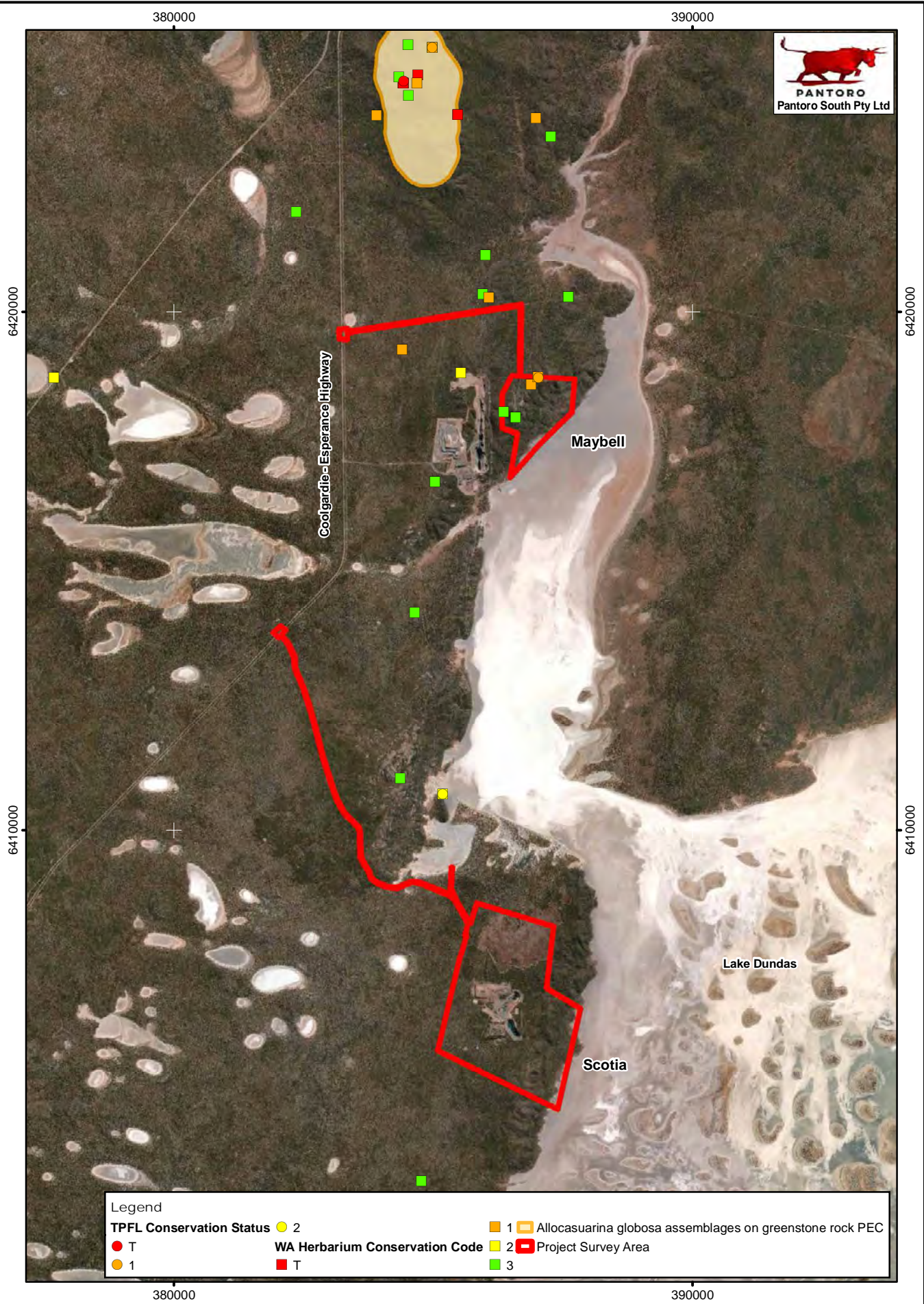
0 1.6 km
 Scale: 1:100,000
 MGA94 (Zone 50)

CAD Ref: a2764_f01_06
 Date: May 2020 Rev: D | A4

Mattiske Consulting Pty Ltd
 28 Central Road, Kalamunda WA 6076 - Tel: 9257 1625 - Fax: 9257 1640
 Author: E M Mattiske MCPL Ref: CNG2001/007/20
 Drawn: CAD Resources - www.cadresources.com.au
 Tel: (08) 9246 3242 - Fax (08) 9246 3202

Norseman Gold Project
DBCA Threatened & Priority Species
Sheet 1 of 2

Figure: **8.1**



Legend	
TPFL Conservation Status	● 2
● T	● 1
● 1	■ 1
WA Herbarium Conservation Code	■ 2
■ T	■ 3
	■ Allocasuarina globosa assemblages on greenstone rock PEC
	■ Project Survey Area

Notes: Image: DigitalGlobe (27/11/2016), Flora: DBCA (18-0320FL)

0 1.6 km
 Scale: 1:100,000
 MGA94 (Zone 50)
 CAD Ref: a2764_f01_06
 Date: May 2020 Rev: D | A4

Mattiske Consulting Pty Ltd
 28 Central Road, Kalamunda WA 6076 - Tel: 9257 1625 - Fax: 9257 1640
 Author: E M Mattiske MCPL Ref: CNG2001/007/20
 Drawn: CAD Resources - www.cadresources.com.au
 Tel: (08) 9246 3242 - Fax (08) 9246 3202

Norseman Gold Project
DBCAs Threatened & Priority Species
Sheet 2 of 2

Figure: **8.2**

5. FIELD SURVEY RESULTS

A total of 101 quadrats were surveyed in five of the Norseman Gold Project survey areas (Gladstone, North Royal, Gladstone-North Royal Haul Roads, Jimberlana Pipeline and Scotia) by four botanists from Mattiske Consulting Pty Ltd, from the 30th March 2020 to the 3rd April 2020 (“Autumn 2020”), in accordance with methods outlined in *Technical Guidance – Flora and vegetation surveys for environmental impact assessment* (EPA 2016b). The survey site locations are listed in Appendix E and the sites, along with survey tracks, are shown in Figure 9.

5.1. Flora

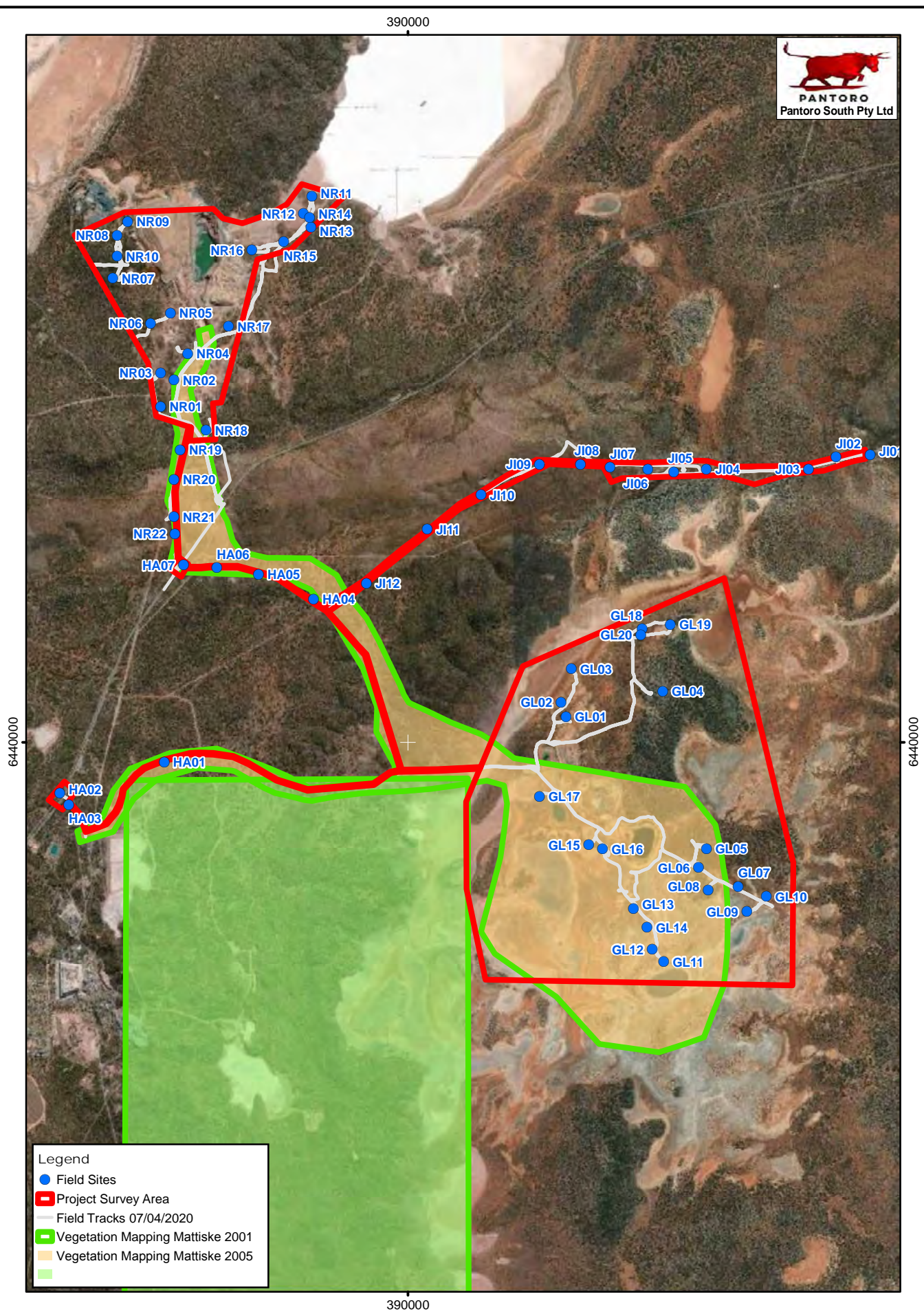
A total of 178 vascular plant taxa, representative of 72 genera and 38 families, were recorded within the five Norseman Gold Project survey areas; eight of these taxa were recorded opportunistically. The majority of taxa recorded were representative of the Myrtaceae (31 taxa), Chenopodiaceae (27 taxa) and Fabaceae (24 taxa) families (see Appendix F for a complete species list). The most common genera were *Eucalyptus* (20 taxa), *Acacia* (16 taxa) and *Eremophila* (11 taxa). Nineteen taxa could be annuals or short-lived perennials; none had a distinctly annual life-form.

In the Northern survey areas (Gladstone, North Royal, Gladstone-North Royal Haul Roads and Jimberlana Pipeline), 138 vascular plant taxa were recorded, representative of 60 genera and 33 families. Most taxa were part of the Myrtaceae (26 taxa), Chenopodiaceae (24 taxa), Fabaceae and Scrophulariaceae (13 taxa each) families. The most common genera were *Eucalyptus* (16 taxa), *Eremophila* (11 taxa) and *Acacia* (10 taxa).

In the Scotia survey area (Scotia and its haul road), 101 vascular plant taxa were recorded, representative of 50 genera and 31 families. Most taxa were part of the Myrtaceae (18 taxa), Fabaceae (15 taxa) and Chenopodiaceae (10 taxa) families. The most common genera were *Eucalyptus* (13 taxa), *Acacia* (9 taxa) and *Eremophila* (6 taxa).

Most of the vegetation was neither flowering nor fruiting, making identification to specific or subspecific level difficult or impossible. Eleven taxa were identified to family level only, and 24 to genus level. Three taxa of the genus *Tecticornia* could not be identified to species level by a taxonomic expert at the WAH (due to lack of fruit), but are recognised to be separate taxa (K. Shepherd 2020, personal communication, 28 April). Likewise, two taxa within *Melaleuca* were identified only as ‘*Melaleuca* sp. 1’ and ‘*Melaleuca* sp. 2’, and three taxa in the family Poaceae were identified similarly. In addition, three taxa were identified at species level but were question-marked at subspecies level, 32 were identified to genus level but were question-marked at species level, and seven were question-marked for both genus and species.

Species accumulation curves were used to evaluate the sampling adequacy for each of the Northern and Scotia survey areas and are presented in Figures 10.1 and 10.2. In the Northern survey areas the incidence-based coverage estimator of species richness was 179.7. Based on this value and the total of 132 taxa recorded (in vegetation mapping sites *only*), approximately 73 % of the flora species potentially present within this survey area were recorded. In the Scotia survey area, 100 taxa were recorded and the incidence-based coverage estimator of species richness was 136.6, resulting in an estimate of approximately 73% of the flora species potentially present within this survey area being recorded during this survey.



Legend

- Field Sites
- ▭ Project Survey Area
- Field Tracks 07/04/2020
- ▭ Vegetation Mapping Mattiske 2001
- ▭ Vegetation Mapping Mattiske 2005

Notes: Image: DigitalGlobe (20/1/2019), Flora: DBCA (18-0320FL)

0 850 m

 Scale: 1:60,000

 MGA94 (Zone 50)

28 Central Road, Kalamunda WA 6076 - Tel: 9257 1625 - Fax: 9257 1640

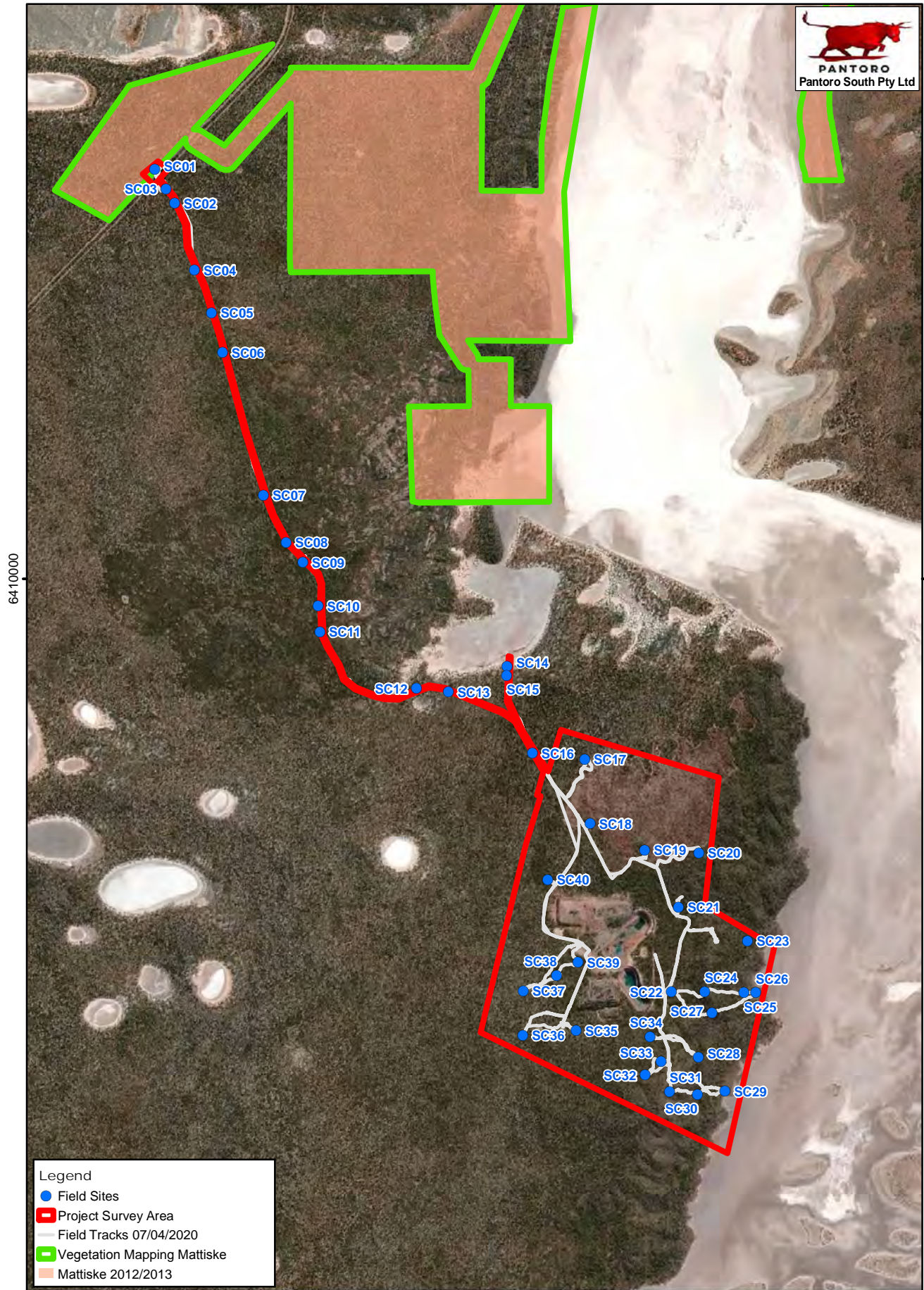
 Author: E M Mattiske MCPL Ref: CNG2001/007/20

 Drawn: CAD Resources ~ www.cadresources.com.au

 Tel: (08) 9246 3242 - Fax (08) 9246 3202

Norseman Gold Project
Survey Sites and Tracks
Sheet 1 of 2

Figure:
9.1



Legend

- Field Sites
- Project Survey Area
- Field Tracks 07/04/2020
- Vegetation Mapping Mattiske
- Mattiske 2012/2013

N
 0 700 m
 Scale: 1:50,000
 MGA94 (Zone 50)

CAD Ref: a2764_f01_09
 Date: May 2020

Rev: A | A4

Mattiske Consulting Pty Ltd
 28 Central Road, Kalamunda WA 6076 - Tel: 9257 1625 - Fax: 9257 1640
 Author: E M Mattiske MCPL Ref: CNG2001/007/20
 Drawn: CAD Resources - www.cadresources.com.au
 Tel: (08) 9246 3242 - Fax (08) 9246 3202

**Norseman Gold Project
 Survey Sites and Tracks
 Sheet 2 of 2**

Figure:
9.2

Notes: Image: DigitalGlobe (20/1/2019), Flora: DBCA (18-0320FL)

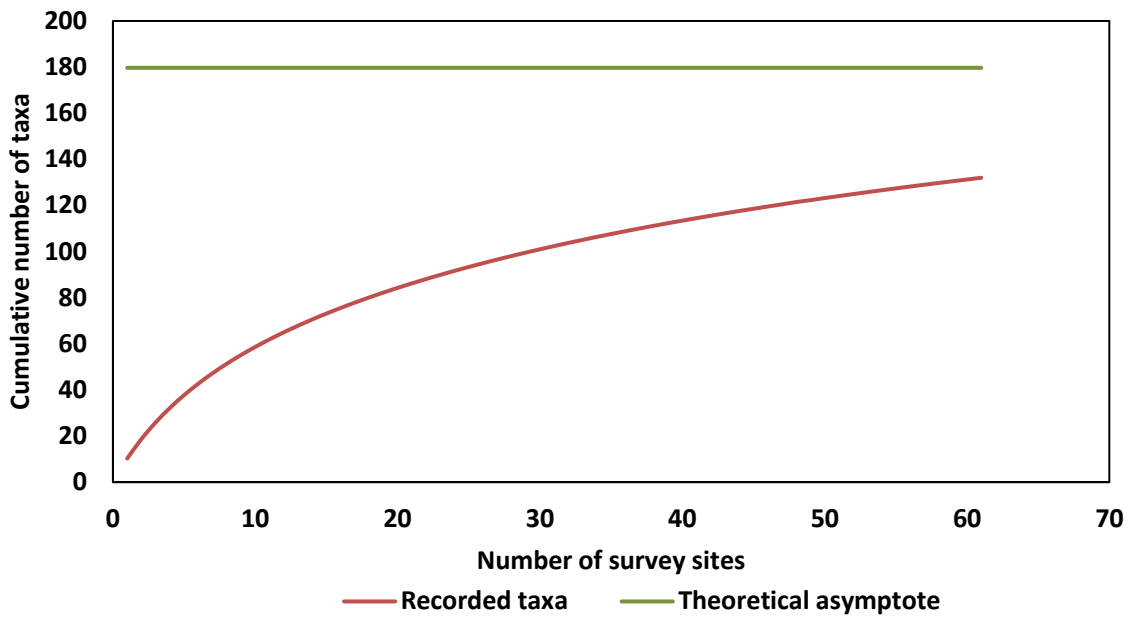


FIGURE 10.1: Average randomised Species Accumulation Curve for the Northern survey areas, April 2020

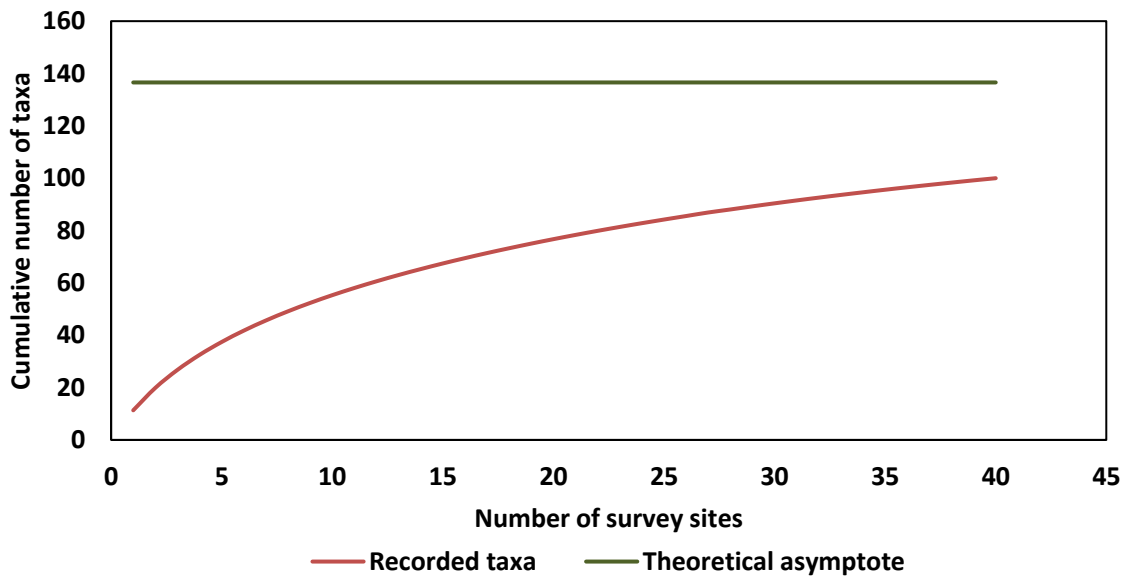


FIGURE 10.2: Average randomised Species Accumulation Curve for the Scotia survey area, April 2020

5.1.1. Threatened and Priority Flora

No live threatened flora species pursuant to pursuant to Part 2, Division 1, Subdivision 2 of the BC Act and as listed by DBCA (2018a), or pursuant to section 179 of the EPBC Act or listed by the DAWE (2020b), were recorded within the five Norseman Gold Project survey areas. One threatened species, *Davesia microcarpa* (T), was previously recorded within the survey areas, with the most recent record from 2001 (DBCA 2020b). Three sites, two along Jemberlana pipeline and one where the North Royal pipeline meets the Eyre Highway, where *Davesia microcarpa* (T) was previously found (DBCA 2020b) were traversed, with no alive specimens recorded in the current survey (Table 5). One dead plant was recorded at two of

the locations. As this species regenerates from seed it is likely to occur again when establishment and growth conditions are suitable.

Two priority flora species as listed by DBCA (2018b), *Calandrinia lefroyensis* (P1) and *Acacia kerryana* (P2), were recorded in two of the Northern survey areas (see Figures 12.1 and 12.2 in following Section 5.2). Furthermore, *Eremophila parvifolia* ?subsp. *parvifolia* (P4), which was recorded throughout the four Northern survey areas, was unable to be confidently identified to a sub-species level as a fruiting specimen is required. This species will be treated with a precautionary approach as the Priority 4 subspecies. A brief description of these species is provided below.

- PRIORITY 1: *Calandrinia lefroyensis* – MONTIACEAE

A semi-erect to erect perennial herb, often scrambling through other plants (0.14-0.26 m high and 0.04-0.16 m wide) (Obbens 2018). This species is known only from salt lake flats between Kalgoorlie and Norseman, with the nearest record being 45 km north of Norseman (WAH 1998-). There are eight records in Florabase (WAH 1998-), all from the last 15 years. This species was only recognised in 2018 (Obbens 2018), and was previously known as '*Calandrinia* sp. *Widgiemooltha* (F. Obbens & E. Reid FO 9/05)'. It was not found in any previous surveys in and around the Norseman Gold Project survey areas.

One specimen was found in the northern reaches of the Gladstone survey area, on flats on the edge of a salty drainage area (Table 5). The plant was in flower (Plate 1). One other specimen was found immediately adjacent; however, it was not flowering. Whilst the collected specimen was flowering in April, it is known from other populations to flower from early October to mid November (Obbens 2018).



Plate 1: *Calandrinia lefroyensis* (P1) (Photo: E. Chetwin)

- PRIORITY 2: *Acacia kerryana* – FABACEAE

A low, spreading, dense shrub (0.5-1 m high). A scattered distribution occurs south of Kambalda to Lake Cronin (Forrestania) and Norseman. This species is commonly associated with shallow loam on low rocky hills within low rocky shrubland (WorldWideWattle 2020). The WAH houses 16 specimens of *Acacia kerryana* (WAH 1998-). This species was not recorded in previous surveys around Norseman (Appendix B); however, it was listed in both the Threatened and Priority Flora (DBCA 2020b) and WAH (2020) databases of Threatened and Priority Flora as occurring in the area, with two locations within 2 km of the Jimberlana pipeline (Appendix D).

Acacia kerryana (P2) was ranked as having a Medium likelihood of occurrence in the Northern survey areas prior to this survey.

The shrub is distinctive in habit (Plate 2) in the low shrubland where it was observed within the Jimberlana Pipeline survey area. At one location on the south side of the Jimberlana pipeline Mattiske recorded 40 individuals in a 60 m long and 10 m wide strip, with only a few plants on the north side of the pipeline (Table 5). This population extended in a 10 m wide strip approximately 400 m to the west. All plants in this population were sterile at the time of the survey. A second population was located in a disturbed area ~1.8 km to the west of the first, stretching 400 m along the south side of the Jimberlana pipeline. One plant in this population was flowering and was collected for identification purposes. No count was made of plants in this population at the time. This area is intended to be revisited in order to properly delineate the populations of *Acacia kerryana* (P2) already identified, and to map any more populations that may exist both inside and outside the impact area of the pipeline and associated vehicle track.



Plate 2: *Acacia kerryana* (P2) habit (Photo: E. Chetwin)

- POTENTIAL PRIORITY 4: *Eremophila parvifolia* ?subsp. *parvifolia* – SCROPHULARIACEAE

A low spreading divaricate shrub to 0.5 m tall, flowering yellow and purple in June or September to October or January to February (Plate 3). This species occurs from near Yalata, South Australia, westwards along the Nullarbor to near Caiguna, Western Australia (Chinnock 2007). The WAH houses 12 specimens of *Eremophila parvifolia* subsp. *parvifolia*. This species was recorded previously by Landcare Services (1997) on the East Polar Bear peninsula ~30 km north of Norseman, but was not found in the Threatened and Priority Flora (DBCA 2020b) or WAH Flora (2020) databases. It was ranked as having a Low likelihood of occurrence in the Northern survey areas prior to this survey (Appendix D).

Scattered populations of this species were recorded across the Northern survey areas in April 2020 (see Table 5 for exact coordinates of priority specimens). This species was flowering at a few sites, but no fruiting specimens were found.

Plate 3: *Eremophila parvifolia* subsp. *parvifolia* (P4) (WAH 1998-)

Table 5: Location and extent of priority species within the Norseman Gold Project survey areas

SPECIES	SURVEY AREA	No. INDIVIDUALS	AREA OF POPN. (m)	LOCATION (GDA94 Z50)	
				EASTING (mE)	NORTHING (mN)
<i>Acacia kerryana</i> (P2)	Jimberlana	40	10 x 60 ^a	392758	6443187
<i>Acacia kerryana</i> (P2)	Jimberlana	1	1 x 1 ^b	390547	6442691
<i>Calandrinia lefroyensis</i>	Gladstone	2	1 x 1	392821	6441244
<i>Daviesia microcarpa</i> (T)	Jimberlana	0 alive, 1 dead	-	392309	6443214
<i>Daviesia microcarpa</i> (T)	Jimberlana	0 alive, 1 dead	-	392406	6443230
<i>Daviesia microcarpa</i> (T)	Gladstone-North Royal Haul Roads	0 alive, 0 dead	-	387265	6442022
<i>Eremophila parvifolia</i> subsp. <i>parvifolia</i> (P4)	Gladstone	2	20 x 20	393465	6438298
<i>Eremophila parvifolia</i> subsp. <i>parvifolia</i> (P4)	Gladstone	2	20 x 20	393027	6441361
<i>Eremophila parvifolia</i> subsp. <i>parvifolia</i> (P4)	Gladstone-North Royal Haul Roads	1	20 x 20	387795	6442016
<i>Eremophila parvifolia</i> subsp. <i>parvifolia</i> (P4)	Gladstone-North Royal Haul Roads	1	20 x 20	387375	6443377
<i>Eremophila parvifolia</i> subsp. <i>parvifolia</i> (P4)	Jimberlana	2	20 x 20	394935	6443288
<i>Eremophila parvifolia</i> subsp. <i>parvifolia</i> (P4)	Jimberlana	1	20 x 20	393443	6443153
<i>Eremophila parvifolia</i> subsp. <i>parvifolia</i> (P4)	North Royal	1	20 x 20	387037	6444834
<i>Eremophila parvifolia</i> subsp. <i>parvifolia</i> (P4)	North Royal	1	20 x 20	386600	6445354
<i>Eremophila parvifolia</i> subsp. <i>parvifolia</i> (P4)	North Royal	1	20 x 20	386651	6445849
<i>Eremophila parvifolia</i> subsp. <i>parvifolia</i> (P4)	North Royal	10	20 x 20	388204	6445678
<i>Eremophila parvifolia</i> subsp. <i>parvifolia</i> (P4)	North Royal	1	20 x 20	387931	6444799
<i>Eremophila parvifolia</i> subsp. <i>parvifolia</i> (P4)	North Royal	1	20 x 20	387675	6443602

^a – This population continued to the west in an area 10 x 400 m, but numbers of individuals were not recorded.^b - This location is in the centre of a population that extends at least 10 x 400 m, but numbers of individuals were not recorded.

5.1.2. Other Significant Flora

Six collections were made of *Lepidosperma* species plants from seven locations, two from the Northern survey areas and four from the Scotia area, Table 6. However, even though all collections had good, suitable material that could be used for identification, it was not possible for a taxonomic expert at the WAH to satisfactorily identify the specimens beyond genus level (M. Hislop 2020, personal communication, 11 May) due to issues with classification of the genus.

Table 6: Location and extent of the *Lepidosperma* species (currently under taxonomic review) within the Norseman Gold Project survey areas

SPECIES	SURVEY AREA	No. INDIVIDUALS	AREA OF POPN. (m)	LOCATION (GDA94 Z50)	
				EASTING (mE)	NORTHING (mN)
<i>Lepidosperma</i> sp.	Jimberlana	2-5	20x20	390224	6442456
<i>Lepidosperma</i> sp.	North Royal	2-5	20x20	387305	6442600
<i>Lepidosperma</i> sp.	North Royal	1	20x20	387316	6442409
<i>Lepidosperma</i> sp.	Scotia	6-10	20x20	385328	6409183
<i>Lepidosperma</i> sp.	Scotia	2-5	20x20	385324	6409097
<i>Lepidosperma</i> sp.	Scotia	2-5	20x20	387115	6405165
<i>Lepidosperma</i> sp.	Scotia	1	20x20	386625	6405346

Eight taxa recorded within the Norseman Gold Project survey areas represent extensions to their current known distributions based on WAH data in FloraBase (WAH 1998-). Three other taxa, *Acacia ?beauverdiana*, *Eremophila parvifolia ?subsp. parvifolia* (P4) and *Rhagodia ?eremaea* could not definitively be identified to species due to lack of either fruiting or flowering material, but are listed here as tentative range extensions. A list of species representing a range extension for this area and the approximate distance from their currently known distribution is presented below (Table 7). Two of the taxa listed below, *Eremophila parvifolia ?subsp. parvifolia* (P4) and *Rhagodia ?eremaea* have been found in previous surveys in the area, but these records do not appear in Florabase (WAH 1998-) (Appendix C). In this report 100 km has been used as a basis to determine an extension to the currently known range for a species. A rating has also been applied to each species, of Low (100-149 km), Moderate (150-199 km) or High (<200 km) range extension.

Table 7: Taxa recorded within the Norseman Gold Project survey areas in 2019 representing an extension to currently known distributions (WAH 1998-)

SPECIES	DISTANCE (km)	RATING
<i>Acacia ?beauverdiana</i>	110 km	Low
<i>Dianella revoluta</i> var. <i>divaricate</i>	115 km	Low
<i>Enneapogon avenaceus</i>	140 km	Low
<i>Enteropogon ramosus</i>	110 km	Low
<i>Eragrostis lacunaria</i>	215 km	High
<i>Eremophila parvifolia</i> subsp. <i>?parvifolia</i> (P4)	175 km	Moderate
<i>Eucalyptus distuberosa</i> subsp. <i>distuberosa</i>	140 km	Low
<i>Maireana lobiflora</i>	165 km	Moderate
<i>Myoporum montanum</i>	100 km	Low
<i>Paspalidium gracile</i>	100 km	Low
<i>Rhagodia ?eremaea</i>	150 km	Moderate

5.1.3. Introduced (Weed) Species and Declared Pest (Plant) Organisms

Two introduced (weed) species, *Asphodelus fistulosus* (Onion Weed) (GPS: 387302mE: 6443032mN) and *Gazania linearis* (GPS: 392602mE:6438087mN), were recorded within the Norseman Gold Project survey areas (see Appendix F). Neither of these are declared pest organisms pursuant to section 22 of the BAM Act (both are permitted under section 11 of the BAM Act).

Under the Department of Parks and Wildlife (DPaW) 2013 Weed Prioritisation Process (DPaW 2013), *Gazania linearis* is considered to be one of the 17 Goldfields Region priority alert weeds; in 2014 it was not found within the DBCA estate (DPaW 2014) and should be reported to the local DBCA office. *Asphodelus fistulosus* has an Ecological Impact rating of Unknown and an Invasiveness rating of Rapid.

These species were recorded in very small numbers at one site each: *Asphodelus fistulosus* at a very disturbed area on the North Royal pipeline route (vegetation community CL); *Gazania linearis* in sparse low shrubland with grasses in an occasionally inundated area at the edge of salt lake within the Gladstone survey area (vegetation community NS3). *Asphodelus fistulosus* was previously recorded by Mattiske (2001a) in the Gladstone area, and *Gazania linearis*, whilst appearing in the results of the NatureMap (DBCA 1998-) search, was not recorded in any of the previous surveys described in this report.

5.2. Vegetation

5.2.1. Statistical Analysis

Statistical analyses for the Northern and Scotia survey areas were conducted separately due to distinct differences between the areas in species composition, vegetation communities, landforms and hydrology observed in the field.

5.2.1.1. Northern Survey Areas

SIMPROF analysis identified 15 significantly associated groups of survey quadrats ($P_i = 3.764$; $p < 0.001$). Four outlier quadrats were identified using PRIMER (communities NW1, NW2a, NW2b, NW12 – see Table 8, Figure 11.1); another two outliers were based on the occurrence of species not found in any other quadrats in the Northern survey areas, but making up a significant part of the quadrat in which they were found (communities NW3 and NW9). Three of the groups identified by PRIMER were combined into two vegetation communities (NW2 and NW11). The remaining eight groups of quadrats identified by PRIMER were assigned to ten vegetation communities, resulting in a total of 18 vegetation communities for the Northern survey areas (Figure 11.1). Field observations indicated that Eucalypt woodlands form a significant part of the vegetation of the Northern survey areas; this was not reflected in the PRIMER groupings nor in the SIMPER results. Most of the PRIMER groups were assigned on the basis of their understorey, as could be seen in the SIMPER results; four groups included a mixture of woodland and shrubland quadrats. Therefore the PRIMER groups were not used strictly; rather they were used along with field observations of species composition, vegetation structure, topography and aerial photography to guide the delineation of the remaining vegetation communities.

Six outlier quadrats, each clearly within their own distinct vegetation community, were outlined as described above. Community NW1 was a 0.2 ha stand of *Eucalyptus prolixa* with almost no understorey restricted to a low area and surrounded by *Tecticornia* spp. Communities NW2a and NW2b are both found in an area of rocky hills along the Jimberlana pipeline; they differ from community NW2 in that they both have a significant coverage mid-tall shrub layer of *Acacia* sp. (sterile, but the same species based on field observation). Community NW2a was in a creekline that ran across the Jimberlana pipeline route, and NW2b was in a slightly disturbed area with evidence of sheet flow running parallel to the pipeline route and between two tracks. Vegetation community NW3 had a significant tall shrub layer of *Melaleuca quadrifaria*, which was not seen in any other survey quadrats. It is located on a small rise adjacent to a tailings dump in the North Royal survey area. Community NW9 is a dominated *Eucalyptus spreata* and

occurs in the Gladstone area on the 3rd dune ridge back from a salt lake, a landform restricted in areal distribution. Vegetation community NW12 occurred on another restricted landform, the 2nd dune ridge back from a salt lake, and contained isolated trees of *Pittosporum angustifolium* over sparse low salt tolerant shrubs. Two communities, NW8 and NS1, each contain only two quadrats; these communities were part of one group in the PRIMER analysis. Vegetation community NW8, comprising *Eucalyptus torquata* low woodland, was found on the haul road between the Eyre Highway and the Jimberlana pipeline, and appears on aerial photographs to extend no further than 1 km in an east-west direction and 400 m in a north-south direction. Community NS1 is an open shrubland found at the edge of a salt lake and salty drainage in the North Royal survey area. While this community may exist elsewhere in the broader region, it was not observed elsewhere in the Northern survey areas. A greater degree of replication within the aforementioned vegetation communities was not possible due to their restricted areal extent. The other nine vegetation communities in the Northern survey areas contained from three to nine quadrats.

5.2.1.2. Scotia Survey Area

SIMPROF analysis identified 12 significantly associated groups of survey quadrats ($P_i = 5.085$; $p < 0.001$). Where appropriate, outliers and small groupings were assigned to broader comparative vegetation units based on factors including species composition and site descriptions. For the purposes of vegetation mapping (i.e. extrapolating quadrat data to generalise vegetation communities over broad areas), an inclusive rather than exclusive approach was adopted. Based on this approach, nine significantly dissimilar vegetation communities were delineated within the Scotia survey area, including two outliers (Figure 11.2, Table 8).

The two outliers recognised were community groups S3 and S4. Community S3 was located on a small portion of the Scotia access road, leading to a salt lake. This community is not considered to be restricted; rather, the survey area did not cover large areas near the salt lake, reducing the ability for site replication in this community. The S4 community was recognised from one site in the Scotia survey area, located on a small ridge with outcropping present. This community did not occur often and replication within the survey area was not possible. Community groups S1, S2 and W5 each contain two survey quadrats. Again these communities were not common within the survey area; however, associated geology and landforms seen from aerial photography suggest these communities may be present within the broader region.

5.2.2. Vegetation Communities

A summary of the vegetation communities mapped in both the Northern and Scotia survey areas is presented below and details are given in Appendices G and H. Maps of the vegetation communities in the Northern survey areas are shown in Figures 12.1-12.2 and for the nine in the Scotia survey area they are in Figures 13.1-13.2. A total of 2664.8 ha mapped area is represented in Figures 12.1-12.2 and 13.1-13.2; 1963.9 ha in the Northern survey areas and 700.9 ha in the Scotia survey area. Note that mapped areas shown in Figures 12.1-12.2 extend outside the survey boundary polygon for the Gladstone-North Royal Haul Road survey area; this was because the boundary polygon was tight against the edge of the existing Haul Road, which has no vegetation. The total area inside the survey boundary polygons is 2557.4 ha.

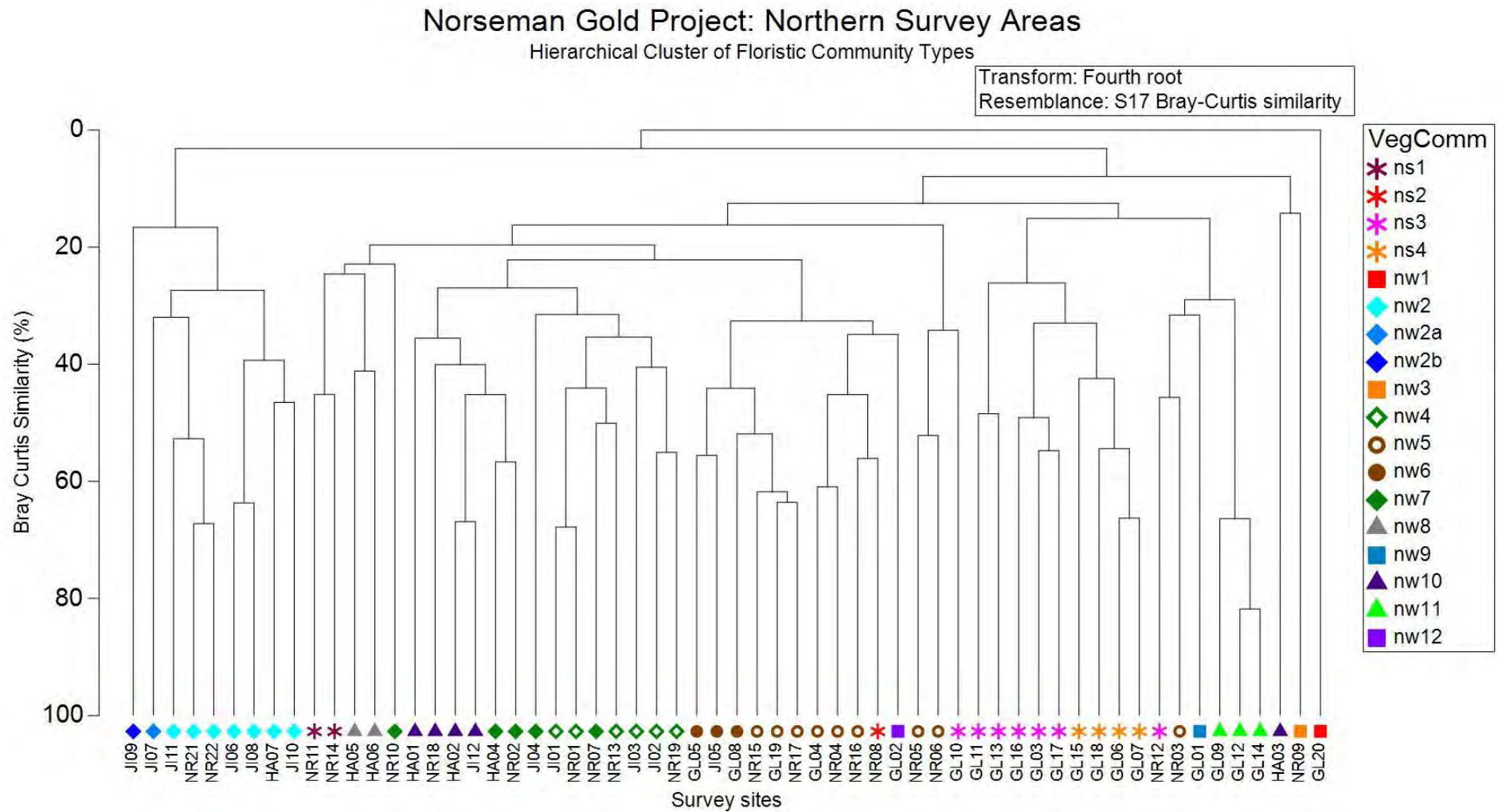


Figure 11.1: Dendrogram of Vegetation Communities for the Northern survey areas

Norseman Gold Project: Scotia Survey Area

Hierarchical Cluster of Floristic Community Types

Transform: Fourth root
Resemblance: S17 Bray-Curtis similarity

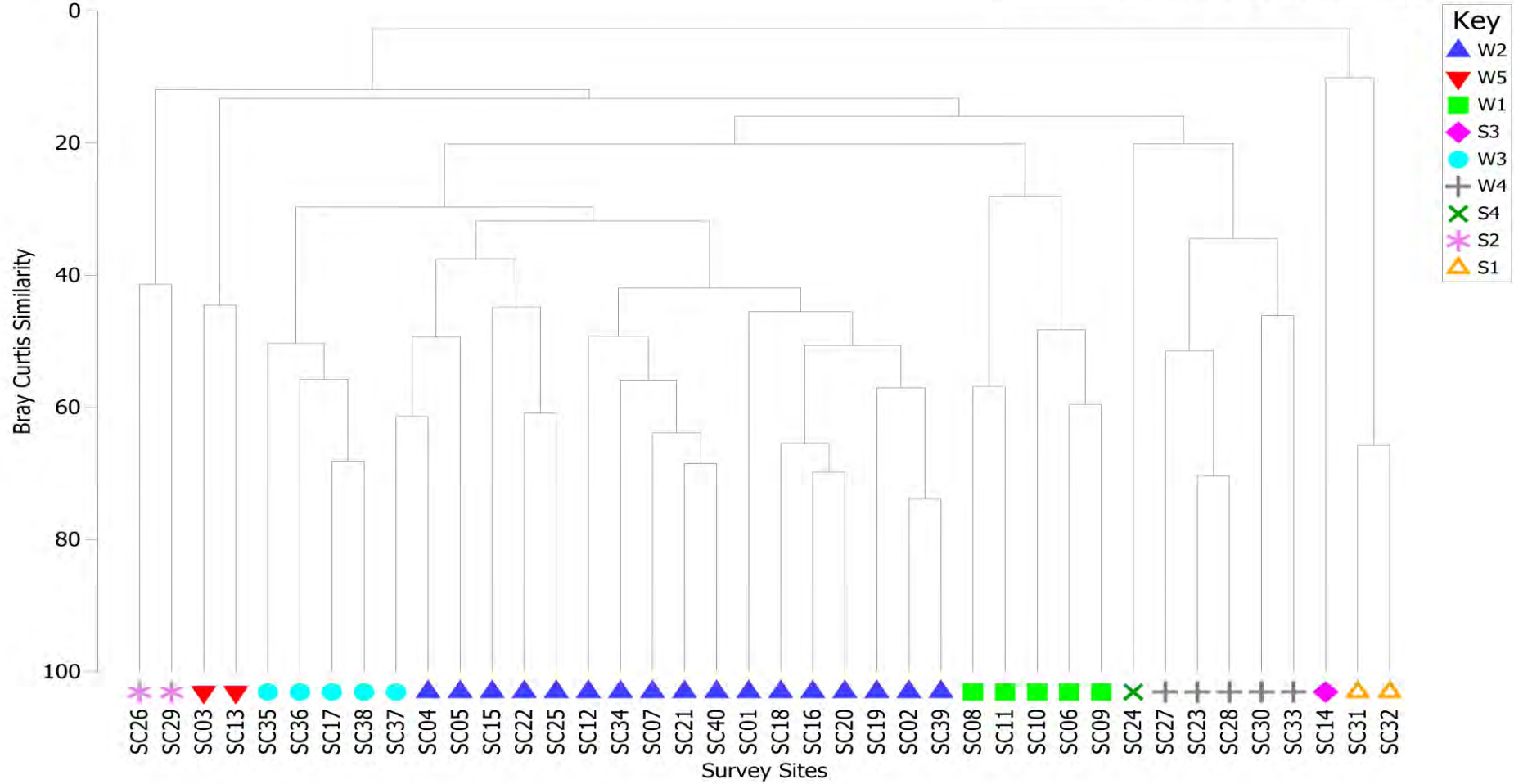


Figure 11.2: Dendrogram of Vegetation Communities for the Scotia survey area

5.2.2.1. Northern Survey Area

Eighteen vegetation communities were defined across the Northern (N) survey areas: twelve Eucalypt woodland (W) communities, two other woodland (W) communities and four shrubland (S) communities (Table 8).

Table 8: Vegetation communities in the Northern survey areas

VEG. COMM	DESCRIPTION	AREA (ha)	% of NORTH AREAS
NW1	Closed low mallet forest of <i>Eucalyptus prolixa</i> on red-brown clayey loam flats in deep litter on red-brown clayey loam on flats.	1.0	0.05
NW2	Open mallee woodland of <i>Eucalyptus planipes</i> and occasional <i>Eucalyptus longissima</i> over sparse mid-low shrubland of <i>Allocasuarina helmsii</i> , <i>Eremophila</i> spp. and <i>Westringia rigida</i> over open-sparse low hummock grassland of <i>Triodia scariosa</i> on occasionally rocky red-brown sandy clayey loam on flats to mid-slopes.	67.4	3.43
NW2a	Isolated clumps of <i>Eucalyptus?oleosa</i> subsp. <i>oleosa</i> low mallees over tall <i>Acacia</i> sp. shrubland over isolated clumps of <i>Grevillea anethifolia</i> mid shrubs over isolated clumps of <i>Triodia scariosa</i> mid hummock grass on red-brown sandy clayey loam in a creekline.	1.0	0.05
NW2b	Isolated clumps of <i>Eucalyptus planipes</i> mallees over mid sparse shrubland of <i>Acacia</i> sp., <i>Senna artemisioides</i> ?subsp. <i>filifolia</i> and <i>Eremophila?deserti</i> over low open shrubland of <i>Dodonaea?microzyga</i> on red-brown sandy loam on mid slopes with evidence of sheet flow.	0.6	0.03
NW3	Open low woodland of <i>Eucalyptus lesouefii</i> over open shrubland of <i>Melaleuca quadrifaria</i> over <i>Dodonaea stenozyga</i> and <i>Cratystylis conocephala</i> on brown clay on low rises.	3.4	0.17
NW4	Open low woodland of <i>Eucalyptus lesouefii</i> over tall isolated clumps of <i>Melaleuca?sheathiana</i> and <i>Eremophila</i> spp. shrubs over low isolated clumps of <i>Cratystylis conocephala</i> shrubs on brown sandy clayey loam with some surface rocks on flats and gentle slopes.	58.2	2.96
NW5	Mid woodland of <i>Eucalyptus lesouefii</i> and <i>Eucalyptus salubris</i> over mid isolated shrubs of <i>Eremophila scoparia</i> and occasional low <i>E. parvifolia</i> subsp. <i>?parvifolia</i> (P4) shrubs over open low chenopod shrubland of <i>Tecticornia</i> sp. 3 and <i>Atriplex?vesicaria</i> on orange to brown sandy clay with some surface gravel on flats and gentle slopes.	288.8	14.71
NW6	Mid woodland of <i>Eucalyptus salubris</i> over isolated tall <i>Santalum acuminatum</i> shrubs over isolated mid <i>Eremophila</i> spp. shrubs over low sparse shrubland of <i>Atriplex?vesicaria</i> , <i>Cratystylis conocephala</i> and <i>Olearia muelleri</i> on red-brown clayey loam with occasional surface rocks on ridges and upland flats.	64.8	3.30
NW7	Low woodland of <i>Eucalyptus salubris</i> and <i>E. lesouefii</i> over tall sparse shrubland of <i>Melaleuca?sheathiana</i> or <i>M. lanceolata</i> over mid-low sparse shrubland of <i>Atriplex?nummularia</i> and <i>Atriplex?vesicaria</i> on red to brown sandy clay with scattered surface rocks on flats and lower slopes.	55.7	2.84
NW8	Open low woodland of <i>Eucalyptus torquata</i> over mid sparse shrubland of <i>Beyeria sulcata</i> var. <i>brevipes</i> and <i>Eremophila</i> spp. over low isolated clumps of shrubs of <i>Scaevola spinescens</i> , <i>Atriplex?vesicaria</i> and <i>Olearia muelleri</i> on red to brown clayey loam on lower slopes.	12.9	0.66
NW9	Low woodland of <i>Eucalyptus spreta</i> over isolated samphire shrubs of <i>Tecticornia</i> sp. 3 and isolated tussock grassland of Poaceae sp. 3 on dry, powdery cream clayey loam on low dunes ridges near salt lakes.	10.3	0.53
NW10	Mid woodland of mixed <i>Eucalyptus</i> spp. over tall sparse shrubland of <i>Melaleuca?sheathiana</i> over open mid-low shrubland of <i>Atriplex?nummularia</i> and <i>A. ?vesicaria</i> on brown clayey loam with some surface rocks on gentle mid slopes.	35.2	1.79
NW11	Open low woodland of <i>Casuarina obesa</i> over low isolated clumps of <i>Rhagodia?drummondii</i> , <i>Atriplex?vesicaria</i> and <i>Tecticornia</i> sp. 3 chenopod shrubs and isolated tussock grassland of Poaceae sp. 3 on dry, powdery cream clay on low dune ridges at the edge of salt lakes.	76.3	3.89
NW12	Isolated clumps of <i>Pittosporum angustifolium</i> low trees over isolated clumps of mid <i>Eremophila?deserti</i> shrubs over sparse low shrubland of <i>Atriplex?vesicaria</i> , <i>Tecticornia</i> sp. 3 and <i>Frankenia interioris</i> var. <i>interioris</i> on dry, powdery brown clayey loam on low dune ridges near salt lakes.	31.2	1.59

Table 8: Vegetation communities in the Northern survey areas (continued)

VEG. COMM.	DESCRIPTION	AREA (ha)	% of NORTH AREAS
NS1	Open shrubland of <i>Callitris preissii</i> , ? <i>Geijera linearifolia</i> over <i>Senna artemisioides</i> ?subsp. <i>filifolia</i> , <i>Pittosporum angustifolium</i> , <i>Santalum acuminatum</i> and <i>Eremophila scoparia</i> over ? <i>Westringia rigida</i> , <i>Scaevola spinescens</i> and <i>Rhagodia ?drummondii</i> over mixed low chenopod shrubs on red sandy clay on flats near salt lakes.	8.9	0.45
NS2	Low shrubland of <i>Eremophila ?decipiens</i> , <i>Tecticornia</i> sp. 3 and <i>Atriplex ?vesicaria</i> on red-brown clay on valley floors.	7.0	0.35
NS3	Low open chenopod shrubland of <i>Maireana amoena</i> , <i>Atriplex</i> spp. and <i>Tecticornia</i> spp. on cream to red sandy clay on flats on the edge of salt lakes and salty drainages.	318.6	16.22
NS4	Sparse mid shrubland of <i>Dodonaea viscosa</i> subsp. <i>angustissima</i> over open low shrubland of <i>Eremophila ?decipiens</i> , <i>Scaevola spinescens</i> , <i>Atriplex ?vesicaria</i> , <i>Rhagodia ?drummondii</i> , mixed Chenopodiaceae spp. and <i>Frankenia</i> sp. on red-brown sandy clay on low rises at the edge of salt lakes and salty drainages.	159.4	8.12
CL	Previously cleared or disturbed.	413.0	17.44
SL	Salt lake or non-vegetated lake bed.	432.0	21.42

5.2.2.2. Scotia Survey Area

Nine vegetation communities were defined in the Scotia survey area: five Eucalypt woodland (W) communities and four shrubland (S) communities (Table 9).

Table 9: Vegetation communities in the Scotia survey area

VEG. COMM.	DESCRIPTION	AREA (ha)	% of SCOTIA SURVEY AREA
W1	Woodland of <i>Eucalyptus dundasii</i> and <i>Eucalyptus salubris</i> and occasional <i>Eucalyptus clelandiorum</i> over <i>Scaevola spinescens</i> , <i>Beyeria sulcata</i> , <i>Exocarpos aphyllus</i> and <i>Santalum acuminatum</i> on orange to pale brown clayey loam on flats and gently sloping terrain.	3.9	0.56
W2	Woodland to open woodland of <i>Eucalyptus flocktoniae</i> complex, <i>Eucalyptus lesouefii</i> and <i>Eucalyptus dundasii</i> over sparse shrubland of <i>Melaleuca sheathiana</i> , <i>Scaevola spinescens</i> , <i>Beyeria sulcata</i> and <i>Exocarpos aphyllus</i> over isolated shrubs of <i>Olearia muelleri</i> on orange-red to brown clayey loam on flats and slopes.	290.8	41.49
W3	Open woodland of <i>Eucalyptus longicornis</i> over open shrubland of <i>Melaleuca sheathiana</i> , <i>Cratystylis conocephala</i> over mixed sparse chenopod shrubland on pale brown clayey loam flats.	226.4	32.30
W4	Open woodland of <i>Eucalyptus torquata</i> over <i>Melaleuca sheathiana</i> , <i>Dodonaea microzyga</i> and <i>Alyxia buxifolia</i> on red-brown clayey loam on hillside slopes.	71.3	10.17
W5	Open woodland of <i>Eucalyptus gracilis</i> and <i>Eucalyptus flocktoniae</i> over sparse shrubland of <i>Olearia</i> sp. <i>Eremicola</i> (Diels & Pritzel s.n. PERTH 00449628) and <i>Olearia muelleri</i> on red-orange clayey loam flats.	1.7	0.25
S1	Shrubland of <i>Allocasuarina campestris</i> , <i>Acacia neurophylla</i> subsp. <i>neurophylla</i> , <i>Melaleuca ?hamata</i> and <i>Cryptandra graniticola</i> over mixed Asteraceae sp. and <i>Lepidosperma</i> sp. on red-brown clayey loam and ironstone outcropping on upper slopes.	14.0	1.99
S2	Sparse shrubland of <i>Scaevola spinescens</i> , <i>Exocarpos aphyllus</i> and <i>Grevillea acuaria</i> over <i>Atriplex</i> spp. and <i>Maireana</i> spp. on orange clay flats on salt lake margins.	8.3	1.18
S3	Open woodland of <i>Eucalyptus ?salicola</i> over open shrubland of <i>Bossiaea barbarae</i> , <i>Acacia assimilis</i> subsp. <i>assimilis</i> and <i>Melaleuca lanceolata</i> over <i>Lepidosperma</i> sp. on pale orange sand flats on salt lake margins.	0.2	0.02

Table 9: Vegetation communities in the Scotia survey area (continued)

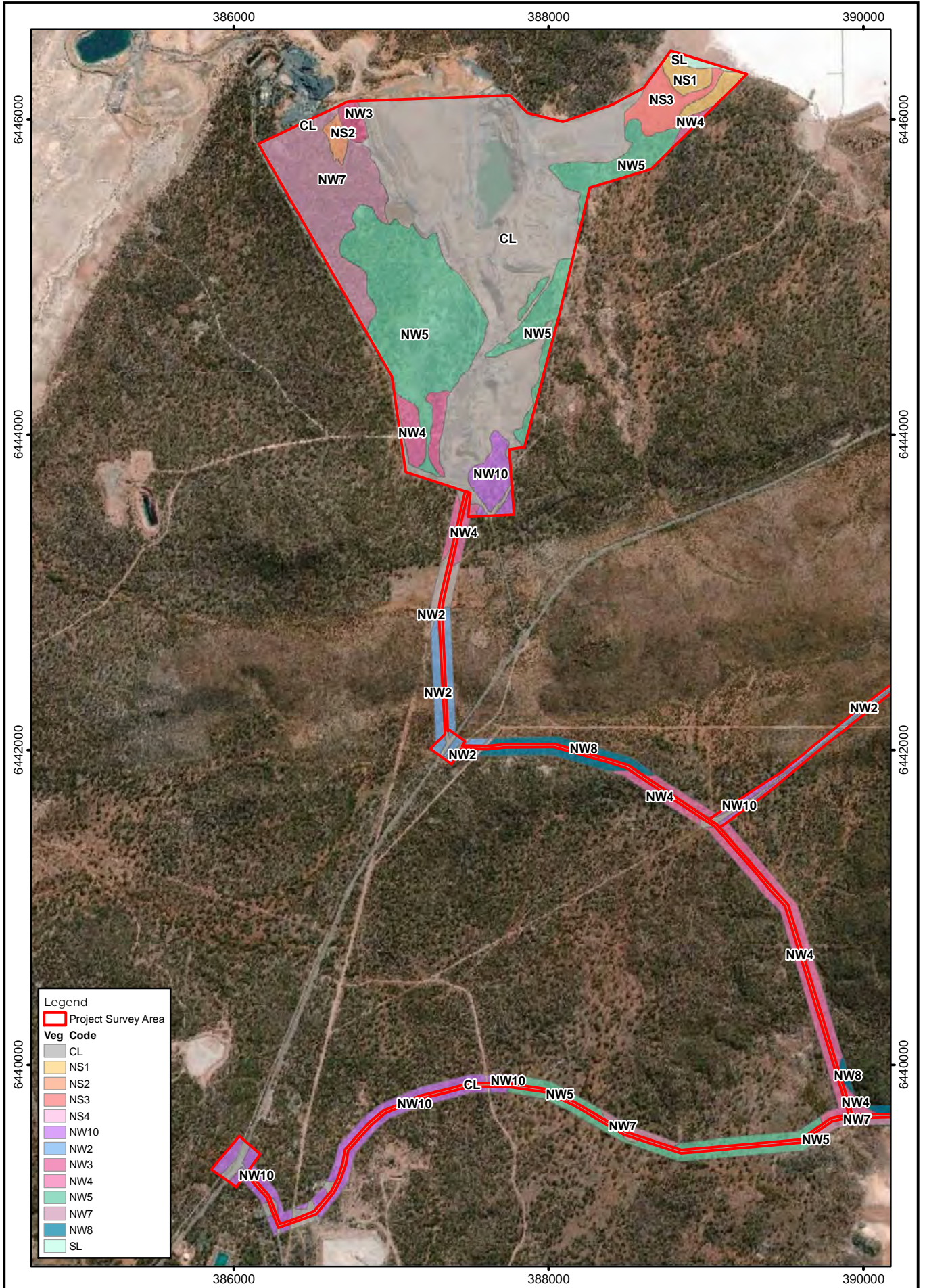
VEG. COMM.	DESCRIPTION	AREA (ha)	% of SCOTIA SURVEY AREA
S4	Open shrubland of <i>Grevillea nematophylla</i> subsp. <i>nematophylla</i> over <i>Hibbertia pungens</i> , <i>Allocasuarina acutivalvis</i> subsp. <i>acutivalvis</i> and <i>Dampiera latealata</i> .	2.4	0.34
CL	Previously cleared or disturbed.	70.6	10.08
SL	Salt lake or non-vegetated lake bed.	11.3	1.61

The vegetation communities NS3 (16.22 %), NW5 (14.71 %) and NS4 (8.12 %) made up most of the vegetated areas of the Northern survey areas, with all other communities comprising less than 5 % of the Northern areas. Salt lake and non-vegetated lake bed (SL) and previously disturbed areas (CL) covered significant parts of the Northern survey areas, with total extent across the Northern survey areas being 21.42 % and 17.44 %, respectively. The broad coverage of the shrubland communities NS3 and NS4, which are found adjacent to salt lakes, is not surprising given the extent of salt lakes in the Northern areas, particularly in the Gladstone survey area.

The Eucalypt woodland communities W2 (41.49 %), W3 (32.30 %) and W4 (10.17 %) made up the major part of the Scotia survey area, with the remaining two woodland communities (W1, W5) and the shrubland communities (S1-S4) in total comprising less than 5 % of the survey area. Only 1.61 % of the Scotia area was salt lake (SL) and 10.08 % of the survey area was disturbed (CL).

5.2.3. Threatened and Priority Ecological Communities

No TECs or PECs were recorded as occurring in the Norseman Gold survey areas. The Priority 1 ecological community, '*Allocasuarina globosa* assemblages on greenstone rock' (Esperance District), which is known to exist approximately 3 km north of the Maybell area, was not observed in any of the areas surveyed in Autumn 2020.



Legend

Project Survey Area

Veg_Code

- CL
- NS1
- NS2
- NS3
- NS4
- NW10
- NW2
- NW3
- NW4
- NW5
- NW7
- NW8
- SL

Imagery: ESRI, DigitalGlobe (May 2019)

N

0 250 500 m

Scale: 1:32,500
MGA94 (Zone 50)

CAD Ref: a2764_f03_03
Date: June 2020

Rev: A | A4

Mattiske Consulting Pty Ltd

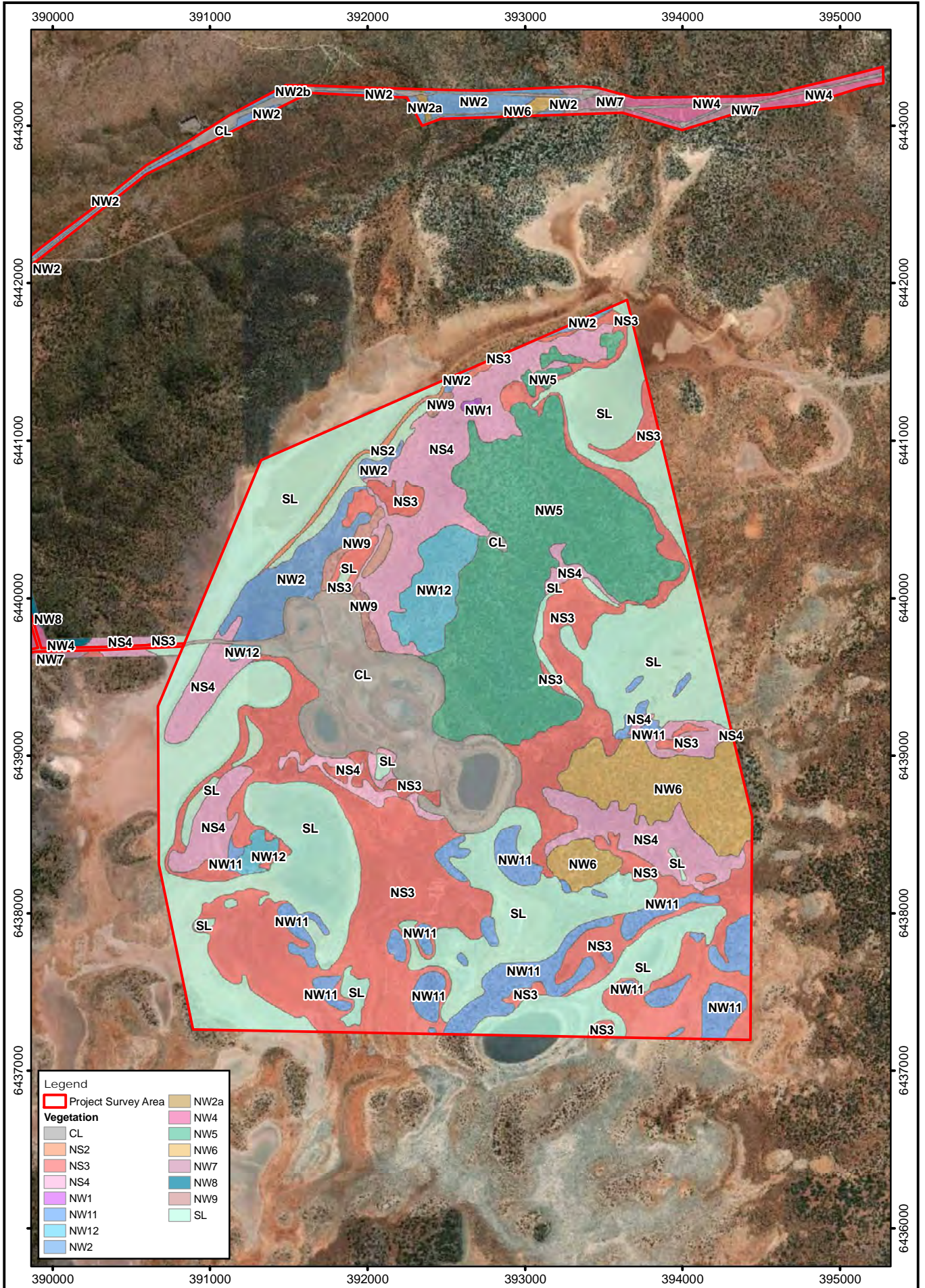
28 Central Road, Kalamunda WA 6076 - Tel: 9257 1625 - Fax: 9257 1640

Author: E M Mattiske | MCPL Ref:

Drawn: CAD Resources ~ www.cadresources.com.au
Tel: (08) 9246 3242 - Fax (08) 9246 3202

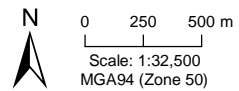
**Norseman Gold Project
North Royal/ & G-NR Haul Roads
Survey Areas Vegetation**

Figure:
12.1



Legend

Project Survey Area	NW2a
Vegetation	NW4
CL	NW5
NS2	NW6
NS3	NW7
NS4	NW8
NW1	NW9
NW11	SL
NW12	
NW2	



Mattiske Consulting Pty Ltd
 28 Central Road, Kalamunda WA 6076 - Tel: 9257 1625 - Fax: 9257 1640

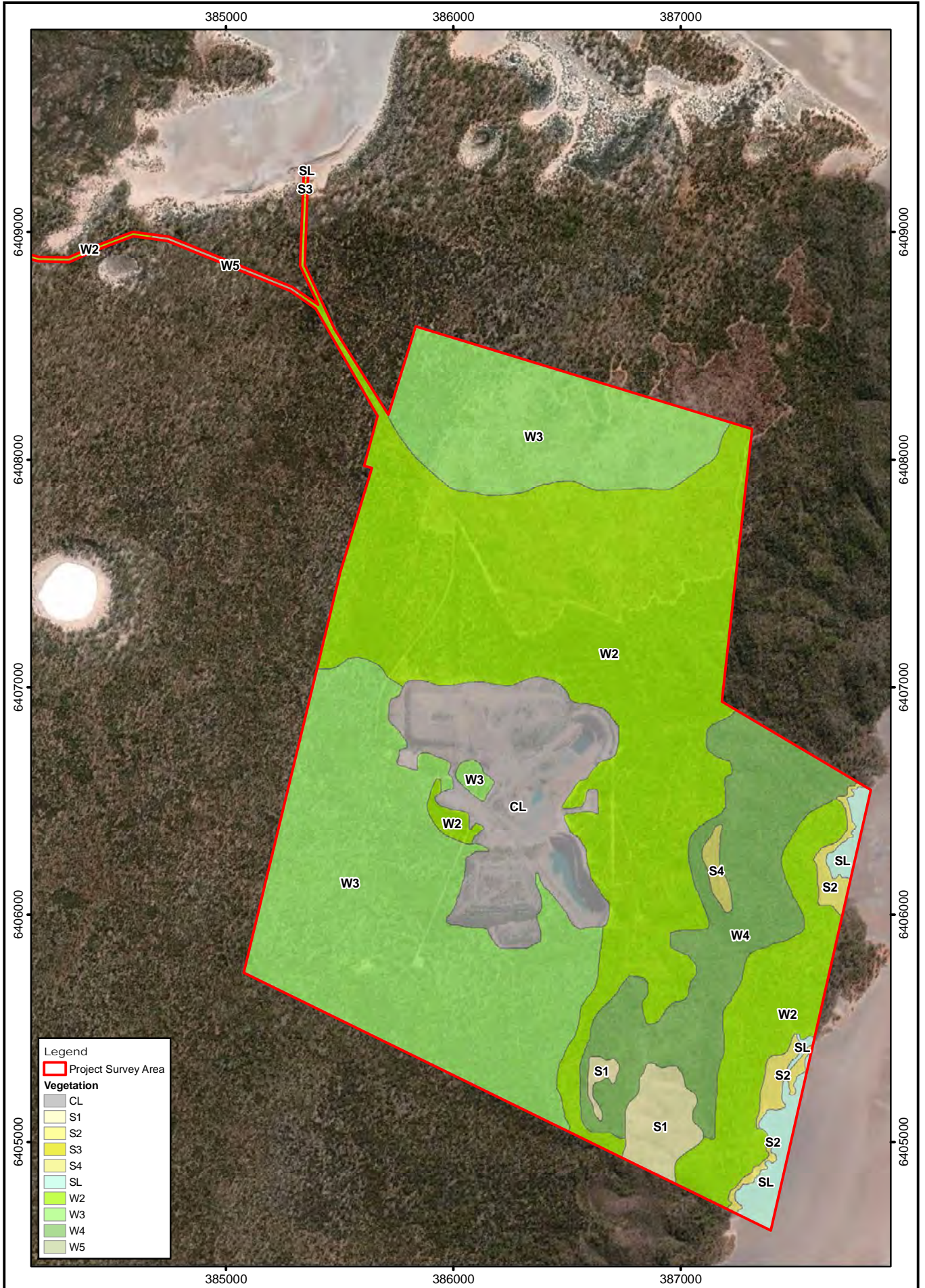
Author: E M Mattiske MCPL Ref:
 Drawn: CAD Resources ~ www.cadresources.com.au
 Tel: (08) 9246 3242 - Fax (08) 9246 3202

**Norseman Gold Project
 Gladstone & Jimberlana Pipeline
 Survey Areas Vegetation**

Figure:
12.2

Imagery: ESRI, DigitalGlobe (May 2019)

CAD Ref: a2764_f03_04
 Date: June 2020 Rev: A | A4



Legend

Project Survey Area

Vegetation

- CL
- S1
- S2
- S3
- S4
- SL
- W2
- W3
- W4
- W5

Imagery: ESRI, DigitalGlobe (May 2019)

N

0 200 400 m

Scale: 1:22,500
MGA94 (Zone 50)

CAD Ref: a2764_f03_01
Date: June 2020

Rev: A | A4

Mattiske Consulting Pty Ltd

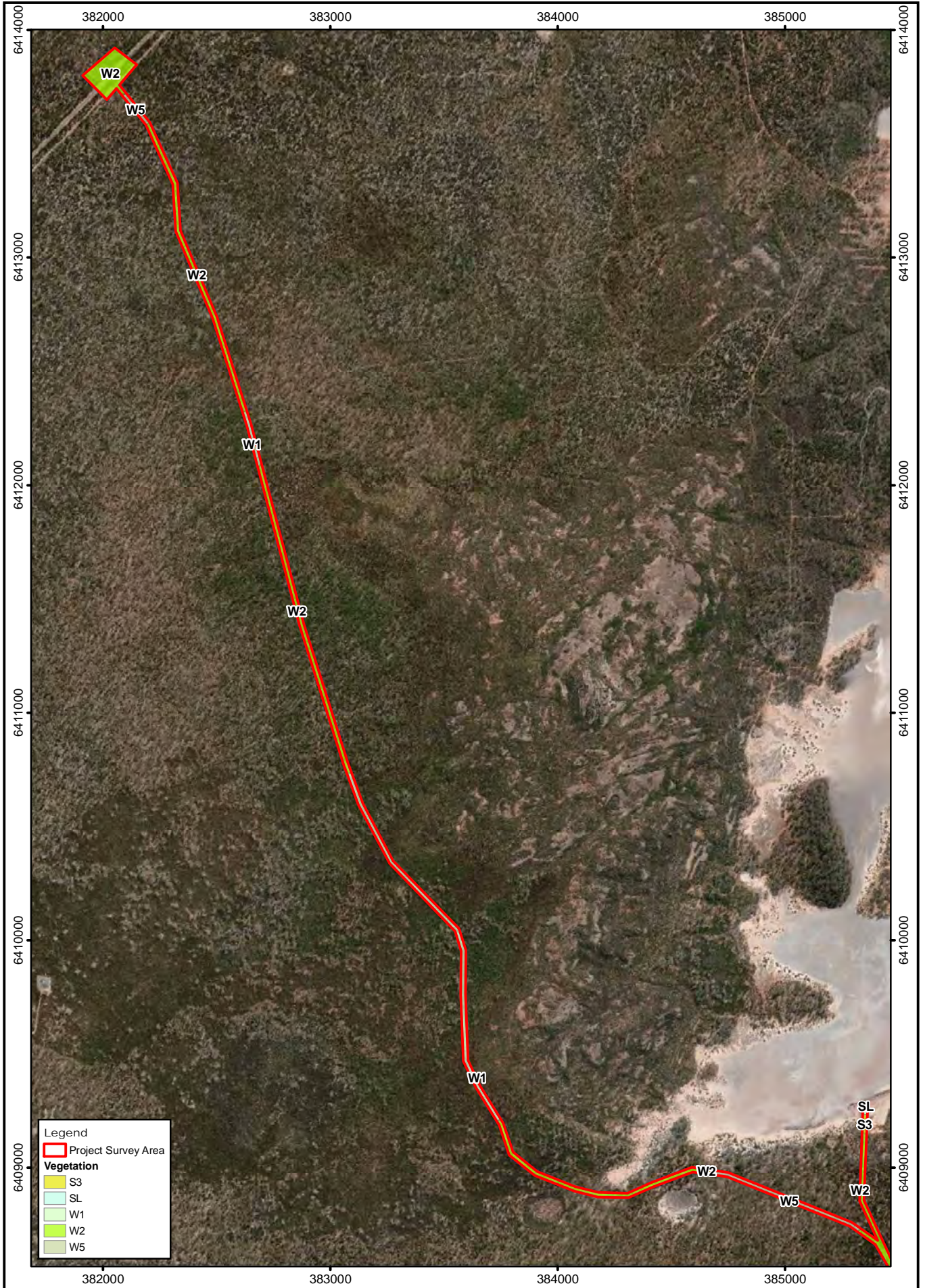
28 Central Road, Kalamunda WA 6076 - Tel: 9257 1625 - Fax: 9257 1640

Author: E M Mattiske MCPL Ref:

Drawn: CAD Resources - www.cadresources.com.au
Tel: (08) 9246 3242 - Fax (08) 9246 3202

**Norseman Gold Project
Scotia Survey Area
Vegetation**

Figure:
13.1



Legend

- Project Survey Area
- Vegetation**
- S3
- SL
- W1
- W2
- W5

Imagery: ESRI, DigitalGlobe (May 2019)

N

0 200 400 m

Scale: 1:22,500
MGA94 (Zone 50)

CAD Ref: a2764_f03_02
Date: June 2020

Rev: A | A4



Mattiske Consulting Pty Ltd

28 Central Road, Kalamunda WA 6076 - Tel: 9257 1625 - Fax: 9257 1640

Author: E M Mattiske | MCPL Ref:

Drawn: CAD Resources - www.cadresources.com.au
Tel: (08) 9246 3242 - Fax (08) 9246 3202

Norseman Gold Project Scotia Survey Area Vegetation

Figure:
13.2

5.2.4. Vegetation Condition

Of the 101 survey sites, 56 had a condition ranking of Pristine and 33 Excellent. The remaining sites comprised five ranked Very Good, one Good and one Completely Degraded (five sites had no ranking recorded); all of which were in the Northern survey areas. The vegetated areas themselves were relatively undisturbed, with few introduced species, a very small amount of grazing (likely by kangaroos or camels as no signs of stock were observed), and only a few small areas with signs of recent fire. The five sites with a ranking of Very Good had some disturbance such as vehicle tracks, rubbish and cut or broken stumps. The site ranked as Good was J102, on the Jimberlana pipeline, and had been burnt in the last 6-10 years, with no mature Eucalypts present and many stumps and branches on the ground (new growth was seen, both seedlings and resprouting of both trees and shrubs). The Completely Degraded site, NR20, had been cleared in the past and can clearly be seen on aerial photographs.

When the condition of each vegetation community is considered (as an average of the condition ranking of the survey sites within the community), throughout all survey areas 16 vegetation communities had a condition of Pristine (59.3 % of the overall survey area, excluding salt lake and non-vegetated lake bed), 10 communities had a condition of Excellent (19.5 % of the overall survey area), and one Very Good (3.3 % of the overall survey area). Previously cleared or disturbed areas were ranked Completely Degraded (17.9 % of the overall).

Table 10 lists the condition ranking for each vegetation community within the Northern and Scotia survey areas. It can be seen that the vegetation condition in the Scotia area is generally better than that in the Northern areas, although both areas have very little disturbance within the areas of native vegetation.

Table 10: Vegetation Condition by Vegetation Community in the Northern and Scotia survey areas

*Not including salt lake and non-vegetated lake bed.

NORTHERN SURVEY AREAS			SCOTIA SURVEY AREA		
VEGETATION CONDITION	VEGETATION COMMUNITY	% OF TOTAL AREA*	VEGETATION CONDITION	VEGETATION COMMUNITY	% OF TOTAL AREA*
Pristine	NS2, NS3, NS4, NW1, NW2, NW2a, NW4, NW6, NW9, NW11	49.5	Pristine	S2, S4, W1, W2, W3, W4, W5	87.7
Excellent	NS1, NW2b, NW3, NW5, NW7, NW8, NW10, NW12	28.3	Excellent	S1, S3	2.0
Very Good	NW11	4.9			-
Completely Degraded	CL	22.2			10.2

6. DISCUSSION

6.1. Flora

Whilst only 178 vascular plant taxa were recorded in the Norseman Gold Project survey areas in Autumn 2020, compared with a potential total of 804 taxa identified in the desktop study, the most common families and genera were very similar, with Myrtaceae being the most common family in both the desktop study and the field survey, and Fabaceae also being in the top three in both. *Eucalyptus* was the most common genus in both the desktop study and the field survey, with *Acacia* second and *Eremophila* third in both. The desktop study's most common family was Asteraceae, whereas in the field survey Chenopodiaceae was in the top three families.

When the separate Northern and Scotia field survey areas are compared with the corresponding North and South desktop study areas, the most common families and genera matched perfectly, with Myrtaceae always the most common family, followed by either Chenopodiaceae or Fabaceae, and with *Eucalyptus* the most common genus, followed by either *Acacia* or *Eremophila*.

The much smaller number of taxa recorded in the field (178) than what was expected given the results of the desktop study (804 taxa) can be explained by several factors, including the size of the desktop study (approximately 63,000 ha) compared with the field survey (2,665 ha mapped), i.e. a greater sample size; and the greater variation in ecosystems covered by the desktop study than the field survey. Species accumulation analysis shows that approximately 73% of taxa potentially present in the survey areas were recorded.

Less vascular plant taxa listed as Threatened or Priority either at Federal or State level (see Appendix A for definitions) were recorded in this field survey (one dead Threatened (*Daviesia macrocarpa*), one Priority 1, one Priority 2 and one potential Priority 4 species; section 5.1.1, Appendix F) than had the potential to occur in the Norseman Gold Project study area based on the desktop assessment (three Threatened and 37 Priority listed flora taxa; section 4.8.1, Appendix D). Some of this discrepancy is likely due to factors related to the size and coverage of the desktop study versus the field survey, as mentioned above for taxa in general.

There were also far fewer introduced species recorded in the field survey (two; section 5.1.3, Appendix F) than were expected to occur based on the desktop study (42 potential species; section 4.8.2, Appendix C). Both the species recorded in the field survey had the potential to occur in the survey areas based on the desktop assessment.

Of the eleven taxa recorded in the field survey representing extensions to their known range (section 5.1.2), three are ranked as Moderate extensions and one as a High range extension. Whilst two of the Moderate ranked taxa have actually been recorded previously in the area (Appendix C), *Maireana lobiflora* (Moderate range extension) and *Eragrostis lacunaria* (High range extension) have not. Both species have been recorded previously in the Coolgardie IBRA region (WAH 1998-).

6.2. Vegetation

Vegetation in the Norseman Gold Project survey areas is predominantly Eucalypt woodlands, with areas of chenopod shrubland near salty drainage systems. This is consistent with the Pre-European vegetation of the area (section 4.5) and that previously described around the greater Norseman area (Cowan 2001, Appendix B).

The *Eucalyptus* woodlands of the greater Norseman area are known to be very diverse. Observations made during the field survey and the results of the statistical analysis of the vegetation show that the

woodlands in the Norseman Gold Project survey area comprise a mosaic of various *Eucalyptus* species over slowly varying understorey species. Due to the complex nature of the woodland communities and the difficulty in identifying many species without flowering and fruiting material, definition of distinct vegetation communities was difficult. Fine scale changes in the landscape and species composition and cover were often unable to be observed from the aerial photographs. In areas where the landscape was flat or gently sloping (much of the survey area), gradients into adjacent communities were gradual with species occurring within communities on gradual changes in local site conditions. Only where ridges and rocky outcroppings were observed (predominantly in the Scotia survey area) were community boundaries more defined.

The vegetation communities found in the survey areas are discussed below.

6.2.1. Eucalypt woodlands

Eucalypt woodlands in Norseman Gold Project survey areas comprise a mosaic of vegetation communities, with continual slight changes in canopy *Eucalyptus* species, the mid stratum species and the lower stratum.

In the woodlands of the Northern survey areas the tree species *Eucalyptus lesouefii* and *E. salubris* were commonly dominant in the canopy, either singly or together. The mid stratum was often dominated by *Melaleuca* species (particularly *M. sheathiana*) and/or *Eremophila* species (particularly *E. scoparia*). The most common species in the lower stratum were the chenopods including *Atriplex vesicaria*, *Atriplex nummularia*, *Tecticornia* sp. 3 and *Maireana appressa*, along with the low shrubs *Cratystylis conocephala*, *Eremophila decipiens*, *Eremophila parvifolia* subsp. *parvifolia* (P4), *Olearia muelleri* and *Scaevola spinescens*. The lower stratum appeared to show a trend of greater numbers of *Tecticornia* spp. and *Maireana* spp. nearer salt lakes and salty drainages, with various *Atriplex* species and *Scaevola spinescens* appearing next and covering a broad variety of landforms, and an increase in *Eremophila* spp., *Cratystylis conocephala* and *Olearia muelleri* on higher ground further from the lakes.

Although a large part of the Northern survey areas was dominated by *Eucalyptus lesouefii* – *E. salubris* woodlands, there are several other Eucalypt woodland communities in the Northern areas. On rockier hilly areas along the Jemberlana pipeline and the North Royal pipeline mallee woodlands are present (communities NW2, NW2a and NW2B). These have a mid stratum of *Allocasuarina helmsii*, *Eremophila* species and *Acacia* sp. with a lower stratum of *Triodia scariosa*. Three other Eucalypt woodland communities, with only one or two survey quadrats in each, are defined on the basis of their differing Eucalyptus canopy (communities NW1, NW8, NW9). Vegetation community NW10 is also a Eucalypt woodland, with mixed Eucalyptus species in the upper stratum.

The dominant tree species of the Eucalypt woodlands in the Scotia survey area were more variable, with *Eucalyptus dundasii*, *E. flocktoniae* subsp. *flocktoniae*, *E. lesouefii* and *E. longicornis* all contributing significantly to the canopy layer. *Melaleuca sheathiana*, *Eremophila* species (*E. scoparia* and *E. psilocalyx*), *Alyxia buxifolia*, *Beyeria sulcata* var. *brevipes* and *Exocarpos aphyllus* were the most common species in the mid stratum. The lower stratum was dominated by *Olearia muelleri* and *Scaevola spinescens*, with some contribution from Chenopodiaceae species (particularly *Atriplex vesicaria*) and *Cratystylis conocephala*.

In general, the Scotia area had more varied canopy species in its Eucalypt woodland communities than did the Northern survey areas, which had most of its woodland areas dominated by two species. The Scotia area, however, had more diversity in its mid stratum. The Northern survey areas appeared to have more salt-tolerant species in the lower stratum, reflecting the larger areas in the Gladstone and North Royal areas adjacent to salt lakes or salty drainage lines.

Distinguishing separate vegetation communities in this continuum of Eucalypt woodland vegetation proved difficult, and several survey sites were on what could be considered (in hindsight) to be ecotones, so there are very likely several approaches to defining the vegetation communities in this vegetation.

6.2.2. Other vegetation communities

In the Northern survey areas there are two non-Eucalypt woodland vegetation communities (NW11 and NW12), both on low dune ridges near salt lakes. These have a similar understorey with *Atriplex ?vesicaria* and *Tecticornia* sp. 3 shrubs. There are four shrubland communities in the Northern areas, with three found very near salt lakes and salty drainage lines. They differ in their upper stratum, but all generally have *Eremophila* species in their mid stratum and chenopod shrubs such as *Atriplex ?vesicaria*, *Maireana* species, *Tecticornia* sp. 3 and *Rhagodia ?drummondii* and other shrubs like *Scaevola spinescens* and *Frankenia* sp. in the lower stratum.

The vegetation of the four shrubland communities of the Scotia survey area was highly variable. The upper stratum included *Allocasuarina* species, *Grevillea* species, *Acacia* species and *Melaleuca* species. *Scaevola spinescens* dominated the mid stratum with some contribution from *Alyxia buxifolia*, and the lower stratum comprised species such as *Atriplex ?vesicaria*, *Lepidosperma* sp. and *Frankenia* sp.

6.2.3. Species Richness

Average species richness (per quadrat) within each of the vegetation communities varied from 2.0 (no standard error as there was only one quadrat) in community NS1 to 16.0 ± 1.0 in NW1 (Appendices G and H). In general, average species richness in the vegetation communities of the Scotia survey area (11.3 ± 0.5) was greater than in the Northern survey areas (10.3 ± 0.5), but values varied more widely in the Northern areas (2.0 to 16.0 ± 1.0 , as mentioned above) than in the Scotia area (7.0 in community S4 to 14.5 ± 0.2 in community S2). The greater range may reflect the wider variety of ecosystems surveyed in the Northern areas, from areas of seasonal inundation with low chenopod shrubs through to rocky ridges with Eucalypt woodlands, versus those in the Scotia area. The higher overall richness in the Scotia area may be because the woodland communities in the Scotia area (which formed a greater proportion of the survey area than the woodlands in the Northern areas) had higher average species richness (11.4 ± 0.5) than those in Northern areas (10.0 ± 0.5).

6.2.4. Comparison with previous mapping

Previous mapping in and adjacent to the Gladstone and Gladstone-North Royal Haul Roads survey areas was used to assist with vegetation mapping in those areas. The Gladstone and Daisy survey (Mattiske Consulting Pty Ltd 2001a), which covered some of the current survey areas, defined seven vegetation communities in the area and two outside. Seven of those vegetation communities reasonably closely resemble those defined here. They are: (1b) Low chenopod shrublands dominated by samphires, associated with salt lakes – corresponds to the current community NS3; (1c) *Casuarina*, *Callitris* and *Myoporum* tall shrublands with a range of halophytic sclerophyllous shrubs, associated with salt lakes – corresponds approximately to current communities NS1, NS4 and NW11; (1d) Extensive low-lying saltbush plains adjacent to salt lakes – corresponds approximately to NW12; (2a) Broad drainage channels, undulating plains and low hills with *Eucalyptus salubris* woodlands and Chenopodiaceae species understorey – corresponds approximately to NW7 and possibly NW5; (3a) *Eucalyptus* woodlands dominated by *E. lesouefii*, *E. flocktoniae* subsp. *flocktoniae* and *E. dundasii* with *Atriplex* species and *Cratystylis conocephala* dominated understorey – similar to NW3, NW4 and NW10; (4a) Low mallee shrublands with diverse sclerophyllous shrubs on granite hills – corresponds to NW2, NW2a, NW2b; (4b) *Eucalyptus* woodlands with diverse sclerophyllous understorey on ironstone, greenstone and metamorphosed sedimentary hills and upper slopes – approximately corresponds to NW6 and NW8.

The mapping immediately to the south of the Gladstone-North Royal Haul Roads survey area (Mattiske Consulting Pty Ltd 2005) contains more detailed vegetation communities. Several of the 2005 communities bordering the south edge of the current survey area can be loosely correlated with the current vegetation communities. They are (2005 community listed first): (S1) Mixed open tall-mid shrubland over diverse halophytic shrubs on low dunes on the fringes of salt lakes – corresponds roughly with current communities

NS1 and NS4; (H1) Low Open Shrubland of *Tecticornia* species and *Frankenia* species on fringes of salt lakes – NS3; (E1 and E2) Open *Eucalyptus* Woodland over mid-low shrubland on clay-loams on lower slopes and extensive flats – NW4, NW5 and NW7; (E4) Open *Eucalyptus* Woodland over tall-mid shrubland over low halophytic shrubland on clay-loams on valley floors – NW6; (E7) Low Open *Eucalyptus* Woodland over tall-mid shrubland on sandy-gravels on mid slopes – NW6, NW7, NW10.

To the north of the Scotia survey area, the mapping over the Mt Henry area (Mattiske Consulting Pty Ltd 2013a, 2013b) resulted in the definition of 11 vegetation communities; three Eucalypt woodlands and eight shrublands. The three communities from the 2013 mapping that correspond reasonably closely to those defined in the current (Scotia) survey are (2013 communities listed first): (W1) Woodland to open woodland of *Eucalyptus dundasii*, *Eucalyptus torquata* and other mixed *Eucalyptus* spp. over *Melaleuca sheathiana*, *Exocarpos aphyllus*, *Scaevola spinescens*, *Alyxia buxifolia*, *Eremophila glabra* subsp. *glabra* and *Pomaderris forrestiana* over *Westringia rigida* and *Ptilotus obovatus* on orange-brown clayey loam with gravel on slopes and ridges – corresponds to current community W4; (W2) Woodland of *Eucalyptus urna*, *Eucalyptus lesouefii* and *Eucalyptus oleosa* subsp. *oleosa* and other mixed *Eucalyptus* spp. over *Melaleuca sheathiana*, *Exocarpos aphyllus*, *Scaevola spinescens* and *Eremophila scoparia* over *Olearia muelleri* and *Westringia rigida* on orange sandy clayey loam on flats and slopes – W2; (S4) Open scrub to scrub of *Acacia ?burkittii* and *Allocasuarina campestris* with occasional *Acacia neurophylla* subsp. *neurophylla* and occasional emergent *Eucalyptus griffithsii* over *Dodonaea microzyga* var. *acrolobata*, *Trymalium myrtillus* subsp. *myrtillus*, *Scaevola spinescens* and *Dampiera latealata* over *Lepidosperma* sp. aff. *lyonsii* and small annual and perennial herbs on red to brown clayey loam on flats, slopes, valleys and micro channels - S1.

6.3. Local and regional context and impact

The vegetation communities defined within both the Northern and Scotia survey areas by Mattiske Consulting Pty Ltd in Autumn 2020 fit within the Pre-European vegetation associations of the area (section 4.5), are typical of the regional vegetation of the Great Western Woodlands (section 4.6), and show the same gradation from salt lake vegetation with low chenopod shrublands on salt lake fringes into woodlands with mixed *Eucalyptus* species as noted for the area by Beard (1990), Cowan (2001) and DEC (2010) (section 4.5, 4.6). The communities are all very similar to those mapped in previous surveys in the area.

Approximately 0.18 % of the statewide extent of Pre-European vegetation association 9.0 (primarily in the North Royal survey area), 0.11 % of association 221.3 (mostly in the Jemberlana Pipeline area), 0.10 % of association 524.1 (mostly in the Jemberlana Pipeline area) and 1.26 % of association 3106.0 fall within the areas surveyed in Autumn 2020. As the vegetation of the Norseman Gold Project survey areas is common at statewide and regional levels, clearing should not have significant detrimental effects at those levels.

Of local importance with regard to clearing is the presence of Priority listed flora species within the survey areas.

7. CONCLUSION

A desktop assessment of flora and vegetation of the entire Norseman Gold Project area was performed in March 2020, prior to a detailed flora and vegetation field survey of five smaller survey areas.

The Norseman Gold Project area lies within the *Coolgardie 3 – Eastern Goldfields* Subregion of the Coolgardie Bioregion, and more specifically, falls within the Great Western Woodlands. As such, it was expected that the majority of the vegetation to be encountered in the field survey would comprise *Eucalyptus* woodlands, often over *Eremophila* species and/or chenopod shrublands, and *Triodia* species grasslands with mallees in some places. A total of 804 vascular plant taxa, representative of 260 genera and 115 families, were found to have the potential to occur within the Norseman Gold Project study areas (based on NatureMap & EPBC Act search results and previous surveys in the area), with the most common families being Myrtaceae, Fabaceae and Asteraceae, and the most common genera being *Eucalyptus*, *Acacia* and *Eremophila*. Forty-two introduced species had the potential to occur within the Norseman Gold Project area, four of which are Declared Pest species.

The desktop study found that three Threatened flora species, had the possibility of occurring in the Norseman Gold Project area. *Daviesia microcarpa* (T) and *Eucalyptus platydisca* (T) were assessed as having a High likelihood of occurrence in the North study areas. One Priority **ecological, 'Allocasuarina globosa assemblages on greenstone rock' supporting the other Threatened flora species** *Allocasuarina globosa* (T) is known to occur south of Norseman, and thus was assessed as having the potential to occur in the Scotia survey area.

A total of 37 Priority flora species, including eleven Priority 1, five Priority 2, seventeen Priority 3 and four Priority 4 flora species, were assessed as having the potential to occur within the Norseman Gold Project study areas. No Threatened ecological communities were found to have the potential to occur in the Norseman Gold Project area.

The field survey was carried out from the 30th March 2020 to the 3rd April 2020, during which 61 quadrats were surveyed in the Northern survey areas (Gladstone, North Royal, Gladstone-North Royal Haul Roads and Jemberlana Pipeline) and 40 quadrats in the Scotia survey area.

In the Northern survey areas, 138 vascular plant taxa were recorded, representative of 60 genera and 33 families. The most common families were Myrtaceae, Chenopodiaceae, Fabaceae and Scrophulariaceae, and the most common genera were *Eucalyptus*, *Eremophila* and *Acacia*. In the Scotia survey area, 101 vascular plant taxa were recorded, representative of 50 genera and 31 families. Most taxa were part of the Myrtaceae, Fabaceae and Chenopodiaceae families. The most common genera were *Eucalyptus*, *Acacia* and *Eremophila*. Whilst only 178 vascular plant taxa were recorded in both the Norseman Gold Project survey areas in autumn 2020, compared with a potential total of 804 taxa identified in the desktop study, the most common families and genera were very similar. The much smaller number of taxa recorded in the field than what was expected given the results of the desktop study (804 taxa) can be explained by several factors: the timing of the field survey resulting in few annual taxa being recorded; the size of the desktop study compared with the field; and the greater variation in ecosystems covered by the desktop study than the field survey. Species accumulation analysis shows that approximately 73% of taxa potentially present in the survey areas were recorded during the field survey.

The area that had previously supported the *Daviesia microcarpa* (T) were re-assessed and no alive plants were recorded in the current survey. Two priority flora species, *Calandrinia lefroyensis* (P1) and *Acacia kerryana* (P2), were recorded in the Gladstone and Jemberlana Pipeline survey areas, respectively. *Eremophila parvifolia* ?subsp. *parvifolia* (P4), which was recorded throughout the four Northern survey areas, was unable to be confidently identified to a sub-species level as a fruiting specimen is required. This species is treated with a precautionary approach as the Priority 4 subspecies. The lower number of Threatened or Priority taxa recorded in the field survey, relative to that expected from the desktop study,

is likely due to the timing of the survey, as only five of the potential Threatened and Priority listed taxa are known to flower in March or April, making recognition in the field very difficult.

Eleven taxa, including three potential identifications, recorded within the survey areas represent extensions to their current known distributions based on known data. Three of the taxa are ranked as being Moderate range extensions and one as High.

Two introduced (weed) species, **Asphodelus fistulosus* (Onion Weed) and **Gazania linearis*, were recorded in very small numbers at one site each. Under the Department of Parks and Wildlife Weed Prioritisation Process, **Gazania linearis* is considered to be one of the 17 Goldfields Region priority alert weeds.

In the Northern survey areas, a total of 18 vegetation communities were defined and mapped: twelve Eucalypt woodland communities, two other woodland communities and four shrubland communities. Two of the shrubland communities, dominated by salt-tolerant species, formed almost 25 % of the Northern survey areas, reflecting the significant areas of salt lake in these areas. Nine vegetation communities were defined in the Scotia survey area: five Eucalypt woodland communities and four shrubland communities. Three Eucalypt woodland communities made up almost 85 % of the Scotia survey area. No Threatened or Priority ecological communities were recorded as occurring in the Norseman Gold survey areas.

Approximately 93 % of the sites with a recorded condition ranking were assessed as being in Pristine or Excellent condition. The vegetation condition in the Scotia survey area is generally better than that in the Northern areas, although both areas have very little disturbance within the areas of native vegetation. Whilst there was significant disturbance within the Norseman Gold Project survey areas as a whole, the vegetated areas themselves were little disturbed.

Vegetation in the Norseman Gold Project survey areas was found to be predominantly Eucalypt woodlands, with areas of chenopod shrubland near salty drainage systems. This is consistent with the Pre-European vegetation of the area and that previously described around the greater Norseman area. Observations made during the field survey and the results of the statistical analysis of the vegetation show that the woodlands in the Norseman Gold Project survey area comprise a mosaic of various *Eucalyptus* species over slowly varying understorey species. Due to the complex nature of the woodland communities and the difficulty in identifying many species without flowering and fruiting material, distinguishing separate vegetation communities was difficult. It is acknowledged that there are therefore very likely several approaches to defining the vegetation communities in this vegetation.

In general, average species richness in the vegetation communities of the Scotia survey was greater than in the Northern survey areas, but values varied more widely in the Northern areas, likely reflecting the wider variety of ecosystems surveyed in those areas.

The vegetation communities defined within both the Northern and Scotia survey areas fit within the Pre-European vegetation associations of the area, are typical of the regional vegetation of the Great Western Woodlands, and show the same gradation from salt lake vegetation with low chenopod shrublands on salt lake fringes into woodlands with mixed *Eucalyptus* species as noted for the area in earlier regional studies. The communities are all very similar to those mapped in previous local surveys in the area. As the vegetation of the Norseman Gold Project survey areas is common at statewide and regional levels, clearing should not have significant detrimental effects at those levels. However, the presence of Priority listed flora species within the survey areas is of local importance with regard to clearing of vegetation.

8. ACKNOWLEDGEMENTS

The authors would like to thank Karen de Roer and Paul Androvic from Pantoro Ltd for their assistance with this project. The authors would also like to thank taxonomists from the Western Australian Herbarium for their plant identification support.

9. PERSONNEL

The following Mattiske Consulting Pty Ltd personnel were involved in this project:

NAME	POSITION	PROJECT INVOLVEMENT	FLORA COLLECTION PERMITS
Dr EM Mattiske	Managing Director & Principal Ecologist	Planning, managing, reporting	N/A
Ms E Chetwin	Project Leader, Experienced Botanist	Planning, fieldwork, plant identification, data analysis, reporting	FB62000026-2
Ms L Taaffe	Experienced Botanist	Fieldwork, plant identification, data analysis, reporting	FB62000021-2
Mr N Watson	Botanist	Fieldwork, plant identification	FB62000146
Ms M Behn	Ecologist	Fieldwork	N/A
Mrs J Wescombe	Experienced Botanist	Reporting	N/A

10. REFERENCES

- Alpin, TEH 1979, 'The flora' in *Environment and Science*, ed. BJ O'Brien, University of Western Australia Perth, Nedlands, pp. 53-76.
- Beard, JS 1970, *Vegetation Survey of Western Australia - Western Australia Vegetation Series 1: 1,000,000 Sheet 4 - Nullarbor*, University of Western Australia Press, Nedlands, WA.
- Beard, JS 1975, *Vegetation Survey of Western Australia - Western Australia Vegetation Series 1: 1,000,000 Explanatory notes to Sheet 4 – Nullarbor*, University of Western Australia Press, Nedlands, WA.
- Beard, JS 1990, *Plant life of Western Australia*, Kangaroo Press, Kenthurst, NSW.
- Biodiversity Conservation Act 2016* (WA)
- Biosecurity and Agriculture Management Act 2007* (WA)
- Biosecurity and Agriculture Management Regulations 2013* (WA)
- Botanica Consulting 2010, *Level 1 flora and vegetation survey, Brockway Timber Reserve*. Unpublished report prepared for Matsa Resources, November 2010.
- Bureau of Meteorology 2020, *Climate data online*, Commonwealth of Australia. Available from: <http://www.bom.gov.au/climate/data/?ref=fr>. 05 May 2020.
- Chao, A 2004, 'Species richness estimation' in *Encyclopaedia of statistical sciences*, eds. N Balakrishnan, CB Read & B Vidakovic, Wiley, New York.
- Chinnock, RJ 2007, *Eremophila and allied genera: A Monograph of the Myoporaceae*, The Botanic Gardens and State Herbarium, Department of Environment and Heritage, Government of South Australia, pp. 237-239.
- Clarke, KR & Gorley, RN 2015, *PRIMER v7 - User Manual/Tutorial*, PRIMER-e, Devon, United Kingdom.
- Colwell, RK 2013, *EstimateS – Statistical estimation of species richness and shared species from samples*, Version 9. Available from: viceroy.colorado.edu/estimates.
- Cowan, M 2001, 'Coolgardie 3 (COO3 – Eastern Goldfields subregion)' in *A biodiversity audit of Western Australia's 53 biogeographical subregions in 2002*, eds. JE May & NL McKenzie, Department of Conservation and Land Management, Western Australia, pp. 156-169.
- Department of Agriculture, Water and the Environment 2015, *EPBC Act: Protected matters search tool*, Commonwealth of Australia. Available from: <http://www.environment.gov.au/epbc/protected-matters-search-tool>. 06 March 2020.
- Department of Agriculture, Water and the Environment 2020a, *Australia's bioregions (IBRA)*, Commonwealth of Australia. Available from: <http://www.environment.gov.au/topics/land/national-reserve-system/science-maps-and-data/australias-bioregions-ibra>. 06 March 2020.
- Department of Agriculture, Water and the Environment 2020b, *EPBC Act list of threatened flora*, Commonwealth of Australia. Available from: <http://www.environment.gov.au/cgi-bin/sprat/public/publicthreatenedlist.pl?wanted=flora>. 06 March 2020.
- Department of Agriculture, Water and the Environment 2020c, *Weeds of National Significance*. Available from: <http://www.environment.gov.au/biodiversity/invasive/weeds/weeds/lists/wons.html>. 06 March 2020.
- Department of Agriculture, Water and the Environment 2020d, *EPBC Act list of threatened ecological communities*, Commonwealth of Australia. Available from: <http://www.environment.gov.au/cgi-bin/sprat/public/publiclookupcommunities.pl>. 06 March 2020.
- Department of Biodiversity, Conservation and Attractions 2007-, *NatureMap: Mapping Western Australia's biodiversity*, Government of Western Australia. Available from: <https://naturemap.dbca.wa.gov.au/>. 06 March 2020.

- Department of Biodiversity, Conservation and Attractions 2018a, *Wildlife conservation (rare flora) notice 2018, 11 September 2018*, Minister for the Environment. Available from: <https://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/threatened-plants>. 06 March 2020.
- Department of Biodiversity, Conservation and Attractions 2018b, *Threatened and Priority Flora List – 05 December 2018*. Available from: <https://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/threatened-plants>. 06 March 2020.
- Department of Biodiversity, Conservation and Attractions 2018c, *List of Threatened Ecological Communities endorsed by the Western Australian Minister for Environment - 28 June 2018*. Available from: <https://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/wa-s-threatened-ecological-communities>. 06 March 2020.
- Department of Biodiversity, Conservation and Attractions 2019, *Conservation codes for Western Australian flora and fauna, 03 January 2019*. Available from: <https://www.dpaw.wa.gov.au/images/documents/plants-animals/threatened-species/Listings/Conservation%20code%20definitions.pdf>. 06 March 2020.
- Department of Biodiversity, Conservation and Attractions 2020a, *Priority Ecological Communities for Western Australia Version 29 (05 May 2020)*. Available from: <https://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/wa-s-threatened-ecological-communities>. 18 May 2020.
- Department of Biodiversity, Conservation and Attractions 2020b, *Threatened flora, fauna and ecological communities database searches*. Available from: <https://www.dpaw.wa.gov.au/images/documents/plants-animals/threatened-species/database-search-request-information-sheet.pdf>. Searched 18 March 2020.
- Department of Environment and Conservation 2010, *A biodiversity and cultural conservation strategy for the Great Western Woodlands*, Government of Western Australia. Available from: <https://www.dpaw.wa.gov.au/management/off-reserve-conservation/the-great-western-woodlands>. 06 March 2020.
- Department of Environment and Conservation 2013, *Definitions, categories and criteria for threatened and priority ecological communities*, Government of Western Australia. Available from: <http://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/wa-s-threatened-ecological-communities>. 06 March 2020.
- Department of Parks and Wildlife 2013, *Weed prioritisation process for DPaW (formerly DEC) – "An integrated approach to weed management on DPaW-managed lands in WA", November 2013*, Government of Western Australia. Available from: <https://www.dpaw.wa.gov.au/plants-and-animals/plants/weeds/156-how-does-dpaw-manage-weeds>. 06 March 2020.
- Department of Parks and Wildlife 2014, *Ecological impact and invasiveness rankings from the Department of Parks and Wildlife Goldfields Region species prioritisation process 2014*, Government of Western Australia. Available from: <https://www.dpaw.wa.gov.au/plants-and-animals/plants/weeds/156-how-does-dpaw-manage-weeds>. 06 March 2020.
- Department of Primary Industries and Regional Development 2020, *Western Australian Organism List*, Government of Western Australia. Available from: <https://www.agric.wa.gov.au/organisms>. 06 March 2020.
- Environmental Protection (Environmentally Sensitive Areas) Notice 2005 (WA)*
- Environment Protection and Biodiversity Conservation Act 1999 (Cth)*
- Environmental Protection Act 1986 (WA)*
- Environmental Protection Authority 2016a, *Environmental Factor Guideline: Flora and Vegetation*, Environmental Protection Authority, Western Australia.

- Environmental Protection Authority 2016b, *Technical Guidance – Flora and vegetation surveys for environmental impact assessment*, Environmental Protection Authority, Western Australia.
- Executive Steering Committee for Australian Vegetation Information 2003, *Australian vegetation attribute manual: National vegetation information system, version 6.0*, Department of the Environment and Heritage, Canberra.
- GHD Pty Ltd 2009, *Report for proposed small scale mining operation – targeted flora survey*. Unpublished report prepared for Matsa Resources Ltd, October 2009.
- GHD Pty Ltd 2010a, ***Addendum to 'Report for proposed small scale mining operation – targeted flora survey' (GHD, 2009)***. Unpublished memorandum prepared for Matsa Resources Ltd, April 2010.
- GHD Pty Ltd 2010b, *Report for Brockway exploration area – flora and fauna assessment*. Unpublished report prepared for Matsa Resources Ltd, May 2010.
- Goldfields Environmental Management Pty Ltd 1989, *Notes on the flora and fauna of the Red, White and Blue lease of Australis Mining N.L.*. Unpublished report prepared for Australis Mining N.L., April 1989.
- Keighery, BJ 1994, *Bushland plant survey: a guide to plant community survey for the community*, Wildflower Society of WA (Inc.), Western Australia.
- Keighery, GJ, Newbey, KR and Hall, NJ 1993, *Vegetation and Flora*. In: Hall, NJ and McKenzie, NL, eds., **'The biological survey of the Eastern Goldfields of Western Australia – Part 9. Norseman-Balladonia study area'**, **Records of the Western Australian Museum Supplement 42**, Western Australian Museum, Perth, WA.
- Landcare Services Pty Ltd 1995, *Baseline vegetation survey Phase I – Norseman, WA*. Unpublished report prepared for WMC Central Norseman Gold Corporation, October 1995.
- Landcare Services Pty Ltd 1996, *Baseline vegetation survey Phase II – Norseman, WA*. Unpublished report prepared for Central Norseman Gold Corporation Ltd, June 1996.
- Landcare Services Pty Ltd 1997, *Baseline vegetation survey Phase II – Norseman, WA*. Unpublished report prepared for Central Norseman Gold Corporation Ltd, July 1997.
- Marianna Partners Environmental Services 1996, *Mercury-Mt Henry and Iron Prince Project Areas, Norseman, WA – Pre-mining environmental survey*. Unpublished report prepared for Australasian Gold Mines NL, July 1996.
- Mattiske Consulting Pty Ltd 2001a, *Flora and vegetation survey, Gladstone and Daisy project areas, Norseman*. Unpublished report prepared for Central Norseman Gold Corporation Ltd, August 2001.
- Mattiske Consulting Pty Ltd 2001b, *Monitoring the effects of tailing storage facilities on tree health at Phoenix and Venture pit tailings storage facilities, Norseman*. Unpublished report prepared for Central Norseman Gold Corporation Ltd, August 2001.
- Mattiske Consulting Pty Ltd 2002, *Flora and vegetation survey, proposed mining area, Cobbler, Norseman*. Unpublished report prepared for Croesus Mining NL, August 2002.
- Mattiske Consulting Pty Ltd 2005, *Flora, vegetation and vertebrate fauna survey on proposed tailings dam area*. Unpublished report prepared for Croesus Mining NL by Mattiske Consulting Pty Ltd and Ninox Wildlife Consulting, April 2005.
- Mattiske Consulting Pty Ltd 2013a, *Flora and vegetation survey of the Mt Henry survey area*. Unpublished report prepared for Panoramic Resources Ltd, January 2013.
- Mattiske Consulting Pty Ltd 2013b, *Flora and vegetation survey of the Mt Henry survey area*. Unpublished report prepared for Panoramic Resources Ltd, September 2013.
- Native Vegetation Solutions 2019, *Targeted threatened flora search of the Maybell and Lord Percy project areas, November 2019*. Unpublished memorandum prepared for Pantoro Limited, December 2019.

- Obbens, FJ 2018, *Three new perennial species of Calandrinia (Montiaceae) from southern Western Australia*, *Nuytsia* 29: 193-204.
- Outback Ecology Environmental Management Services 2003, *Baseline environmental study – Lake Cowan*. Unpublished report prepared for Croesus Mining NL and Central Norseman Gold Corporation, July 2003.
- Paul Armstrong & Associates 2004, *Rare flora and vegetation survey of North Scotia prospect, conducted August 2004*. Unpublished report prepared for Kinross Gold Australia Pty Ltd, October 2004.
- Rally Revegetation and Environmental Services 2004, *Bullen (M63/15) flora survey*. Unpublished report prepared for Croesus Mining NL, September 2004.
- Rally Revegetation and Environmental Services 2005, *Eco-system Function Analysis, Croesus Mining N.L. Davyhurst, Norseman and Binduli mine sites*. Unpublished report prepared for Croesus Mining NL, July-August 2005.
- Specht, RL 1970, 'Vegetation' in *Australian Environment*, 4th edn., ed. GW Leeper, Melbourne University Press, Melbourne, pp. 44-67.**
- Tille, P 2006, *Soil-landscapes of Western Australia's Rangelands and Arid Interior*, Resource Management Technical Report 313, Department of Agriculture and Food, Perth, WA.
- Umwelt (Australia) Pty Ltd 2016, *Supporting documentation for clearing permit (purpose) application – Maybell mine*. Unpublished report prepared for Central Norseman Gold Corporation Limited, May 2016.
- Western Australian Herbarium 1998-, *FloraBase – the Western Australian Flora*, Department of Parks and Wildlife. Available from: <https://florabase.dpaw.wa.gov.au>. 06 March 2020.
- Western Australian Herbarium 2020, *Western Australian Herbarium Flora Database*. Searched 18 March 2020.
- WorldWideWattle ver. 2 2020, *Acacia kerryana*. Available from: <http://worldwidewattle.com/speciesgallery/kerryana.php?id=3400>. 05 May 2020.

APPENDIX A1: THREATENED AND PRIORITY FLORA DEFINITIONS

Under section 179 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), threatened flora are categorised as extinct, extinct in the wild, critically endangered, endangered, vulnerable and conservation dependent (Table A1.1).

Table A1.1 Federal definition of threatened flora species

Note: Adapted from section 179 of the EPBC Act.

CODE	CATEGORY	DEFINITION
Ex	Extinct	Species which at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
ExW	Extinct in the Wild	Species which is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or 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.
CE	Critically Endangered	Species which 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.
E	Endangered	Species which is not critically endangered and it is facing a very high risk of extinction in the wild in the immediate or near future, as determined in accordance with the prescribed criteria.
V	Vulnerable	Species which is not critically endangered or endangered and is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
CD	Conservation Dependent	Species which at a particular time if, at that time, 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 within a period of 5 years.

The *Biodiversity Conservation Act 2016* (BC Act) provides for (amongst other things) the protection of flora that is facing an extremely high risk of extinction in the wild in the immediate, near or medium-term future in Western Australia under Part 10 (Division 2).

Threatened flora are listed in the *Wildlife Conservation (Rare Flora) Notice 2018* (under Part 2, Division 1, Subdivision 2 of the BC Act; Department of Biodiversity, Conservation and Attractions (DBCA) 2018a) and are categorised under Schedules 1-3. A flora species is defined as threatened if it is facing an extremely high risk of extinction in the wild in the immediate, near or medium-term future, pursuant to sections 20, 21 and 22 of the BC Act (DBCA 2019). Threatened species are categorised as critically endangered, endangered, and vulnerable (Table A1.2).

Table A1.2 State definition of threatened flora species

Note: Adapted from DBCA (2019).

CODE	CATEGORY	DEFINITION
CR	Critically endangered	Species considered to be facing an extremely high risk of becoming extinct in the wild (listed under Schedule 1 of the <i>Wildlife Conservation (Rare Flora) Notice 2018</i>).
EN	Endangered	Species considered to be facing a very high risk of becoming extinct in the wild (listed under Schedule 2 of the <i>Wildlife Conservation (Rare Flora) Notice 2018</i>).
VU	Vulnerable	Species considered to be facing a high risk of becoming extinct in the wild (listed under Schedule 3 of the <i>Wildlife Conservation (Rare Flora) Notice 2018</i>).

Priority flora species are defined as “possibly threatened species that do not meet the survey criteria, or are otherwise data deficient” or species that are “adequately known, are rare but not threatened, meet criteria for near threatened or have recently been removed from the threatened species list” for **other than taxonomic reasons**” (DBCA 2019). Priority species are not afforded the same level of protection under state or federal legislation as the listed Threatened species, however are considered significant under the Environmental Protection Authority’s *Environmental Factor Guideline: Flora and Vegetation* (Environmental Protection Authority 2016a). The Department of Biodiversity, Conservation and Attractions categorises priority flora into four categories: Priority 1; Priority 2, Priority 3 and Priority 4 (Table A1.3).

Table A1.3: State definition of priority flora species

Note: Adapted from DBCA (2019).

CODE	CATEGORY	DEFINITION
P1	Priority 1: Poorly-known species	Known from one or a few locations (< 5) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation; or are otherwise under threat of habitat destruction or degradation. In urgent need of further survey.
P2	Priority 2: Poorly-known species	Known from one or a few locations (< 5). Some occurrences are on lands managed primarily for nature conservation. In urgent need of further survey.
P3	Priority 3: Poorly-known species	Known from several locations and the species does not appear to be under imminent threat; or from few but widespread locations with either a large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. In need of further survey.
P4	Priority 4: Rare, Near Threatened, and other species in need of monitoring	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. b) Near Threatened - Species that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. c) Other - Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

APPENDIX A2: THREATENED AND PRIORITY ECOLOGICAL COMMUNITY DEFINITIONS

Under section 181 of the EPBC Act, threatened ecological communities are categorised as critically endangered, endangered and vulnerable (Table A2.1).

Table A2.1 Federal definition of threatened ecological communities

Note: Adapted from section 181 and section 182 of the EPBC Act.

CATEGORY	DEFINITION
Critically Endangered	If, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future.
Endangered	If, at that time, it is not critically endangered and is facing a very high risk of extinction in the wild in the near future.
Vulnerable	If, at that time, it is not critically endangered or endangered, and is facing a high risk of extinction in the wild in the medium-term future.

Threatened ecological communities (TECs) are listed in the *List of Threatened Ecological Communities endorsed by the Western Australian Minister for Environment (28 June 2018)* (under Part 2, Division 2, Subdivision 1 of the BC Act; DBCA 2018c). An ecological community is defined as threatened if it is facing an extremely high risk of collapse in the immediate, near or medium-term future, pursuant to sections 28, 29 and 30 of the BC Act. Threatened ecological communities are categorised as critically endangered, endangered, and vulnerable (Table A2.2).

Currently there is no Western Australian legislation covering the conservation of state listed threatened ecological communities (TECs), however, a non-statutory process is in place, whereby the DBCA (and former equivalent departments) have been identifying and informally listing TECs since 1994. Some of these TECs are also endorsed by the Federal Minister as threatened, and some of these are listed under the EPBC Act and therefore afforded legislative protection at the Commonwealth level.

Table A2.2 State definition of threatened ecological communities

Note: Adapted from Department of Environment and Conservation (2013).

CODE	CATEGORY	DEFINITION
CR	Critically Endangered	An ecological community will be listed as CR when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future, meeting any one or more of the following criteria: <ol style="list-style-type: none"> 1. The estimated geographic range and distribution has been reduced by at least 90% and is either continuing to decline with total destruction imminent, or is unlikely to be substantially rehabilitated in the immediate future due to modification; 2. The current distribution is limited i.e. highly restricted, having very few small or isolated occurrences, or covering a small area; or 3. The ecological community is highly modified with potential of being rehabilitated in the immediate future.
EN	Endangered	An ecological community will be listed as EN when it has been adequately surveyed and is not CR, but is facing a very high risk of total destruction in the near future. The ecological community must meet any one or more of the following criteria: <ol style="list-style-type: none"> 1. The estimated geographic range and distribution has been reduced by at least 70% and is either continuing to decline with total destruction imminent in the short term future, or is unlikely to be substantially rehabilitated in the short term future due to modification; 2. The current distribution is limited i.e. highly restricted, having very few small or isolated occurrences, or covering a small area; or 3. The ecological community is highly modified with potential of being rehabilitated in the short term future.
VU	Vulnerable	An ecological community will be listed as VU when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing high risk of total destruction in the medium to long term future. The ecological community must meet any one or more of the following criteria: <ol style="list-style-type: none"> 1. The ecological community exists largely as modified occurrences that are likely to be able to be substantially restored or rehabilitated; 2. The ecological community may already be modified and would be vulnerable to threatening process, and restricted in range or distribution; or 3. The ecological community may be widespread but has potential to move to a higher threat category due to existing or impending threatening processes.

Priority ecological communities (PECs) are defined as possible threatened ecological communities that do not meet the stringent survey criteria for the assessment of threatened ecological communities, and are listed by the DBCA (2020a) in the *Priority Ecological Communities for Western Australia – Version 29 (05 May 2020)*. Similarly to priority flora, PECs are not afforded legislative protection, however are considered significant under the Environmental Protection Authority's (2016a) *Environmental Factor Guideline: Flora and Vegetation*. The Department of Biodiversity, Conservation and Attractions categorises priority ecological communities into five categories: Priority 1; Priority 2, Priority 3, Priority 4 and Priority 5 (Table A2.3).

Table A2.3 State definition of priority ecological communities

Note: Adapted from Department of Environment and Conservation (2013).

CODE	CATEGORY	DEFINITION
P1	Priority 1 (Poorly known ecological communities)	Ecological communities that are known from very few, restricted occurrences (generally ≤ 5 occurrences or a total area of ≤ 100 ha). Most of these occurrences are not actively managed for conservation (e.g. located within agricultural or pastoral lands, urban areas, or active mineral leases) and for which immediate threats exist.
P2	Priority 2 (Poorly known ecological communities)	Communities that are known from few small occurrences (generally ≤ 10 occurrences or a total area of ≤ 200 ha). At least some occurrences are not believed to be under immediate threat of destruction or degradation.
P3	Priority 3 (Poorly known ecological communities)	<ol style="list-style-type: none"> 1. Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation; 2. Communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat; or 3. Communities made up of large, and/or widespread occurrences, that may or not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing and inappropriate fire regimes.
P4	Priority 4 (Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring)	<ol style="list-style-type: none"> 1. Rare – Communities known from few occurrences that are considered to have been adequately surveyed, sufficient knowledge is available, and are considered not to be currently threatened. 2. Near Threatened – Communities considered to have been adequately surveyed and do not qualify for Conservation Dependent, but are close to qualifying for Vulnerable. 3. Communities that have been removed from the list of threatened communities during the past five years.
P5	Priority 5 (Conservation Dependent ecological communities)	Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

APPENDIX A3: CATEGORIES AND CONTROL MEASURES OF DECLARED PEST (PLANT) ORGANISMS IN WESTERN AUSTRALIA

Section 22 of **Western Australia's *Biosecurity and Agriculture Management Act 2007*** (BAM Act) makes provision for a plant taxon to be listed as a declared pest organism in respect to parts of, or the entire State. According to the BAM Act, a declared pest is defined as a prohibited organism (section 12), or an organism for which a declaration under section 22 (2) of the Act is in force.

Under the *Biosecurity and Agriculture Management Regulations 2013* (WA), declared pest plants are placed in one of three control categories, C1 (exclusion), C2 (eradication) or C3 (management), which determines the measures of control which apply to the declared pest (Table A4.1). The current listing of declared pest organisms and their control category is through the Western Australian Organism List (Department of Primary Industries and Regional Development 2020).

Table A3.1 Categories and control measures of declared pest (plant) organisms

Note: Adapted from *Biosecurity and Agriculture Management Regulations 2013*.

CONTROL CATEGORY	CONTROL MEASURES
<p style="text-align: center;">C1 (Exclusion)</p> <p>‘(a) Category 1 (C1) — Exclusion: if in the opinion of the Minister introduction of the declared pest into an area or part of an area for which it is declared should be prevented.’</p> <p>Pests will be assigned to this category if they are not established in Western Australia and control measures are to be taken, including border checks, in order to prevent them entering and establishing in the State.</p>	<p>In relation to a category 1 declared pest, the owner or occupier of land in an area for which an organism is a declared pest or a person who is conducting an activity on the land must take such of the control measures specified in subregulation (1) as are reasonable and necessary to destroy, prevent or eradicate the declared pest.</p>
<p style="text-align: center;">C2 (Eradication)</p> <p>‘(b) Category 2 (C2) — Eradication: if in the opinion of the Minister eradication of the declared pest from an area or part of an area for which it is declared is feasible.’</p> <p>Pests will be assigned to this category if they are present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still a possibility.</p>	<p>In relation to a category 2 declared pest, the owner or occupier of land in an area for which an organism is a declared pest or a person who is conducting an activity on the land must take such of the control measures specified in subregulation (1) as are reasonable and necessary to destroy, prevent or eradicate the declared pest.</p>
<p style="text-align: center;">C3 (Management)</p> <p>‘(c) Category 3 (C3) — Management: if in the opinion of the Minister eradication of the declared pest from an area or part of an area for which it is declared is not feasible but that it is necessary to:</p> <p>(i) alleviate the harmful impact of the declared pest in the area; or</p> <p>(ii) reduce the number or distribution of the declared pest in the area; or</p> <p>(iii) prevent or contain the spread of the declared pest in the area.’</p> <p>Pests will be assigned to this category if they are established in Western Australia but it is feasible, or desirable, to manage them in order to limit their damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area which currently is free of that pest.</p>	<p>In relation to a category 3 declared pest, the owner or occupier of land in an area for which an organism is a declared pest or a person who is conducting an activity on the land must take such of the control measures specified in subregulation (1) as are reasonable and necessary to:</p> <p>(a) alleviate the harmful impact of the declared pest in the area for which it is declared; or</p> <p>(b) reduce the number or distribution of the declared pest in the area for which it is declared; or</p> <p>(c) prevent or contain the spread of the declared pest in the area for which it is declared.</p>

APPENDIX A4: OTHER DEFINITIONS

Environmentally sensitive areas

Environmentally sensitive areas are declared by the State Minister under section 51B of the *Environmental Protection Act 1986* (EP Act) and are listed in the *Environmental Protection (Environmentally Sensitive Areas) Notice 2005*, gazetted 8 April 2005. Specific environmentally sensitive areas relevant to this report include: a defined wetland and the area within 50 metres of the wetland; the area covered by vegetation within 50 metres of rare flora; the area covered by a threatened ecological community; a Bush Forever site – further areas and information are described in the *Environmental Protection (Environmentally Sensitive Areas) Notice 2005*.

Conservation significant flora

Under the *Environmental Factor Guideline: Flora and Vegetation* (Environmental Protection Authority 2016a), flora may be considered significant for a range of reasons, including, but not limited to the following:

- being identified as threatened or priority species;
- locally endemic or associated 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.

Conservation significant vegetation

Under the *Environmental Factor Guideline: Flora and Vegetation* (Environmental Protection Authority 2016a), vegetation may be considered significant for a range of reasons, including, but not limited to the following:

- being identified as threatened or priority ecological communities;
- 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.

APPENDIX A5: NVIS STRUCTURAL FORMATION TERMINOLOGY

Note: Adapted from Environmental Steering Committee for Australian Vegetation Information (2003).

COVER CHARACTERISTICS							
Foliage cover*	70-100	30-70	10-30	<10	≈0	0-5	unknown
Crown cover**	>80	50-80	20-50	0.25-20	<0.25	0-5	unknown
% cover***	>80	50-80	20-50	0.25-20	<0.25	0-5	unknown
Cover code	d	c	i	r	bi	bc	unknown

GROWTH FORM	HEIGHT RANGES (m)	STRUCTURAL FORMATION CLASSES						
		closed forest	open forest	woodland	open woodland	isolated trees	isolated clumps of trees	trees
tree, palm	<10, 10-30, >30	closed forest	open forest	woodland	open woodland	isolated trees	isolated clumps of trees	trees
tree mallee	<3, <10, 10-30	closed mallee forest	open mallee forest	mallee woodland	open mallee woodland	isolated mallee trees	isolated clumps of mallee trees	mallee trees
shrub, cycad, grass-tree, tree-fern	<1, 1-2, >2	closed shrubland	shrubland	open shrubland	sparse shrubland	isolated shrubs	isolated clumps of shrubs	shrubs
mallee shrub	<3, <10, 10-30	closed mallee shrubland	mallee shrubland	open mallee shrubland	sparse mallee shrubland	isolated mallee shrubs	isolated clumps of mallee shrubs	mallee shrubs
heath shrub	<1, 1-2, >2	closed heathland	heathland	open heathland	sparse heathland	isolated heath shrubs	isolated clumps of heath shrubs	heath shrubs
chenopod shrub	<1, 1-2, >2	closed chenopod shrubland	chenopod shrubland	open chenopod shrubland	sparse chenopod shrubland	isolated chenopod shrubs	isolated clumps of chenopod shrubs	chenopod shrubs
samphire shrub	<0.5, >0.5	closed samphire shrubland	samphire shrubland	open samphire shrubland	sparse samphire shrubland	isolated samphire shrubs	isolated clumps of samphire shrubs	samphire shrubs
hummock grass	<2, >2	closed hummock grassland	hummock grassland	open hummock grassland	sparse hummock grassland	isolated hummock grasses	isolated clumps of hummock grasses	hummock grasses
tussock grass	<0.5, >0.5	closed tussock grassland	tussock grassland	open tussock grassland	sparse tussock grassland	isolated tussock grassland	isolated clumps of tussock grasses	tussock grasses
other grass	<0.5, >0.5	closed grassland	grassland	open grassland	sparse grassland	isolated grasses	isolated clumps of grasses	other grasses
sedge	<0.5, >0.5	closed sedgeland	sedgeland	open sedgeland	sparse sedgeland	isolated sedges	isolated clumps of sedges	sedges
rush	<0.5, >0.5	closed rushland	rushland	open rushland	sparse rushland	isolated rushes	isolated clumps of rushes	rushes
forb	<0.5, >0.5	closed forbland	forbland	open forbland	sparse forbland	isolated forbs	isolated clumps of forbs	forbs
fern	<1, 1-2, >2	closed fernland	fernland	open fernland	sparse fernland	isolated ferns	isolated clumps of ferns	ferns
bryophyte	<0.5	closed bryophyteland	bryophyteland	open bryophyteland	sparse bryophyteland	isolated bryophytes	isolated clumps of bryophytes	bryophytes
lichen	<0.5	closed lichenland	lichenland	open lichenland	sparse lichenland	isolated lichens	isolated clumps of lichens	lichens
vine	<10, 10-30, >30	closed vineland	vineland	open vineland	sparse vineland	isolated vines	isolated clumps of vines	vines
aquatic	0-0.5, <1	closed aquatic bed	aquatic bed	open aquatic bed	sparse aquatics	isolated aquatics	isolated clumps of aquatics	aquatics
seagrass	0-0.5, <1	closed seagrass bed	seagrass bed	open seagrass bed	sparse seagrasses	isolated seagrasses	isolated clumps of seagrasses	seagrasses

APPENDIX A6: DEFINITION OF VEGETATION CONDITION SCALE FOR THE SOUTH WEST AND INTERZONE BOTANICAL PROVINCES

Vegetation condition ratings relate to vegetation structure, level of disturbance at each structural layer and the ability of the vegetation unit to regenerate (Table A5.1). Vegetation condition provides complementary information for assessing the significance of potential impacts.

Table A6.1 Definition of Vegetation Condition Categories

Note: Adapted from Keighery (1994).

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

APPENDIX B: PREVIOUS FLORA AND VEGETATION FIELD SURVEYS CONDUCTED IN THE NORSEMAN AREA, 1989-2019

Note: Threatened and Priority Flora are listed with their status as at March 2020 (WAH 1998-) - see Appendix A for definitions.

SURVEY YEAR (MONTH)	AUTHOR (REPORT YEAR)	LOCATION	PURPOSE	METHODS	FLORA AND VEGETATION RESULTS
1989 (Apr)	Goldfields Environmental Management Pty Ltd (1989)	North: Red, White & Blue Lease (8km south of Norseman)	Flora, vegetation, soils, fauna habitat	2 x sampling sites of 1 ha each All flowering plants and ferns recorded	Flora: 44 flowering plant species Priority flora: 2 species – <i>Philothea apiculata</i> (P2), <i>Eucalyptus brockwayi</i> (P3). Vegetation Communities: 2
1995 (Mar)	Landcare Services Pty Ltd (1995)	North: Harlequin, Active Tailings Dam, North Royal, Bullen Hill, OK, Viking South: Scotia Hill	Baseline vegetation and initial rehabilitation monitoring	Baseline vegetation – 30 sites of 10m x 50m Vegetation composition and structure in five 10m x 10m quadrats at 12 sites Species abundance and foliage cover recorded at 12 sites Species presence/absence recorded at 18 sites	Flora: 263 vascular plant species Threatened flora: 1 – <i>Eucalyptus platydisca</i> (T) Priority flora: 9 - <i>Acacia dorsenna</i> (P1), <i>Eucalyptus jimberlanica</i> (P1), <i>Grevillea phillipsiana</i> (P1), <i>Philothea apiculata</i> (P2), <i>Comesperma calcicola</i> (P3), <i>Eremophila purpurascens</i> (P3), <i>Eucalyptus brockwayi</i> (P3), <i>Darwinia polycephala</i> (P4), <i>Eremophila parvifolia</i> subsp. <i>parvifolia</i> (P4). Vegetation Communities: 14
1995 (Oct)	Landcare Services Pty Ltd (1996)	North: Active Tailings Dam, Golden Dragon, Harlequin, North Royal, Penneshaw, Polar Bear, Venture	Baseline vegetation Phase 2	Baseline vegetation – 13 areas, ?31 sites Similar to March 19995 survey	Flora: 248 vascular plant species (98 additional to March survey) Threatened flora additional to March 1995 survey: 1 – <i>Daviesia microcarpa</i> (T) Priority flora additional to March 1995 survey: 3 – <i>Eucalyptus websteriana</i> subsp. <i>norsemanica</i> (P1), <i>Diocirea microphylla</i> (P3), <i>Phebalium drummondii</i> (P3). Introduced flora species: 2 significant species
1996 (unknown)	Marianna Partners Environmental Services (1996)	South: Mt Henry, Iron Prince	Baseline survey – flora, soil, fauna	Survey area 175 ha Transects	Flora: 253 vascular plant species Priority flora: 2 species – <i>Philothea apiculata</i> (P2), <i>Eucalyptus brockwayi</i> (P3). Introduced flora species: 0 species Vegetation Communities: 4

APPENDIX B: PREVIOUS FLORA AND VEGETATION FIELD SURVEYS CONDUCTED IN THE NORSEMAN AREA, 1989-2019

Note: Threatened and Priority Flora are listed with their status as at March 2020 (WAH 1998-) - see Appendix A for definitions.

SURVEY YEAR (MONTH)	AUTHOR (Report year)	LOCATION	PURPOSE	METHODS	FLORA AND VEGETATION RESULTS
1996 (Sep-Oct)/1997 (June)	Landcare Services Pty Ltd (1997)	North: East Polar Bear, Lady Miller/Penneshaw South: Albion, Bromus/Goodia	Increase knowledge of endemic flora Add to client's reference herbarium Identify priority and threatened flora	Total survey area ~218 km ² 50 sites across 4 areas	Flora: 98 endemic plant species additional to Oct 1995 cumulative total Threatened flora additional to 1995 & 1996 surveys: 1 - <i>Allocasuarina globosa</i> (T) Priority flora additional to 1995 & 1996 surveys: 4 <i>Ptilotus rigidus</i> (P1), <i>Acacia truculenta</i> (P3), <i>Diocirea microphylla</i> (P3), <i>Eremophila parvifolia</i> subsp. <i>parvifolia</i> (P4) Introduced flora species: 7 species
2001 (May)	Mattiske Consulting Pty Ltd (2001a)	North: Gladstone, Daisy	Flora and vegetation survey	Flora and Vegetation Survey: Total survey area ~10 km ² 6 sites	Flora: 144 vascular plant taxa Threatened flora species: 2 species - <i>Daviesia microcarpa</i> (T), <i>Eucalyptus platydisca</i> (T) Priority flora: 2 species – <i>Eremophila purpurascens</i> (P3), <i>Darwinia polycephala</i> (P4) Introduced flora species: 9 species Vegetation Communities: 7
2001 (Jul)	Mattiske Consulting Pty Ltd (2001b)	North: Phoenix and Venture Tailings Storage Facilities	Tree Health	Tree Health Survey: 250 trees (Phoenix), 170 trees (Venture)	Flora: 5 Eucalypt species (Phoenix), 3 Eucalypt species (Venture)
2002 (Aug)	Mattiske Consulting Pty Ltd (2002)	North: Cobbler	Flora and vegetation survey	Vehicle and foot traverse	Flora: 89 vascular plant taxa Threatened flora species: 0 species Priority flora: 3 species Introduced flora species: 1 Vegetation Communities: 15
2003 (June)	Outback Ecology Environmental Management Services (2003)	North: Lake Cowan	Baseline environmental (terrestrial and aquatic flora and fauna) Targeted flora search	5 aquatic sites	Flora: 54 vascular plant taxa Threatened flora species: 0 species Priority flora: 0 species Introduced flora species: 2 Vegetation Communities: 8

APPENDIX B: PREVIOUS FLORA AND VEGETATION FIELD SURVEYS CONDUCTED IN THE NORSEMAN AREA, 1989-2019

Note: Threatened and Priority Flora are listed with their status as at March 2020 (WAH 1998-) - see Appendix A for definitions.

SURVEY YEAR (MONTH)	AUTHOR (Report year)	LOCATION	PURPOSE	METHODS	FLORA AND VEGETATION RESULTS
2004 (Aug)	Paul Armstrong & Associates (2004)	South: North Scotia	Rare flora search Vegetation mapping	Vehicle and foot traverse	Flora: 132 plant taxa Priority flora: 3 species – <i>Drosera salina</i> (P2), <i>Eremophila purpurascens</i> (P3), <i>Melaleuca macronychia</i> subsp. <i>trygonoides</i> (P3). Introduced flora species: 6 Vegetation Communities: 10
2004 (Sep)	Rally Revegetation and Environmental Services (2004)	North: Bullen	Flora and Vegetation survey	Total survey area ~5 ha	Threatened flora species: 0 species Priority flora: 0 species Vegetation Communities: 4
2005 (Feb)	Mattiske Consulting Pty Ltd (2005)	North: Proposed Tailings Dam	Flora and Vegetation survey Vertebrate fauna habitat survey	Vehicle and foot traverse	Flora: 134 plant taxa Threatened flora species: 0 species Priority flora: 3 species – <i>Acacia dorsenna</i> (P1), <i>Eremophila purpurascens</i> (P3), <i>Eucalyptus brockwayi</i> (P3). Introduced flora species: 2 Vegetation Communities: 17
2005 (Aug)	Rally Revegetation and Environmental Services (2005)	North: Daisy, Gladstone, Golden Dragon South: Scotia	Ecosystem Function Analysis of Waste Dumps	Transects 10 m wide x 50 m long with sampling points every 10 m Analogue transects	-
2009 (Sep, Nov)	GHD Pty Ltd (2009)	South: Mt Henry, North Scotia	Targeted Flora	Foot traverse	Threatened flora species: 0 species Priority flora: 3 species – <i>Philothea apiculata</i> (P2), <i>Eremophila purpurascens</i> (P3), <i>Eucalyptus brockwayi</i> (P3).
2010 (Mar)	GHD Pty Ltd (2010a)	South: Mt Henry, North Scotia	Targeted Flora	Foot traverse	Priority flora: 1 species – <i>Philothea apiculata</i> (P2).

APPENDIX B: PREVIOUS FLORA AND VEGETATION FIELD SURVEYS CONDUCTED IN THE NORSEMAN AREA, 1989-2019

Note: Threatened and Priority Flora are listed with their status as at March 2020 (WAH 1998-) - see Appendix A for definitions.

SURVEY YEAR (MONTH)	AUTHOR (Report year)	LOCATION	PURPOSE	METHODS	FLORA AND VEGETATION RESULTS
2010 (Apr)	GHD Pty Ltd (2010b)	South: Brockway Timber Reserve	Baseline flora and flora assessment	Total survey area 300 ha Vehicle and foot traverse	Flora: 116 plant taxa Threatened flora species: 0 species Priority flora: 4 species – <i>Philotheca apiculata</i> (P2), <i>Beyeria sulcata</i> var. <i>truncata</i> (P3), <i>Eremophila purpurascens</i> (P3), <i>Eucalyptus brockwayi</i> (P3). Introduced flora species: 3 Vegetation Communities: 5
2010 (Sep)	Botanica Consulting (2010)	South: Brockway Timber Reserve	Level 1 Flora and Vegetation survey	Total survey area 519 ha	Flora: 139 plant taxa Threatened flora species: 0 species Priority flora: 4 species – <i>Philotheca apiculata</i> (P2), <i>Beyeria sulcata</i> var. <i>truncata</i> (P3), <i>Eremophila purpurascens</i> (P3), <i>Eucalyptus brockwayi</i> (P3). Introduced flora species: 2 Vegetation Communities: 4
2012 (Oct)	Mattiske Consulting Pty Ltd (2013a)	South: Mt Henry, Selene, North Scotia	Level 1 Flora and Vegetation survey Targeted flora (ridges)	66 sites (20 m x 20 m quadrats)	Flora: 150 vascular plant taxa Threatened flora species: 0 species Priority flora: 6 species – <i>Philotheca apiculata</i> (P2), <i>Allocasuarina eriochlamys</i> subsp. <i>grossa</i> (P3), <i>Eremophila purpurascens</i> (P3), <i>Eucalyptus brockwayi</i> (P3), <i>Goodenia laevis</i> subsp. <i>laevis</i> (P3), <i>Melaleuca coccinea</i> (P3). Introduced flora species: 3 Vegetation Communities: 6

APPENDIX B: PREVIOUS FLORA AND VEGETATION FIELD SURVEYS CONDUCTED IN THE NORSEMAN AREA, 1989-2019

Note: Threatened and Priority Flora are listed with their status as at March 2020 (WAH 1998-) - see Appendix A for definitions.

SURVEY YEAR (MONTH)	AUTHOR (Report year)	LOCATION	PURPOSE	METHODS	FLORA AND VEGETATION RESULTS
2013 (June)	Mattiske Consulting Pty Ltd (2013b)	South: Mt Henry, Selene, North Scotia	Level 2 Flora and Vegetation survey Targeted flora (ridges)	Total survey area ~1340 ha 82 sites (20 m x 20 m quadrats)	Flora: 102 vascular plant taxa (additional to 2012 survey) Threatened flora species: 0 species Priority flora: 2 species (additional to 2012 survey) – <i>Eucalyptus jimberlanica</i> (P1), <i>Cyathostemon</i> sp. Salmon Gums (B. Archer 769) (P3). Introduced flora species: 5 (additional to 2012 survey) Vegetation Communities: 11
2015 (Oct)	Umwelt (Australia) Pty Ltd (2016)	South: Maybell	Level 1 Flora and Vegetation survey in support of application for Native Vegetation Clearing Permit	20 sites Vehicle and foot traverse	Flora: 76 vascular plant taxa Threatened flora species: 0 species Priority flora: 5 species – <i>Philothea apiculata</i> (P2), <i>Allocasuarina eriochlamys</i> subsp. <i>grossa</i> (P3), <i>Eremophila purpurascens</i> (P3), <i>Eucalyptus brockwayi</i> (P3), <i>Melaleuca coccinea</i> (P3). Introduced flora species: 3 Vegetation Communities: 9
2019 (Nov)	Native Vegetation Solutions (2019)	South: Maybell, Lord Percy	Targeted Flora	Known locations and likely habitat targeted	Priority flora: 5 species – <i>Eucalyptus jimberlanica</i> (P1), <i>Philothea apiculata</i> (P2), <i>Allocasuarina eriochlamys</i> subsp. <i>grossa</i> (P3), <i>Eremophila purpurascens</i> (P3), <i>Eucalyptus brockwayi</i> (P3).

APPENDIX D: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE CENTRAL NORSEMAN GOLD SURVEY AREAS

Notes: Refer to Appendix A for State (SCC; Department of Biodiversity, Conservation and Attractions 2017a) and Federal (FCC; EPBC Act) conservation code definitions. IBRA Distribution: AVW – Avon Wheatbelt; COO – Coolgardie; ESP – Esperance Plains; GAS – Gascoyne; GES – Geraldton Sandplains; GVD – Great Victoria Desert; LSD – Little Sandy Desert; MAL – Mallee; MUR – Murchison; NUL – Nullarbor; PIL – Pilbara. Likelihood of occurrence in survey area is based on a Low, Moderate or High ranking. Survey Areas: COB – Cobbler; GLA – Gladstone; GNRHR – Gladstone/North Royal Haul Roads; JIPI – Jimberlana Pipeline; MAY – Maybell; NR – North Royal; SCO – Scotia. FB refers to Florabase (WAH 1998-), TPFL is the Department of Biodiversity, Conservation and Attractions' Threatened and Priority Flora database, and WAH is the Western Australian Herbarium.

Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence												
<i>Allocasuarina globosa</i>	Casuarinaceae	T	VU	Habit: Dioecious shrub, to 2 m high. Flower colour: - Flowering period (indicated in green): (flowering period unknown) <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td>J</td><td>F</td><td>M</td><td>A</td><td>M</td><td>J</td><td>J</td><td>A</td><td>S</td><td style="background-color: #90EE90;">O</td><td>N</td><td>D</td> </tr> </table> Soils & landforms: Laterite, rocky clay and loam. Ridges and rocky slopes. Mallee shrubland. IBRA Distribution: COO Florabase records: 32	J	F	M	A	M	J	J	A	S	O	N	D	Medium in North. Medium in South. Habitat occurs in the survey area. Recorded by LS (1997) at Iron King (2.5 km SE of OK). Six locations in TPFL + WAH databases (1989-2008), all at Mt Deans in Brockway Timber Reserve, ~3 km NE of Maybell.
J	F	M	A	M	J	J	A	S	O	N	D						
<i>Daviesia microcarpa</i>	Fabaceae	T	EN	Habit: Sprawling, tangled shrub, to 0.4 m high, ca 1 m wide. Flower colour: orange & red Flowering period (indicated in green): <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td>J</td><td>F</td><td>M</td><td>A</td><td>M</td><td>J</td><td>J</td><td>A</td><td style="background-color: #90EE90;">S</td><td>O</td><td>N</td><td>D</td> </tr> </table> Soils & landforms: Weathered gravel, red-brown loam. Rocky slopes and disturbed areas. IBRA Distribution: COO Florabase records: 10	J	F	M	A	M	J	J	A	S	O	N	D	High in North. Medium in South. Habitat occurs in the survey area. Recorded by LS (1996) and MCPL (2001a), both at Jimberlana Hill (NR & GNRHR). More than 10 locations near Norseman on TPFL + WAH databases (1974-2016), many along JIPI.
J	F	M	A	M	J	J	A	S	O	N	D						
<i>Eucalyptus platydisca</i>	Myrtaceae	T	VU	Habit: Mallee, 2-4 m high, bark smooth. Flower colour: cream Flowering period (indicated in green): <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td>J</td><td>F</td><td>M</td><td style="background-color: #90EE90;">A</td><td>M</td><td>J</td><td style="background-color: #90EE90;">J</td><td>A</td><td>S</td><td>O</td><td>N</td><td>D</td> </tr> </table> Soils & landforms: Granitic soils, clay. Stony hills. IBRA Distribution: COO Florabase records: 41	J	F	M	A	M	J	J	A	S	O	N	D	High in North. Medium in South. Habitat occurs in the survey area. Recorded by LS (1995) and MCPL (2001a), both at Jimberlana Hill (NR & GNRHR). More than 20 locations near Norseman (Jimberlana Hill and Dundas Hills on TPFL + WAH databases (1935-2004)).
J	F	M	A	M	J	J	A	S	O	N	D						

APPENDIX D: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE CENTRAL NORSEMAN GOLD SURVEY AREAS

Notes: Refer to Appendix A for State (SCC; Department of Biodiversity, Conservation and Attractions 2017a) and Federal (FCC; EPBC Act) conservation code definitions. IBRA Distribution: AVW – Avon Wheatbelt; COO – Coolgardie; ESP – Esperance Plains; GAS – Gascoyne; GES – Geraldton Sandplains; GVD – Great Victoria Desert; LSD – Little Sandy Desert; MAL – Mallee; MUR – Murchison; NUL – Nullarbor; PIL – Pilbara. Likelihood of occurrence in survey area is based on a Low, Moderate or High ranking. Survey Areas: COB – Cobbler; GLA – Gladstone; GNRHR – Gladstone/North Royal Haul Roads; JIPI – Jimberlana Pipeline; MAY – Maybell; NR – North Royal; SCO – Scotia. FB refers to Florabase (WAH 1998-), TPFL is the Department of Biodiversity, Conservation and Attractions' Threatened and Priority Flora database, and WAH is the Western Australian Herbarium.

Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence												
<i>Acacia dorsenna</i>	Fabaceae	P1	-	Habit: Dense, domed shrub, 1-1.6 m high, to 3 m wide. Flower colour: yellow Flowering period (indicated in green): <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td>J</td><td>F</td><td>M</td><td>A</td><td>M</td><td>J</td><td>J</td><td>A</td><td>S</td><td>O</td><td>N</td><td>D</td> </tr> </table> Soils & landforms: Rocky sandy loam or clay loam. Low rocky hills. IBRA Distribution: COO Florabase records: 13	J	F	M	A	M	J	J	A	S	O	N	D	Medium in North. Low in South. Habitat occurs in the survey area. Recorded by LS (1995) at Bullen mine and MCPL (2005) on the east flank of Dundas Hills. Only 2 locations near Norseman, Beacon Hill 2002 (OK/TSF4) and west side of town 1969) on TPFL + WAH databases. All other FB records >20km north & west of Norseman.
J	F	M	A	M	J	J	A	S	O	N	D						
<i>Beyeria?opaca</i>	Euphorbiaceae	P1	-	Habit: Erect, compact shrub, to 1 m high. Flower colour: - Flowering period (indicated in green): (flowering period unknown) <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td>J</td><td>F</td><td>M</td><td>A</td><td>M</td><td>J</td><td>J</td><td>A</td><td>S</td><td>O</td><td>N</td><td>D</td> </tr> </table> Soils & landforms: Red sandy clay. Dunes, slopes. IBRA Distribution: COO Florabase records: 2	J	F	M	A	M	J	J	A	S	O	N	D	Low in North. Medium in South. Habitat potentially occurs in the survey area. Recorded by MCPL (2012) ~1.5 km E of the MAY pit survey area (question-marked). Only 2 records in Florabase (1971, 1995), both >75 km E of Norseman.
J	F	M	A	M	J	J	A	S	O	N	D						
<i>Bossiaea arcuata</i>	Fabaceae	P1	-	Habit: Erect, divaricately branched, superficially leafless shrub, to 1.5 m high. Flower colour: red/yellow Flowering period (indicated in green): <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td>J</td><td>F</td><td>M</td><td>A</td><td>M</td><td>J</td><td>J</td><td>A</td><td>S</td><td>O</td><td>N</td><td>D</td> </tr> </table> Soils & landforms: Deep white sand. Edge of salt lakes. IBRA Distribution: COO Florabase records: 12	J	F	M	A	M	J	J	A	S	O	N	D	Low in North. Low in South. Habitat occurs in the survey area. Nine records in TPFL + WAH databases (2000-2009), all 20-25 km SW of Norseman.
J	F	M	A	M	J	J	A	S	O	N	D						

APPENDIX D: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE CENTRAL NORSEMAN GOLD SURVEY AREAS

Notes: Refer to Appendix A for State (SCC; Department of Biodiversity, Conservation and Attractions 2017a) and Federal (FCC; EPBC Act) conservation code definitions. IBRA Distribution: AVW – Avon Wheatbelt; COO – Coolgardie; ESP – Esperance Plains; GAS – Gascoyne; GES – Geraldton Sandplains; GVD – Great Victoria Desert; LSD – Little Sandy Desert; MAL – Mallee; MUR – Murchison; NUL – Nullarbor; PIL – Pilbara. Likelihood of occurrence in survey area is based on a Low, Moderate or High ranking. Survey Areas: COB – Cobbler; GLA – Gladstone; GNRHR – Gladstone/North Royal Haul Roads; JIPI – Jimberlana Pipeline; MAY – Maybell; NR – North Royal; SCO – Scotia. FB refers to Florabase (WAH 1998-), TPFL is the Department of Biodiversity, Conservation and Attractions' Threatened and Priority Flora database, and WAH is the Western Australian Herbarium.

Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence												
<i>Bossiaea aurantiaca</i>	Fabaceae	P1	-	<p>Habit: Compact, rounded or spreading, spinescent shrub, to 1.5 m high.</p> <p>Flower colour: red/yellow</p> <p>Flowering period (indicated in green):</p> <table border="1"> <tr> <td>J</td><td>F</td><td>M</td><td>A</td><td>M</td><td>J</td><td>J</td><td>A</td><td>S</td><td>O</td><td>N</td><td>D</td> </tr> </table> <p>Soils & landforms: Red sand, red clay loam. Low-lying, winter-damp sites.</p> <p>IBRA Distribution: COO</p> <p>Florabase records: 13</p>	J	F	M	A	M	J	J	A	S	O	N	D	<p>High in North. Low in South.</p> <p>Habitat potentially occurs in the survey area.</p> <p>13 records in TPFL + WAH databases (1968-2014), nearest are ~8 km NW of Norseman (W side of Lake Cowan), 1 km from the W side of COB.</p>
J	F	M	A	M	J	J	A	S	O	N	D						
<i>Eucalyptus jimberlanica</i>	Myrtaceae	P1	-	<p>Habit: Mallee or tree, 4-10 m high, bark smooth.</p> <p>Flower colour: pale yellow-yellow-cream</p> <p>Flowering period (indicated in green):</p> <table border="1"> <tr> <td>J</td><td>F</td><td>M</td><td>A</td><td>M</td><td>J</td><td>J</td><td>A</td><td>S</td><td>O</td><td>N</td><td>D</td> </tr> </table> <p>Soils & landforms: Loam. Valley edges.</p> <p>IBRA Distribution: COO</p> <p>Florabase records: 24</p>	J	F	M	A	M	J	J	A	S	O	N	D	<p>High in North. High in South.</p> <p>Habitat occurs in the survey area.</p> <p>Recorded by LS (1995) at Bullen minesite (TSF4) and 15 km S of Norseman (MAY road) and MCPL (2013) just S of the Mt Henry pit (~1 km from the S end of MAY). More than 20 records in TPFL + WAH databases (1967-2018), most at Jimberlana Hill, & various other locations e.g. W of Lake Cowan ~3 km SW of COB, ~2.5 km S of TSF4, NE of Mt Henry pit at MAY.</p>
J	F	M	A	M	J	J	A	S	O	N	D						
<i>Eucalyptus websteriana</i> subsp. <i>norsemanica</i>	Myrtaceae	P1	-	<p>Habit: Spreading mallee to 3 m high, bark 'minni-ritchi'.</p> <p>Flower colour: yellow</p> <p>Flowering period (indicated in green):</p> <table border="1"> <tr> <td>J</td><td>F</td><td>M</td><td>A</td><td>M</td><td>J</td><td>J</td><td>A</td><td>S</td><td>O</td><td>N</td><td>D</td> </tr> </table> <p>Soils & landforms: Rocky rises.</p> <p>IBRA Distribution: COO</p> <p>Florabase records: 15</p>	J	F	M	A	M	J	J	A	S	O	N	D	<p>High in North. Medium in South.</p> <p>Habitat occurs in the survey area.</p> <p>Recorded by LS (1995) at Lake Cowan Causeway (COB) and MCPL (2002) at COB. More than 10 records in TPFL + WAH databases (1974-2008), all just west of Lake Cowan at or near COB.</p>
J	F	M	A	M	J	J	A	S	O	N	D						

APPENDIX D: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE CENTRAL NORSEMAN GOLD SURVEY AREAS

Notes: Refer to Appendix A for State (SCC; Department of Biodiversity, Conservation and Attractions 2017a) and Federal (FCC; EPBC Act) conservation code definitions. IBRA Distribution: AVW – Avon Wheatbelt; COO – Coolgardie; ESP – Esperance Plains; GAS – Gascoyne; GES – Geraldton Sandplains; GVD – Great Victoria Desert; LSD – Little Sandy Desert; MAL – Mallee; MUR – Murchison; NUL – Nullarbor; PIL – Pilbara. Likelihood of occurrence in survey area is based on a Low, Moderate or High ranking. Survey Areas: COB – Cobble; GLA – Gladstone; GNRHR – Gladstone/North Royal Haul Roads; JIPI – Jimberlana Pipeline; MAY – Maybell; NR – North Royal; SCO – Scotia. FB refers to Florabase (WAH 1998-), TPFL is the Department of Biodiversity, Conservation and Attractions' Threatened and Priority Flora database, and WAH is the Western Australian Herbarium.

Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence												
<i>Grevillea phillipsiana</i>	Proteaceae	P1	-	Habit: Prickly shrub, 0.8-1.5 m high. Flower colour: red/red & orange Flowering period (indicated in green): <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td>J</td><td>F</td><td>M</td><td>A</td><td>M</td><td>J</td><td>J</td><td>A</td><td>S</td><td>O</td><td>N</td><td>D</td> </tr> </table> Soils & landforms: Red sand, stony loam. Granite hills. IBRA Distribution: COO, NUL Florabase records: 19	J	F	M	A	M	J	J	A	S	O	N	D	High in North. Medium in South. Habitat occurs in the survey area. Recorded by LS (1995, 1996) at Lake Cowan Causeway. 12 records in TPFL + WAH databases (1951-2002), all just west of Lake Cowan at or near COB.
J	F	M	A	M	J	J	A	S	O	N	D						
<i>Lepidosperma lyonsii</i>	Cyperaceae	P1	-	Habit: Tufted rhizomatous, perennial herb (sedge), leaves 0.31-0.53 m high, culms and leaves distichous. Flower colour: brown-light brown, white Flowering period (indicated in green): <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td>J</td><td>F</td><td>M</td><td>A</td><td>M</td><td>J</td><td>J</td><td>A</td><td>S</td><td>O</td><td>N</td><td>D</td> </tr> </table> Soils & landforms: Pale orange skeletal sandy loam with banded ironstone gravel & rock, well-drained shallow stony loam with quartz. Gentle hill slopes, upper slopes of large hill. IBRA Distribution: COO Florabase records: 48	J	F	M	A	M	J	J	A	S	O	N	D	Low in North. Medium in South. Habitat occurs in the survey area. Recorded by MCPL (2012, 2013) as <i>Lepidosperma</i> aff. <i>lyonsii</i> at 7 sites around the Mt Henry pit (MAY). Florabase (2018) has one nearby record 15 km NW of Norseman.
J	F	M	A	M	J	J	A	S	O	N	D						

APPENDIX D: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE CENTRAL NORSEMAN GOLD SURVEY AREAS

Notes: Refer to Appendix A for State (SCC; Department of Biodiversity, Conservation and Attractions 2017a) and Federal (FCC; EPBC Act) conservation code definitions. IBRA Distribution: AVW – Avon Wheatbelt; COO – Coolgardie; ESP – Esperance Plains; GAS – Gascoyne; GES – Geraldton Sandplains; GVD – Great Victoria Desert; LSD – Little Sandy Desert; MAL – Mallee; MUR – Murchison; NUL – Nullarbor; PIL – Pilbara. Likelihood of occurrence in survey area is based on a Low, Moderate or High ranking. Survey Areas: COB – Cobbler; GLA – Gladstone; GNRHR – Gladstone/North Royal Haul Roads; JIPI – Jimberlana Pipeline; MAY – Maybell; NR – North Royal; SCO – Scotia. FB refers to Florabase (WAH 1998-), TPFL is the Department of Biodiversity, Conservation and Attractions' Threatened and Priority Flora database, and WAH is the Western Australian Herbarium.

Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence												
<i>Micromyrtus papillosa</i>	Myrtaceae	P1	-	<p>Habit: Erect or low, spreading shrub, 0.4-1.2 m high.</p> <p>Flower colour: white</p> <p>Flowering period (indicated in green):</p> <table border="1"> <tr> <td>J</td><td>F</td><td>M</td><td>A</td><td>M</td><td>J</td><td>J</td><td>A</td><td>S</td><td>O</td><td>N</td><td>D</td> </tr> </table> <p>Soils & landforms: Sandy or clay soils, ironstone, granite. Rocky sites, outcrops, on hills from base to summit.</p> <p>IBRA Distribution: COO</p> <p>Florabase records: 16</p>	J	F	M	A	M	J	J	A	S	O	N	D	<p>High in North. Medium in South.</p> <p>Habitat occurs in the survey area. Recorded by LS (1995) at North Royal (NR) and LS (1996) at Bullen Hill North (TSF4) and MCPL (2002) at COB. 16 records in TPFL + WAH databases (1951-2014), most at Jimberlana Hill (NR & GNRHR) and Beacon Hill (OK/TSF4) and also at Brockway Timber Reserve (~5 km N of MAY; 2003) and near the Venture Pit (GNRHR; 1974).</p>
J	F	M	A	M	J	J	A	S	O	N	D						
<i>Philotheca apiculata</i>	Rutaceae	P1	-	<p>Habit: Erect shrub, 0.5-1.5 m high.</p> <p>Flower colour: white-pink</p> <p>Flowering period (indicated in green):</p> <table border="1"> <tr> <td>J</td><td>F</td><td>M</td><td>A</td><td>M</td><td>J</td><td>J</td><td>A</td><td>S</td><td>O</td><td>N</td><td>D</td> </tr> </table> <p>Soils & landforms: Stony clay loam. Rocky outcrops, hillsides.</p> <p>IBRA Distribution: AVW, COO, MAL</p> <p>Florabase records: 28</p>	J	F	M	A	M	J	J	A	S	O	N	D	<p>Medium in North High in South</p> <p>Habitat occurs in the survey area. Recorded by GS (1989) and LS (1996) in the North and LS (1995), Marianna (1996), Botanica (2010), GHD (2010), MCPL (2012, 2013), Umwelt (2016) in the South. More than 20 records in the WAH database (1965-2010), most to the S of Norseman.</p>
J	F	M	A	M	J	J	A	S	O	N	D						
<i>Ptilotus rigidus</i>	Amaranthaceae	P1	-	<p>Habit: Shrub to 0.25 m high.</p> <p>Flower colour: pink</p> <p>Flowering period (indicated in green):</p> <table border="1"> <tr> <td>J</td><td>F</td><td>M</td><td>A</td><td>M</td><td>J</td><td>J</td><td>A</td><td>S</td><td>O</td><td>N</td><td>D</td> </tr> </table> <p>Soils & landforms: Ironstone hills, quartz hills. Associated with salt lakes.</p> <p>IBRA Distribution: COO, MUR</p> <p>Florabase records: 17</p>	J	F	M	A	M	J	J	A	S	O	N	D	<p>Medium in North Low in South</p> <p>Habitat occurs in the survey area. Recorded by LS (1997) at East Polar Bear (~20 km N of NR). One record in WAH database (2015), ~15 km N of NR.</p>
J	F	M	A	M	J	J	A	S	O	N	D						

APPENDIX D: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE CENTRAL NORSEMAN GOLD SURVEY AREAS

Notes: Refer to Appendix A for State (SCC; Department of Biodiversity, Conservation and Attractions 2017a) and Federal (FCC; EPBC Act) conservation code definitions. IBRA Distribution: AVW – Avon Wheatbelt; COO – Coolgardie; ESP – Esperance Plains; GAS – Gascoyne; GES – Geraldton Sandplains; GVD – Great Victoria Desert; LSD – Little Sandy Desert; MAL – Mallee; MUR – Murchison; NUL – Nullarbor; PIL – Pilbara. Likelihood of occurrence in survey area is based on a Low, Moderate or High ranking. Survey Areas: COB – Cobbler; GLA – Gladstone; GNRHR – Gladstone/North Royal Haul Roads; JIPI – Jimberlana Pipeline; MAY – Maybell; NR – North Royal; SCO – Scotia. FB refers to Florabase (WAH 1998-), TPFL is the Department of Biodiversity, Conservation and Attractions' Threatened and Priority Flora database, and WAH is the Western Australian Herbarium.

Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence												
<i>Acacia kerryana</i>	Fabaceae	P2	-	<p>Habit: Low, spreading, domed shrub, 0.3-1 m high.</p> <p>Flower colour: yellow</p> <p>Flowering period (indicated in green):</p> <table border="1"> <tr> <td>J</td><td>F</td><td>M</td><td>A</td><td>M</td><td>J</td><td>J</td><td>A</td><td>S</td><td>O</td><td>N</td><td>D</td> </tr> </table> <p>Soils & landforms: Granitic loamy sand, stony clayey loam or clayey sand. Low stony ridges, undulating plains.</p> <p>IBRA Distribution: COO</p> <p>Florabase records: 16</p>	J	F	M	A	M	J	J	A	S	O	N	D	<p>Medium in North Low in South</p> <p>Habitat occurs in the survey area. Not recorded in any of the previous surveys listed here. Nine records in the TPFL + WAH databases (1980-2014), the most recent ~300 m NE of Jimberlana Hill, one ~700 m N of GNRHR (1991), one ~500 m N of JIPI (1997).</p>
J	F	M	A	M	J	J	A	S	O	N	D						
<i>Aotus</i> sp. Dundas (M.A. Burgman 2835)	Fabaceae	P2	-	<p>Habit: Shrub to 0.8 m high, to 1 m wide.</p> <p>Flower colour: orange, yellow/red, yellow-brown</p> <p>Flowering period (indicated in green):</p> <table border="1"> <tr> <td>J</td><td>F</td><td>M</td><td>A</td><td>M</td><td>J</td><td>J</td><td>A</td><td>S</td><td>O</td><td>N</td><td>D</td> </tr> </table> <p>Soils & landforms: Sand, clayey sand, fine sandy loam. Flats, dunes on edge of salt lake, gentle undulating plains.</p> <p>IBRA Distribution: COO, MAL</p> <p>Florabase records: 23</p>	J	F	M	A	M	J	J	A	S	O	N	D	<p>Low in North Low in South</p> <p>Habitat occurs in the survey area. Not recorded in any of the previous surveys listed here. Four records on the WAH database (1980-2003), one ~1km from MAY (1980), the rest >5 km away.</p>
J	F	M	A	M	J	J	A	S	O	N	D						
<i>Drosera salina</i>	Droseraceae	P2	-	<p>Habit: Erect, flexuose, tuberous, perennial herb to 0.07 m high.</p> <p>Flower colour: white</p> <p>Flowering period (indicated in green):</p> <table border="1"> <tr> <td>J</td><td>F</td><td>M</td><td>A</td><td>M</td><td>J</td><td>J</td><td>A</td><td>S</td><td>O</td><td>N</td><td>D</td> </tr> </table> <p>Soils & landforms: Salt-free white sand. Margins of salt lakes.</p> <p>IBRA Distribution: COO, MAL</p> <p>Florabase records: 14</p>	J	F	M	A	M	J	J	A	S	O	N	D	<p>Low in North Low in South</p> <p>Habitat occurs in the survey area. Recorded by PAA (2004) at edge of Lake Dundas, 2 km NW of the SCO haul road. Next nearest record in FB is 45 km SW of SCO (2014).</p>
J	F	M	A	M	J	J	A	S	O	N	D						

APPENDIX D: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE CENTRAL NORSEMAN GOLD SURVEY AREAS

Notes: Refer to Appendix A for State (SCC; Department of Biodiversity, Conservation and Attractions 2017a) and Federal (FCC; EPBC Act) conservation code definitions. IBRA Distribution: AVW – Avon Wheatbelt; COO – Coolgardie; ESP – Esperance Plains; GAS – Gascoyne; GES – Geraldton Sandplains; GVD – Great Victoria Desert; LSD – Little Sandy Desert; MAL – Mallee; MUR – Murchison; NUL – Nullarbor; PIL – Pilbara. Likelihood of occurrence in survey area is based on a Low, Moderate or High ranking. Survey Areas: COB – Cobbler; GLA – Gladstone; GNRHR – Gladstone/North Royal Haul Roads; JIPI – Jimberlana Pipeline; MAY – Maybell; NR – North Royal; SCO – Scotia. FB refers to Florabase (WAH 1998-), TPFL is the Department of Biodiversity, Conservation and Attractions' Threatened and Priority Flora database, and WAH is the Western Australian Herbarium.

Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence												
<i>Thysanotus brachyantherus</i>	Asparagaceae	P2	-	Habit: Caespitose perennial, herb (with roots becoming tuberous), 0.1-0.4 m high. Flower colour: purple Flowering period (indicated in green): <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td>J</td><td>F</td><td>M</td><td>A</td><td>M</td><td>J</td><td>J</td><td>A</td><td>S</td><td>O</td><td>N</td><td>D</td> </tr> </table> Soils & landforms: Clay over limestone, loam. IBRA Distribution: COO, ESP, MAL, MUR Florabase records: 16	J	F	M	A	M	J	J	A	S	O	N	D	Low in North Low in South Habitat may occur in the survey area. Not recorded in any of the previous surveys listed here. One record on the WWAH database (1980), ~2.5 km N of JIPI.
J	F	M	A	M	J	J	A	S	O	N	D						
<i>Triglochin</i> sp. Condingup (R. Davis 10877)	Juncaginaceae	P2	-	Habit: Aquatic perennial herb to 0.3 m. Flower colour: green Flowering period (indicated in green): <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td>J</td><td>F</td><td>M</td><td>A</td><td>M</td><td>J</td><td>J</td><td>A</td><td>S</td><td>O</td><td>N</td><td>D</td> </tr> </table> Soils & landforms: Brown clay and mud in pools in granite. IBRA Distribution: COO, ESP, MAL Florabase records: 5	J	F	M	A	M	J	J	A	S	O	N	D	Low in North Low in South Habitat may occur in the survey area. Not recorded in any of the previous surveys listed here. One record in WAH database (2011), W of Esperance Hwy, ~10 km W of Scotia.
J	F	M	A	M	J	J	A	S	O	N	D						
<i>Acacia ancistrophylla</i> var. <i>perarcuata</i>	Fabaceae	P3	-	Habit: Rounded or obconic shrub, 0.6-1 m high, to 6 m wide. Flower colour: yellow Flowering period (indicated in green): <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td>J</td><td>F</td><td>M</td><td>A</td><td>M</td><td>J</td><td>J</td><td>A</td><td>S</td><td>O</td><td>N</td><td>D</td> </tr> </table> Soils & landforms: Red sand, clay loam, loam. Undulating plains. IBRA Distribution: AVW, COO, MAL Florabase records: 24	J	F	M	A	M	J	J	A	S	O	N	D	Low in North Low in South Habitat may occur in the survey area. Not recorded in any of the previous surveys listed here. One record in WAH database (1980), ~2.5 km SW of SCO.
J	F	M	A	M	J	J	A	S	O	N	D						

APPENDIX D: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE CENTRAL NORSEMAN GOLD SURVEY AREAS

Notes: Refer to Appendix A for State (SCC; Department of Biodiversity, Conservation and Attractions 2017a) and Federal (FCC; EPBC Act) conservation code definitions. IBRA Distribution: AVW – Avon Wheatbelt; COO – Coolgardie; ESP – Esperance Plains; GAS – Gascoyne; GES – Geraldton Sandplains; GVD – Great Victoria Desert; LSD – Little Sandy Desert; MAL – Mallee; MUR – Murchison; NUL – Nullarbor; PIL – Pilbara. Likelihood of occurrence in survey area is based on a Low, Moderate or High ranking. Survey Areas: COB – Cobbler; GLA – Gladstone; GNRHR – Gladstone/North Royal Haul Roads; JIPI – Jimberlana Pipeline; MAY – Maybell; NR – North Royal; SCO – Scotia. FB refers to Florabase (WAH 1998-), TPFL is the Department of Biodiversity, Conservation and Attractions' Threatened and Priority Flora database, and WAH is the Western Australian Herbarium.

Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence												
<i>Acacia truculenta</i>	Fabaceae	P3	-	Habit: Spreading, straggly, prickly shrub, 0.7-2.2 m high. Flower colour: yellow Flowering period (indicated in green): <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td>J</td><td>F</td><td>M</td><td>A</td><td>M</td><td>J</td><td>J</td><td>A</td><td>S</td><td>O</td><td>N</td><td>D</td> </tr> </table> Soils & landforms: Sand or loam. Flats and gentle slopes. IBRA Distribution: COO, MAL Florabase records: 12	J	F	M	A	M	J	J	A	S	O	N	D	Low in North Low in South Habitat occurs in the survey area. Recorded by LS (1997) ~12 km SW of SCO. Two records in WAH database, the nearest in Brockway Timber Reserve (2003).
J	F	M	A	M	J	J	A	S	O	N	D						
<i>Allocasuarina eriochlamys</i> subsp. <i>grossa</i>	Casuarinaceae	P3	-	Habit: Dioecious or monoecious shrub, 1-3 m high, bracteoles prominently exceeding cone. Flower colour: - Flowering period (indicated in green): (flowering period unknown) <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td>J</td><td>F</td><td>M</td><td>A</td><td>M</td><td>J</td><td>J</td><td>A</td><td>S</td><td>O</td><td>N</td><td>D</td> </tr> </table> Soils & landforms: Stony loam, laterite clay. Granite outcrops. IBRA Distribution: COO, NUL Florabase records: 29	J	F	M	A	M	J	J	A	S	O	N	D	Medium in North High in South Habitat occurs in the survey area. Recorded by LS (1995) at North Royal, MCPL (2012) E of the Mt Henry pit, adjacent to or in MAY, and Umwelt (2016) inside MAY. Twenty records in the WAH database (1935-2007), in and around Norseman.
J	F	M	A	M	J	J	A	S	O	N	D						
<i>Atriplex lindleyi</i> subsp. <i>conduplicata</i>	Chenopodiaceae	P3	-	Habit: Monoecious, short-lived annual or perennial, herb, ca 0.2 m high. Flower colour: - Flowering period (indicated in green): (flowering period unknown) <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td>J</td><td>F</td><td>M</td><td>A</td><td>M</td><td>J</td><td>J</td><td>A</td><td>S</td><td>O</td><td>N</td><td>D</td> </tr> </table> Soils & landforms: Crabhole plains. IBRA Distribution: COO, MUR, PIL Florabase records: 5	J	F	M	A	M	J	J	A	S	O	N	D	Low in North Low in South Habitat may occur in the survey area. Not recorded in any of the previous surveys listed here. One record in WAH database (1997) ~500 m W of OK.
J	F	M	A	M	J	J	A	S	O	N	D						

APPENDIX D: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE CENTRAL NORSEMAN GOLD SURVEY AREAS

Notes: Refer to Appendix A for State (SCC; Department of Biodiversity, Conservation and Attractions 2017a) and Federal (FCC; EPBC Act) conservation code definitions. IBRA Distribution: AVW – Avon Wheatbelt; COO – Coolgardie; ESP – Esperance Plains; GAS – Gascoyne; GES – Geraldton Sandplains; GVD – Great Victoria Desert; LSD – Little Sandy Desert; MAL – Mallee; MUR – Murchison; NUL – Nullarbor; PIL – Pilbara. Likelihood of occurrence in survey area is based on a Low, Moderate or High ranking. Survey Areas: COB – Cobbler; GLA – Gladstone; GNRHR – Gladstone/North Royal Haul Roads; JIPI – Jimberlana Pipeline; MAY – Maybell; NR – North Royal; SCO – Scotia. FB refers to Florabase (WAH 1998-), TPFL is the Department of Biodiversity, Conservation and Attractions' Threatened and Priority Flora database, and WAH is the Western Australian Herbarium.

Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence												
<i>Beyeria sulcata</i> var. <i>truncata</i>	Euphorbiaceae	P3	-	Habit: Shrub to 1.3 m high. Flower colour: - Flowering period (indicated in green): <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td>J</td><td>F</td><td>M</td><td>A</td><td style="background-color: #90EE90;">M</td><td>J</td><td>J</td><td>A</td><td>S</td><td style="background-color: #90EE90;">O</td><td>N</td><td>D</td> </tr> </table> Soils & landforms: Gravelly sand. IBRA Distribution: COO, MAL Florabase records: 7	J	F	M	A	M	J	J	A	S	O	N	D	Low in North High in South Habitat occurs in the survey area. Recorded by LS (1996) at Harlequin (near NR) and Active Tailings Dam (~500 m S of GNRHR), Bot (2010) and GHD (2010) in Brockway Timber Reserve on Banded Iron Formation ridges. Two records in WAH database, from Norseman town (no date) and ~5 km W of COB (2018).
J	F	M	A	M	J	J	A	S	O	N	D						
<i>Chrysocephalum apiculatum</i> subsp. <i>norsemanense</i>	Asteraceae	P3	-	Habit: Annual herb to 0.4 m high. Flower colour: yellow Flowering period (indicated in green): <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td>J</td><td>F</td><td>M</td><td>A</td><td>M</td><td>J</td><td>J</td><td>A</td><td style="background-color: #90EE90;">S</td><td style="background-color: #90EE90;">O</td><td>N</td><td>D</td> </tr> </table> Soils & landforms: Sandy loam and sandy clay. Sandplains. IBRA Distribution: COO, MUR Florabase records: 17	J	F	M	A	M	J	J	A	S	O	N	D	Medium in North Low in South Habitat may occur in the survey area. Not recorded in any of the previous surveys listed here. Seven records in WAH database (1962-1980), five from around GNRHR and JIPI.
J	F	M	A	M	J	J	A	S	O	N	D						
<i>Cyathostemon</i> sp. Salmon Gums (B. Archer 769)	Myrtaceae	P3	-	Habit: Erect, compact shrub, to 3 m high. Flower colour: white Flowering period (indicated in green): <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td>J</td><td>F</td><td>M</td><td>A</td><td style="background-color: #90EE90;">M</td><td>J</td><td>J</td><td>A</td><td>S</td><td style="background-color: #90EE90;">O</td><td style="background-color: #90EE90;">N</td><td>D</td> </tr> </table> Soils & landforms: Orange sand, white sand or sandy clay over granite, light brown clay with gypsum, saline soils. Flats, dry river beds, near claypans. IBRA Distribution: COO, MAL Florabase records: 14	J	F	M	A	M	J	J	A	S	O	N	D	Low in North Low in South Habitat may occur in the survey area. Recorded by MCPL (2013) on the edge of Lake Dundas, E of the North SCO pit (halfway between MAY and SCO). Two records in WAH database (1979, 1997), both ~40 km SW of SCO.
J	F	M	A	M	J	J	A	S	O	N	D						

APPENDIX D: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE CENTRAL NORSEMAN GOLD SURVEY AREAS

Notes: Refer to Appendix A for State (SCC; Department of Biodiversity, Conservation and Attractions 2017a) and Federal (FCC; EPBC Act) conservation code definitions. IBRA Distribution: AVW – Avon Wheatbelt; COO – Coolgardie; ESP – Esperance Plains; GAS – Gascoyne; GES – Geraldton Sandplains; GVD – Great Victoria Desert; LSD – Little Sandy Desert; MAL – Mallee; MUR – Murchison; NUL – Nullarbor; PIL – Pilbara. Likelihood of occurrence in survey area is based on a Low, Moderate or High ranking. Survey Areas: COB – Cobbler; GLA – Gladstone; GNRHR – Gladstone/North Royal Haul Roads; JIPI – Jimberlana Pipeline; MAY – Maybell; NR – North Royal; SCO – Scotia. FB refers to Florabase (WAH 1998-), TPFL is the Department of Biodiversity, Conservation and Attractions' Threatened and Priority Flora database, and WAH is the Western Australian Herbarium.

Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence												
<i>Diocirea microphylla</i>	Scrophulariaceae	P3	-	Habit: Rounded shrub, 0.45-0.9 m high, to 1 m wide. Flower colour: white, red Flowering period (indicated in green): <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td>J</td><td>F</td><td>M</td><td>A</td><td>M</td><td>J</td><td>J</td><td>A</td><td>S</td><td>O</td><td>N</td><td>D</td> </tr> </table> Soils & landforms: Red-brown clay loam. IBRA Distribution: COO Florabase records: 18	J	F	M	A	M	J	J	A	S	O	N	D	Low in North Low in South Habitat may occur in the survey area. Recorded by LS (1997) at Albion, between MAY and SCO. No nearby records in TPFL + WAH databases, nor in FB.
J	F	M	A	M	J	J	A	S	O	N	D						
<i>Eremophila purpurascens</i>	Scrophulariaceae	P3	-	Habit: Erect, bushy shrub, 0.3-1.5 m high. Flower colour: pink & purple/red Flowering period (indicated in green): <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td>J</td><td>F</td><td>M</td><td>A</td><td>M</td><td>J</td><td>J</td><td>A</td><td>S</td><td>O</td><td>N</td><td>D</td> </tr> </table> Soils & landforms: Sandy clay, stony loam over greenstone. Granite hills & rocks. IBRA Distribution: COO Florabase records: 35	J	F	M	A	M	J	J	A	S	O	N	D	High in North High in South Habitat occurs in the survey area. Recorded by 6 previous surveys in the North (1995-2005) and 7 in the South (1995-2016). 30 records in WAH database (1931-2018), throughout both North and South survey areas.
J	F	M	A	M	J	J	A	S	O	N	D						
<i>Eucalyptus brockwayi</i>	Myrtaceae	P3	-	Habit: Tree, 5-20 m high, bark smooth. Flower colour: white-cream Flowering period (indicated in green): <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td>J</td><td>F</td><td>M</td><td>A</td><td>M</td><td>J</td><td>J</td><td>A</td><td>S</td><td>O</td><td>N</td><td>D</td> </tr> </table> Soils & landforms: Gravelly sandy loam. Low rocky hills & slopes. IBRA Distribution: COO, MAL Florabase records: 76	J	F	M	A	M	J	J	A	S	O	N	D	High in North Medium in South Habitat occurs in the survey area. Recorded by 4 previous surveys in the North (1989-2005) and 6 in the South (1996-2016). 73 records in WAH database (1936-2018), around Norseman and all N of SCO.
J	F	M	A	M	J	J	A	S	O	N	D						

APPENDIX D: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE CENTRAL NORSEMAN GOLD SURVEY AREAS

Notes: Refer to Appendix A for State (SCC; Department of Biodiversity, Conservation and Attractions 2017a) and Federal (FCC; EPBC Act) conservation code definitions. IBRA Distribution: AVW – Avon Wheatbelt; COO – Coolgardie; ESP – Esperance Plains; GAS – Gascoyne; GES – Geraldton Sandplains; GVD – Great Victoria Desert; LSD – Little Sandy Desert; MAL – Mallee; MUR – Murchison; NUL – Nullarbor; PIL – Pilbara. Likelihood of occurrence in survey area is based on a Low, Moderate or High ranking. Survey Areas: COB – Cobbler; GLA – Gladstone; GNRHR – Gladstone/North Royal Haul Roads; JIPI – Jimberlana Pipeline; MAY – Maybell; NR – North Royal; SCO – Scotia. FB refers to Florabase (WAH 1998-), TPFL is the Department of Biodiversity, Conservation and Attractions' Threatened and Priority Flora database, and WAH is the Western Australian Herbarium.

Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence												
<i>Eucalyptus pterocarpa</i>	Myrtaceae	P3	-	<p>Habit: Tree, to 15 m high, bark smooth throughout, becoming ribbony, light grey over salmon cream.</p> <p>Flower colour: -</p> <p>Flowering period (indicated in green): (flowering period unknown)</p> <table border="1"> <tr> <td>J</td><td>F</td><td>M</td><td>A</td><td>M</td><td>J</td><td>J</td><td>A</td><td>S</td><td>O</td><td>N</td><td>D</td> </tr> </table> <p>Soils & landforms: Red-brown sandy loam, yellow-brown silty loam. Creek edges, rocky slopes.</p> <p>IBRA Distribution: COO</p> <p>Florabase records: 17</p>	J	F	M	A	M	J	J	A	S	O	N	D	<p>Low in North Low in South</p> <p>Some habitat occurs in the survey area. Not recorded in any of the previous surveys listed here. 14 records in WAH database (1942-2018), all >5 km W of COB.</p>
J	F	M	A	M	J	J	A	S	O	N	D						
<i>Goodenia laevis</i> subsp. <i>laevis</i>	Goodeniaceae	P3	-	<p>Habit: Erect, woody shrub (subshrub), 0.1-0.25 m high, largest leaves 15-25 x 1-3mm, entire.</p> <p>Flower colour: yellow</p> <p>Flowering period (indicated in green):</p> <table border="1"> <tr> <td>J</td><td>F</td><td>M</td><td>A</td><td>M</td><td>J</td><td>J</td><td>A</td><td>S</td><td>O</td><td>N</td><td>D</td> </tr> </table> <p>Soils & landforms: Sandy loam or laterite</p> <p>IBRA Distribution: COO, ESP, MAL</p> <p>Florabase records: 20</p>	J	F	M	A	M	J	J	A	S	O	N	D	<p>Low in North High in South</p> <p>Habitat occurs in the survey area. Recorded by MCPL (2012, 2013) just W of Mt Henry pit and in MAY. 3 records in WAH database (1999-2001), 2 in Brockway Timber Reserve halfway between OK and MAY.</p>
J	F	M	A	M	J	J	A	S	O	N	D						
<i>Melaleuca coccinea</i>	Myrtaceae	P3	-	<p>Habit: Much branched shrub, 1.5-2.6 m high, leaf blade elliptic to ovate, 1.5-2.2 times as long as wide.</p> <p>Flower colour: red</p> <p>Flowering period (indicated in green):</p> <table border="1"> <tr> <td>J</td><td>F</td><td>M</td><td>A</td><td>M</td><td>J</td><td>J</td><td>A</td><td>S</td><td>O</td><td>N</td><td>D</td> </tr> </table> <p>Soils & landforms: Sandy loam over granite. Granite outcrops, sandplain, river valleys.</p> <p>IBRA Distribution: COO, ESP</p> <p>Florabase records: 33</p>	J	F	M	A	M	J	J	A	S	O	N	D	<p>Low in North High in South</p> <p>Habitat occurs in the survey area. Recorded by MCPL (2012) and Umwelt (2016), both inside MAY. 4 records in WAH database (1967-2003), the nearest inside MAY (1998).</p>
J	F	M	A	M	J	J	A	S	O	N	D						

APPENDIX D: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE CENTRAL NORSEMAN GOLD SURVEY AREAS

Notes: Refer to Appendix A for State (SCC; Department of Biodiversity, Conservation and Attractions 2017a) and Federal (FCC; EPBC Act) conservation code definitions. IBRA Distribution: AVW – Avon Wheatbelt; COO – Coolgardie; ESP – Esperance Plains; GAS – Gascoyne; GES – Geraldton Sandplains; GVD – Great Victoria Desert; LSD – Little Sandy Desert; MAL – Mallee; MUR – Murchison; NUL – Nullarbor; PIL – Pilbara. Likelihood of occurrence in survey area is based on a Low, Moderate or High ranking. Survey Areas: COB – Cobbler; GLA – Gladstone; GNRHR – Gladstone/North Royal Haul Roads; JIPI – Jimberlana Pipeline; MAY – Maybell; NR – North Royal; SCO – Scotia. FB refers to Florabase (WAH 1998-), TPFL is the Department of Biodiversity, Conservation and Attractions' Threatened and Priority Flora database, and WAH is the Western Australian Herbarium.

Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence												
<i>Melaleuca macronychia</i> subsp. <i>trygonoides</i>	Myrtaceae	P3	-	<p>Habit: Multi-stemmed, spreading shrub, 1-4 m high, leaves broadly elliptic.</p> <p>Flower colour: red</p> <p>Flowering period (indicated in green):</p> <table border="1"> <tr> <td>J</td><td>F</td><td>M</td><td>A</td><td>M</td><td>J</td><td>J</td><td>A</td><td>S</td><td>O</td><td>N</td><td>D</td> </tr> </table> <p>Soils & landforms: Sandy soils. Granite outcrops.</p> <p>IBRA Distribution: COO, MAL</p> <p>Florabase records: 20</p>	J	F	M	A	M	J	J	A	S	O	N	D	<p>Low in North Medium in South</p> <p>Habitat occurs in the survey area. Recorded by PAA (2004) ~1 km E of the SCO Haul Road. This is the only record in the WAH database.</p>
J	F	M	A	M	J	J	A	S	O	N	D						
<i>Notisia intonsa</i>	Asteraceae	P3	-	<p>Habit: Annual herb, stem and major branches prostrate to erect, 2.5-15 cm long.</p> <p>Flower colour: pink, brown, grey</p> <p>Flowering period (indicated in green):</p> <table border="1"> <tr> <td>J</td><td>F</td><td>M</td><td>A</td><td>M</td><td>J</td><td>J</td><td>A</td><td>S</td><td>O</td><td>N</td><td>D</td> </tr> </table> <p>Soils & landforms: Brown stony saline loams, brown cracking clays, gilgai plains.</p> <p>IBRA Distribution: AVW, COO, ESP, MAL, MUR</p> <p>Florabase records: 25</p>	J	F	M	A	M	J	J	A	S	O	N	D	<p>Low in North Low in South</p> <p>Habitat may occur in the survey area. Not recorded in any of the previous surveys listed here. Two records in WAH database, one ~500 m NW of COB (1999) and the other <1 km from GNRHR (1974).</p>
J	F	M	A	M	J	J	A	S	O	N	D						
<i>Phlegmatospermum eremaeum</i>	Brassicaceae	P3	-	<p>Habit: Prostrate to spreading annual herb, to 0.1 m high.</p> <p>Flower colour: white-cream</p> <p>Flowering period (indicated in green):</p> <table border="1"> <tr> <td>J</td><td>F</td><td>M</td><td>A</td><td>M</td><td>J</td><td>J</td><td>A</td><td>S</td><td>O</td><td>N</td><td>D</td> </tr> </table> <p>Soils & landforms: Stony loam or clay on slopes and plains.</p> <p>IBRA Distribution: AVW, COO, HAM, MAL, NUL</p> <p>Florabase records: 16</p>	J	F	M	A	M	J	J	A	S	O	N	D	<p>Low in North Low in South</p> <p>Habitat may occur in the survey area. Not recorded in any of the previous surveys listed here. One WAH database record, ~4 km NW of COB (1951).</p>
J	F	M	A	M	J	J	A	S	O	N	D						

APPENDIX D: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE CENTRAL NORSEMAN GOLD SURVEY AREAS

Notes: Refer to Appendix A for State (SCC; Department of Biodiversity, Conservation and Attractions 2017a) and Federal (FCC; EPBC Act) conservation code definitions. IBRA Distribution: AVW – Avon Wheatbelt; COO – Coolgardie; ESP – Esperance Plains; GAS – Gascoyne; GES – Geraldton Sandplains; GVD – Great Victoria Desert; LSD – Little Sandy Desert; MAL – Mallee; MUR – Murchison; NUL – Nullarbor; PIL – Pilbara. Likelihood of occurrence in survey area is based on a Low, Moderate or High ranking. Survey Areas: COB – Cobbler; GLA – Gladstone; GNRHR – Gladstone/North Royal Haul Roads; JIPI – Jimberlana Pipeline; MAY – Maybell; NR – North Royal; SCO – Scotia. FB refers to Florabase (WAH 1998-), TPFL is the Department of Biodiversity, Conservation and Attractions' Threatened and Priority Flora database, and WAH is the Western Australian Herbarium.

Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence
<i>Pityrodia chrysocalyx</i>	Lamiaceae	P3	-	Habit: Erect, branched shrub, 0.3-0.75(-1) m high. Flower colour: white Flowering period (indicated in green): J F M A M J J A S O N D Soils & landforms: Sandy soils. IBRA Distribution: COO, MAL Florabase records: 19	Low in North Low in South Habitat may occur in the survey area. Not recorded in any of the previous surveys listed here. 3 records in WAH database (1967-2002), the most recent ~1 km NW of COB.
<i>Darwinia polycephala</i>	Myrtaceae	P4	-	Habit: Diffuse shrub, 0.1-0.5 m high. Flower colour: red-purple Flowering period (indicated in green): J F M A M J J A S O N D Soils & landforms: Sand, clay. Flats, near salt lakes. IBRA Distribution: MAL Florabase records: 34	Medium in North Low in South Habitat may occur in the survey area. Recorded by LS (1995, 1996) <1 km NW of NR and MCPL (2001) inside GLA. 0 records in WAH database. Nearest FB record >50 km to S of survey areas.
<i>Eremophila parvifolia</i> subsp. <i>parvifolia</i>	Scrophulariaceae	P4	-	Habit: Low, divaricate shrub, 0.15-0.7 m high. Flower colour: blue-purple Flowering period (indicated in green): J F M A M J J A S O N D Soils & landforms: Loam, yellow sand, clay, limestone. Plains, claypans. IBRA Distribution: COO, MAL, NUL. Florabase records: 12	Low in North Low in South Habitat may occur in the survey area. Recorded by LS (1997) ~20 km N of NR. 0 records in WAH database. The nearest FB record is > 50 km to the E of the survey areas.

APPENDIX D: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE CENTRAL NORSEMAN GOLD SURVEY AREAS

Notes: Refer to Appendix A for State (SCC; Department of Biodiversity, Conservation and Attractions 2017a) and Federal (FCC; EPBC Act) conservation code definitions. IBRA Distribution: AVW – Avon Wheatbelt; COO – Coolgardie; ESP – Esperance Plains; GAS – Gascoyne; GES – Geraldton Sandplains; GVD – Great Victoria Desert; LSD – Little Sandy Desert; MAL – Mallee; MUR – Murchison; NUL – Nullarbor; PIL – Pilbara. Likelihood of occurrence in survey area is based on a Low, Moderate or High ranking. Survey Areas: COB – Cobbler; GLA – Gladstone; GNRHR – Gladstone/North Royal Haul Roads; JIPI – Kimberlana Pipeline; MAY – Maybell; NR – North Royal; SCO – Scotia. FB refers to Florabase (WAH 1998-), TPFL is the Department of Biodiversity, Conservation and Attractions' Threatened and Priority Flora database, and WAH is the Western Australian Herbarium.

Species	Family	SCC	FCC	Description and Habitat	Likelihood of Occurrence												
<i>Frankenia glomerata</i>	Frankeniaceae	P4	-	Habit: Prostrate shrub. Flower colour: pink-white Flowering period (indicated in green): <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td>J</td><td>F</td><td>M</td><td>A</td><td>M</td><td>J</td><td>J</td><td>A</td><td>S</td><td>O</td><td style="background-color: #90EE90;">N</td><td>D</td> </tr> </table> Soils & landforms: White sand. IBRA Distribution: AVW, COO, GAS, GES, GVD, LSD, MAL Florabase records: 65	J	F	M	A	M	J	J	A	S	O	N	D	Low in North Low in South Habitat may occur in the survey area. Not recorded in any of the previous surveys listed here. One record in TPFL + WAH database (2000) ~3 km N of JIPI.
J	F	M	A	M	J	J	A	S	O	N	D						
<i>Myriophyllum petraeum</i>	Haloragaceae	P4	-	Habit: Aquatic, annual herb, stems to 0.3 m long. Flower colour: white Flowering period (indicated in green): <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td>J</td><td>F</td><td>M</td><td>A</td><td>M</td><td>J</td><td>J</td><td style="background-color: #90EE90;">A</td><td style="background-color: #90EE90;">S</td><td style="background-color: #90EE90;">O</td><td style="background-color: #90EE90;">N</td><td style="background-color: #90EE90;">D</td> </tr> </table> Soils & landforms: Restricted to ephemeral rockpools on granite outcrops. IBRA Distribution: AVW, COO, ESP, MAL Florabase records: 55	J	F	M	A	M	J	J	A	S	O	N	D	Low in North Low in South Habitat may occur in the survey area. Not recorded in any of the previous surveys listed here. 11 records in TPFL + WAH databases (1976-2011), the most recent ~10 km W of SCO and next nearest ~10 km W of MAY (2000)
J	F	M	A	M	J	J	A	S	O	N	D						

APPENDIX E: SITE LOCATIONS FOR THE CENTRAL NORSEMAN GOLD PROJECT SURVEY AREAS,
MARCH-APRIL 2020

Note: Site prefix GL indicates Gladstone area, HA is Gladstone area Haul Roads, JI is Jemberlana Pipeline, NR is North Royal area and pipeline, SC is Scotia area and Haul Road. Datum is GDA94 and UTM zone is 51H.

SITE	EASTING	NORTHING
GL01	391822	6440298
GL02	391765	6440462
GL03	391886	6440847
GL04	392940	6440591
GL05	393443	6438776
GL06	393353	6438556
GL07	393811	6438337
GL08	393465	6438298
GL09	393910	6438048
GL10	394134	6438220
GL11	392950	6437474
GL12	392817	6437616
GL13	392602	6438087
GL14	392756	6437870
GL15	392089	6438820
GL16	392243	6438770
GL17	391517	6439374
GL18	392701	6441310
GL19	393027	6441361
GL20	392686	6441240
HA01	387192	6439770
HA02	385986	6439414
HA03	386090	6439281
HA04	388912	6441657
HA05	388281	6441939
HA06	387795	6442016
HA07	387415	6442044

SITE	EASTING	NORTHING
JI01	395331	6443314
JI02	394935	6443288
JI03	394623	6443152
JI04	393443	6443153
JI05	393068	6443123
JI06	392770	6443151
JI07	392329	6443174
JI08	391990	6443208
JI09	391518	6443208
JI10	390842	6442855
JI11	390224	6442456
JI12	389524	6441840
NR01	387150	6443875
NR02	387302	6444178
NR03	387149	6444260
NR04	387463	6444486
NR05	387263	6444951
NR06	387037	6444834
NR07	386600	6445354
NR08	386651	6445849
NR09	386771	6446007
NR10	386648	6445605
NR11	388894	6446295
NR12	388797	6446096
NR13	388884	6445942
NR14	388869	6446053
NR15	388568	6445773
NR16	388204	6445678
NR17	387931	6444799
NR18	387675	6443602
NR19	387375	6443377
NR20	387302	6443032
NR21	387305	6442600
NR22	387316	6442409

SITE	EASTING	NORTHING
SC01	382026	6413846
SC02	382212	6413529
SC03	382131	6413663
SC04	382397	6412901
SC05	382557	6412500
SC06	382661	6412128
SC07	383043	6410790
SC08	383257	6410347
SC09	383413	6410157
SC10	383555	6409749
SC11	383574	6409507
SC12	384479	6408976
SC13	384779	6408939
SC14	385328	6409183
SC15	385324	6409097
SC16	385568	6408367
SC17	386058	6408311
SC18	386107	6407706
SC19	386622	6407460
SC20	387126	6407431
SC21	386939	6406923
SC22	386872	6406129
SC23	387585	6406605
SC24	387184	6406132
SC25	387552	6406116
SC26	387662	6406119
SC27	387250	6405926
SC28	387123	6405513
SC29	387373	6405193
SC30	387115	6405165
SC31	386852	6405191
SC32	386625	6405346
SC33	386771	6405475
SC34	386669	6405707
SC35	385976	6405762
SC36	385477	6405719
SC37	385483	6406136
SC38	385796	6406284
SC39	385994	6406404
SC40	385710	6407181

APPENDIX G: A SUMMARY OF VEGETATION COMMUNITIES RECORDED WITHIN THE NORTHERN SURVEY AREAS, APRIL 2020

Vegetation Community Description

Vegetation map code: NW1

Structural

Closed low mallet forest of *Eucalyptus prolixa*.

Associated species

?*Daviesia* sp.

Soils and Landforms: Red-brown clayey loam flats with deep litter.

Outcropping: Absent.

Total Area: 1.0 ha

Proportion of total survey area: 0.05 %

Number of Quadrats: 1

Species richness: 2.0 ± 0.0 (s.e.)

Representative Photograph



Quadrat GL20

APPENDIX G: A SUMMARY OF VEGETATION COMMUNITIES RECORDED WITHIN THE NORTHERN SURVEY AREAS, APRIL 2020

Vegetation Community Description

Vegetation map code: NW2

Structural

Open mallee woodland of *Eucalyptus planipes* and occasional *Eucalyptus longissima* over sparse mid-low shrubland of *Allocasuarina helmsii*, *Eremophila* spp. and ?*Westringia rigida* over open-sparse low hummock grassland of *Triodia scariosa*.

Associated species

Grevillea anethifolia, *Melaleuca* spp.

Soils and Landforms: Occasionally rocky red-brown sandy clayey loam on flats to mid-slopes.

Outcropping: Occasional, granite.

Total Area: 67.4 ha

Proportion of total survey area: 3.43 %

Number of Quadrats: 7


Species richness: 11.3 ± 0.9 (s.e.)

Representative Photograph




Quadrat JI06


APPENDIX G: A SUMMARY OF VEGETATION COMMUNITIES RECORDED WITHIN THE NORTHERN SURVEY AREAS, APRIL 2020

Vegetation Community Description	
Vegetation map code: NW2a	
Structural	
Isolated clumps of <i>Eucalyptus ?oleosa</i> subsp. <i>oleosa</i> low mallees over tall <i>Acacia</i> sp. shrubland over isolated clumps of <i>Grevillea anethifolia</i> mid shrubs over isolated clumps of <i>Triodia scariosa</i> mid hummock grass.	
Associated species	
<i>Allocasuarina helmsii</i> , <i>Eremophila ?ionantha</i>	
Soils and Landforms: Red-brown sandy clayey loam in a creekline.	
Outcropping: Absent	
Total Area: 1.0 ha	Proportion of total survey area: 0.05 %
Number of Quadrats: 1	Species richness: 8.0 ± 0.0 (s.e.)
Representative Photograph	
	
Quadrat JI07	


APPENDIX G: A SUMMARY OF VEGETATION COMMUNITIES RECORDED WITHIN THE NORTHERN SURVEY AREAS, APRIL 2020

Vegetation Community Description	
Vegetation map code: NW2b	
Structural	
Isolated clumps of <i>Eucalyptus planipes</i> mallees over mid sparse shrubland of <i>Acacia</i> sp., <i>Senna artemisioides</i> ?subsp. <i>filifolia</i> and <i>Eremophila</i> ? <i>deserti</i> over low open shrubland of <i>Dodonaea</i> ? <i>microzyga</i> .	
Associated species	
<i>Eremophila</i> ? <i>ionantha</i>	
Soils and Landforms: Red-brown sandy loam on mid slopes with evidence of sheet flow.	
Outcropping: Absent.	
Total Area: 0.6 ha	Proportion of total survey area: 0.03 %
Number of Quadrats: 1	Species richness: 10.0 ± 0.0 (s.e.)
Representative Photograph	
	
Quadrat J109	


APPENDIX G: A SUMMARY OF VEGETATION COMMUNITIES RECORDED WITHIN THE NORTHERN SURVEY AREAS, APRIL 2020

Vegetation Community Description	
Vegetation map code: NW3	
Structural	
Open low woodland of <i>Eucalyptus lesouefii</i> over open shrubland of <i>Melaleuca quadrifaria</i> over <i>Dodonaea stenozyga</i> and <i>Cratystylis conocephala</i> .	
Associated species	
-	
Soils and Landforms: Brown clay on low rises.	
Outcropping: Absent.	
Total Area: 3.4 ha	Proportion of total survey area: 0.17 %
Number of Quadrats: 1	Species richness: 4.0 ± 0.0 (s.e.)
Representative Photograph	
	
Quadrat NR09	


APPENDIX G: A SUMMARY OF VEGETATION COMMUNITIES RECORDED WITHIN THE NORTHERN SURVEY AREAS, APRIL 2020

Vegetation Community Description	
Vegetation map code: NW4	
Structural Open low woodland of <i>Eucalyptus lesouefii</i> over tall isolated clumps of <i>Melaleuca ?sheathiana</i> and <i>Eremophila</i> spp. shrubs over low isolated clumps of <i>Cratystylis conocephala</i> shrubs.	
Associated species <i>Atriplex ?vesicaria</i> .	
Soils and Landforms: Brown sandy clayey loam with some surface rocks on flats and gentle slopes.	
Outcropping: Absent.	
Total Area: 58.2 ha	Proportion of survey area: 2.96 %
Number of Quadrats: 6	Species richness: 10.7 ± 2.2 (s.e.)
Representative Photograph	
	
Quadrat NR13	


APPENDIX G: A SUMMARY OF VEGETATION COMMUNITIES RECORDED WITHIN THE NORTHERN SURVEY AREAS, APRIL 2020

Vegetation Community Description	
Vegetation map code: NW5	
Structural	
Mid woodland of <i>Eucalyptus lesouefii</i> and <i>Eucalyptus salubris</i> over mid isolated shrubs of <i>Eremophila scoparia</i> and occasional low <i>E. parvifolia</i> subsp. <i>?parvifolia</i> (P4) shrubs over open low chenopod shrubland of <i>Tecticornia</i> sp. 3 and <i>Atriplex ?vesicaria</i> .	
Associated species	
<i>Maireana</i> spp.	
Soils and Landforms: Orange to brown sandy clay with some surface gravel on flats and gentle slopes.	
Outcropping: Absent.	
Total Area: 288.8 ha	Proportion of total survey area: 14.71 %
Number of Quadrats: 9	Species richness: 8.7 ± 0.9 (s.e.)
Representative Photograph	
	
Quadrat NR17	


APPENDIX G: A SUMMARY OF VEGETATION COMMUNITIES RECORDED WITHIN THE NORTHERN SURVEY AREAS, APRIL 2020

Vegetation Community Description	
<p>Vegetation map code: NW6</p> <p>Structural</p> <p>Mid woodland of <i>Eucalyptus salubris</i> over isolated tall <i>Santalum acuminatum</i> shrubs over isolated mid <i>Eremophila</i> spp. shrubs over low sparse shrubland of <i>Atriplex ?vesicaria</i>, <i>Cratystylis conocephala</i> and <i>Olearia muelleri</i>.</p> <p>Associated species</p> <p><i>Exocarpos aphyllus</i>, <i>?Geijera linearifolia</i>, <i>Scaevola spinescens</i>.</p> <p>Soils and Landforms: Red-brown clayey loam with occasional surface rocks on ridges and upland flats.</p> <p>Outcropping: Absent.</p> <p>Total Area: 64.8 ha</p> <p>Number of Quadrats: 3</p> <p>Proportion of total survey area: 3.30 %</p> <p>Species richness: 13.3 ± 0.7 (s.e.)</p>	
Representative Photograph	
 <p>Quadrat GL05</p>	


APPENDIX G: A SUMMARY OF VEGETATION COMMUNITIES RECORDED WITHIN THE NORTHERN SURVEY AREAS, APRIL 2020

Vegetation Community Description	
<p>Vegetation map code: NW7</p> <p>Structural</p> <p>Low woodland of <i>Eucalyptus salubris</i> and <i>E. lesouefii</i> over tall sparse shrubland of <i>Melaleuca ?sheathiana</i> or <i>M. lanceolata</i> over mid-low sparse shrubland of <i>Atriplex ?nummularia</i> and <i>Atriplex ?vesicaria</i>.</p> <p>Associated species</p> <p><i>Eremophila scoparia</i>, <i>Santalum acuminatum</i></p> <p>Soils and Landforms: Red to brown sandy clay with scattered surface rocks on flats and lower slopes.</p> <p>Outcropping:</p> <p>Total area: 55.7 ha Proportion of total survey area: 2.84 %</p> <p>Number of Quadrats: 5 Species richness: 12.0 ± 0.6 (s.e.)</p>	
Representative Photograph	
	
<p>Quadrat NR07</p>	


APPENDIX G: A SUMMARY OF VEGETATION COMMUNITIES RECORDED WITHIN THE NORTHERN SURVEY AREAS, APRIL 2020

Vegetation Community Description	
Vegetation map code: NW8	
Structural	
Open low woodland of <i>Eucalyptus torquata</i> over mid sparse shrubland of <i>Beyeria sulcata</i> var. <i>brevipes</i> and <i>Eremophila</i> spp. over low isolated clumps of shrubs of <i>Scaevola spinescens</i> , <i>Atriplex?vesicaria</i> and <i>Olearia muelleri</i> .	
Associated species	
Soils and Landforms: Red to brown clayey loam on lower slopes.	
Outcropping: Absent.	
Total area: 12.9 ha	Proportion of total survey area: 0.66 %
Number of Quadrats: 2	Species richness: 14.0 ± 0.0 (s.e.)
Representative Photograph	
	
Quadrat HA05	


APPENDIX G: A SUMMARY OF VEGETATION COMMUNITIES RECORDED WITHIN THE NORTHERN SURVEY AREAS, APRIL 2020

Vegetation Community Description	
Vegetation map code: NW9	
Structural	
Low woodland of <i>Eucalyptus spreata</i> over isolated samphire shrubs of <i>Tecticornia</i> sp. 3 and isolated tussock grassland of <i>Poaceae</i> sp. 3.	
Associated species	
<i>Scaevola spinescens</i>	
Soils and Landforms: Dry, powdery cream clayey loam on low dunes ridges near salt lakes.	
Outcropping: Absent.	
Total area: 10.3 ha	Proportion of total survey area: 0.53 %
Number of Quadrats: 1	Species richness: 6.0 ± 0.0 (s.e.)
Representative Photograph	
	
Quadrat GL01	


APPENDIX G: A SUMMARY OF VEGETATION COMMUNITIES RECORDED WITHIN THE NORTHERN SURVEY AREAS, APRIL 2020

Vegetation Community Description	
Vegetation map code: NW10	
Structural	
Mid woodland of mixed <i>Eucalyptus</i> spp. over tall sparse shrubland of <i>Melaleuca ?sheathiana</i> over open mid-low shrubland of <i>Atriplex ?nummularia</i> and <i>A. ?vesicaria</i> .	
Associated species	
<i>Eucalyptus distuberosa</i> subsp. <i>distuberosa</i> , <i>E. dundasii</i> , <i>E. ?urna</i> , <i>?Geijera linearifolia</i> .	
Soils and Landforms: Brown clayey loam with some surface rocks on gentle mid slopes.	
Outcropping: Absent.	
Total area: 35.2 ha	Proportion of total survey area: 1.79 %
Number of Quadrats: 5	Species richness: 8.20 ± 0.4 (s.e.)
Representative Photograph	
	
Quadrat HA02	

APPENDIX G: A SUMMARY OF VEGETATION COMMUNITIES RECORDED WITHIN THE NORTHERN SURVEY AREAS, APRIL 2020

Vegetation Community Description	
Vegetation map code: NW11	
Structural	
Open low woodland of <i>Casuarina obesa</i> over low isolated clumps of <i>Rhagodia? drummondii</i> , <i>Atriplex? vesicaria</i> and <i>Tecticornia</i> sp. 3 chenopod shrubs and isolated tussock grassland of Poaceae sp. 3.	
Associated species	
<i>Maireana appressa</i> .	
Soils and Landforms: Dry, powdery cream clay on low dune ridges at the edge of salt lakes.	
Outcropping: Absent.	
Total area: 76.3 ha	Proportion of total survey area: 3.89 %
Number of Quadrats: 3	Species richness: 9.3 ± 0.7 (s.e.)
Representative Photograph	
	
Quadrat GL12	


APPENDIX G: A SUMMARY OF VEGETATION COMMUNITIES RECORDED WITHIN THE NORTHERN SURVEY AREAS, APRIL 2020

Vegetation Community Description	
Vegetation map code: NW12	
Structural	
Isolated clumps of <i>Pittosporum angustifolium</i> low trees over isolated clumps of mid <i>Eremophila ?deserti</i> shrubs over sparse low shrubland of <i>Atriplex ?vesicaria</i> , <i>Tecticornia</i> sp. 3 and <i>Frankenia interioris</i> var. <i>interioris</i> .	
Associated species	
<i>Maireana amoena</i> .	
Soils and Landforms: Dry, powdery brown clayey loam on low dune ridges near salt lakes.	
Outcropping: Absent.	
Total area: 31.2 ha	Proportion of total survey area: 1.59 %
Number of Quadrats: 1	Species richness: 14.0 ± 0.0 (s.e.)
Representative Photograph	
	
Quadrat GL02	


APPENDIX G: A SUMMARY OF VEGETATION COMMUNITIES RECORDED WITHIN THE NORTHERN SURVEY AREAS, APRIL 2020

Vegetation Community Description	
<p>Vegetation map code: NS1</p> <p>Structural</p> <p>Open shrubland of <i>Callitris preissii</i>, ?<i>Geijera linearifolia</i> over <i>Senna artemisioides</i> ?subsp. <i>filifolia</i>, <i>Pittosporum angustifolium</i>, <i>Santalum acuminatum</i> and <i>Eremophila scoparia</i> over ?<i>Westringia rigida</i>, <i>Scaevola spinescens</i> and <i>Rhagodia ?drummondii</i> over mixed low chenopod shrubs.</p> <p>Associated species</p> <p><i>Exocarpos aphyllus</i>, <i>Maireana suaedifolia</i>, <i>Pimelea microcephala</i> subsp. <i>microcephala</i>.</p> <p>Soils and Landforms: Red sandy clay on flats near salt lakes.</p> <p>Outcropping: Absent.</p> <p>Total area: 8.9 ha Proportion of total survey area: 0.45 %</p> <p>Number of Quadrats: 2 Species richness: 16.0 ± 1.0 (s.e.)</p>	
Representative Photograph	
	
<p>Quadrat NR11</p>	


APPENDIX G: A SUMMARY OF VEGETATION COMMUNITIES RECORDED WITHIN THE NORTHERN SURVEY AREAS, APRIL 2020

Vegetation Community Description	
Vegetation map code: NS2	
Structural	
Low shrubland of <i>Eremophila</i> ? <i>decepiens</i> , <i>Tecticornia</i> sp. 3 and <i>Atriplex</i> ? <i>vesicaria</i> .	
Associated species	
? <i>Disphyma crassifolium</i> , <i>Eremophila scoparia</i> .	
Soils and Landforms: Red-brown clay on valley floors.	
Outcropping: Absent.	
Total area: 7.0 ha	Proportion of total survey area: 0.35 %
Number of Quadrats: 1	Species richness: 12.0 ± 0.0 (s.e.)
Representative Photograph	
	
Quadrat NR08	

APPENDIX G: A SUMMARY OF VEGETATION COMMUNITIES RECORDED WITHIN THE NORTHERN SURVEY AREAS, APRIL 2020

Vegetation Community Description	
Vegetation map code: NS3	
Structural	
Low open chenopod shrubland of <i>Maireana amoena</i> , <i>Atriplex</i> spp. and <i>Tecticornia</i> spp.	
Associated species	
<i>Atriplex? vesicaria</i> , <i>Frankenia</i> sp., Restionaceae sp., <i>Surreya diandra</i> , <i>Tecticornia</i> sp. 3.	
Soils and Landforms: Cream to red sandy clay on flats on the edge of salt lakes and salty drainages.	
Outcropping: Absent.	
Total area: 318.6 ha	Proportion of total survey area: 16.22 %
Number of Quadrats: 7	Species richness: 7.30 ± 1.2 (s.e.)
Representative Photograph	
	
Quadrat GL13	

APPENDIX G: A SUMMARY OF VEGETATION COMMUNITIES RECORDED WITHIN THE NORTHERN SURVEY AREAS, APRIL 2020

Vegetation Community Description					
<p>Vegetation map code: NS4</p> <p>Structural</p> <p>Sparse mid shrubland of <i>Dodonaea viscosa</i> subsp. <i>angustissima</i> over open low shrubland of <i>Eremophila</i> ?<i>decipiens</i>, <i>Scaevola spinescens</i>, <i>Atriplex</i> ?<i>vesicaria</i>, <i>Rhagodia</i> ?<i>drummondii</i>, mixed <i>Chenopodiaceae</i> spp. and <i>Frankenia</i> sp.</p> <p>Associated species</p> <p><i>Eremophila scoparia</i>, <i>Exocarpos aphyllus</i>, ?<i>Geijera linearifolia</i>, <i>Maireana amoena</i>, <i>Tecticornia</i> sp. 3.</p> <p>Soils and Landforms: Red-brown sandy clay on low rises at the edge of salt lakes and salty drainages.</p> <p>Outcropping: Absent.</p> <table><tr><td>Total area: 159.4 ha</td><td>Proportion of total survey area: 8.12 %</td></tr><tr><td>Number of Quadrats: 4</td><td>Species richness: 14.5 ± 1.0 (s.e.)</td></tr></table>		Total area: 159.4 ha	Proportion of total survey area: 8.12 %	Number of Quadrats: 4	Species richness: 14.5 ± 1.0 (s.e.)
Total area: 159.4 ha	Proportion of total survey area: 8.12 %				
Number of Quadrats: 4	Species richness: 14.5 ± 1.0 (s.e.)				
Representative Photograph					
					
Quadrat GL07					

APPENDIX H: A SUMMARY OF VEGETATION COMMUNITIES RECORDED WITHIN THE SCOTIA SURVEY AREA, APRIL 2020

Vegetation Community Description

Vegetation map code: W1

Structural

Woodland of *Eucalyptus dundasii* and *Eucalyptus salubris* and occasional *Eucalyptus clelandiorum* over *Scaevola spinescens*, *Beyeria sulcata*, *Exocarpos aphyllus* and *Santalum acuminatum*.

Associated species

Acacia erinacea, *Olearia muelleri*.

Soils and Landforms: Orange to pale brown clayey loam on flats and gently sloping terrain.

Outcropping: Occasional.

Total Area: 3.9 ha

Proportion of Scotia survey area: 0.56 %

Number of Quadrats: 5

Species richness: 14.0 ± 1.1 (s.e.)

Representative Photograph



Quadrat SC10

APPENDIX H: A SUMMARY OF VEGETATION COMMUNITIES RECORDED WITHIN THE SCOTIA SURVEY AREA, APRIL 2020

Vegetation Community Description

Vegetation map code: W2

Structural

Woodland to open woodland of *Eucalyptus flocktoniae* complex, *Eucalyptus lesouefii* and *Eucalyptus dundasii*, over sparse shrubland of *Melaleuca sheathiana*, *Scaevola spinescens*, *Beyeria sulcata* and *Exocarpos aphyllus*, over isolated shrubs of *Olearia muelleri*.

Associated species

Eremophila scoparia, *Senna artemisioides*.

Soils and Landforms: Orange-red to brown clayey loam on flats and slopes.

Outcropping: Absent.

Total Area: 290.8 ha

Proportion of total survey area: 41.49 %

Number of Quadrats: 16

Species richness: 10.7 ± 0.8 (s.e.)

Representative Photograph



Quadrat SC05

APPENDIX H: A SUMMARY OF VEGETATION COMMUNITIES RECORDED WITHIN THE SCOTIA SURVEY
AREA, APRIL 2020

Vegetation Community Description

Vegetation map code: W3

Structural

Open woodland of *Eucalyptus longicornis* over open shrubland of *Melaleuca sheathiana*, *Cratystylis conocephala* over mixed sparse chenopod shrubland.

Associated species

Eremophila interstans subsp. *virgata*, *Sclerolaena diacantha*, *Rhagodia ? eremaea*

Soils and Landforms: Pale brown clayey loam flats.

Outcropping: Absent.

Total Area: 226.4 ha

Proportion of total survey area: 32.30 %

Number of Quadrats: 5

Species richness: 10.2 ± 0.7 (s.e.)

Representative Photograph



Quadrat SC35

APPENDIX H: A SUMMARY OF VEGETATION COMMUNITIES RECORDED WITHIN THE SCOTIA SURVEY
AREA, APRIL 2020

Vegetation Community Description

Vegetation map code: W4

Structural

Open woodland of *Eucalyptus torquata* over *Melaleuca sheathiana*, *Dodonaea microzyga* and *Alyxia buxifolia*.

Associated species

Exocarpos aphyllus, *Myoporum platycarpum*, *Ptilotus obovatus*.

Soils and Landforms: Red-brown clayey loam on hillsides and slopes.

Outcropping: Absent.

Total Area: 71.3 ha

Proportion of total survey area: 10.17 %

Number of Quadrats: 5

Species richness: 12.0 ± 1.6 (s.e.)

Representative Photograph



Quadrat SC30

APPENDIX H: A SUMMARY OF VEGETATION COMMUNITIES RECORDED WITHIN THE SCOTIA SURVEY
AREA, APRIL 2020

Vegetation Community Description

Vegetation map code: W5

Structural

Open woodland of *Eucalyptus gracilis* and *Eucalyptus flocktoniae*, over sparse shrubland of *Olearia* sp. Eremicola (Diels & Pritzel s.n. PERTH 00449628) and *Olearia muelleri*.

Associated species

Scaevola spinescens, *Sclerolaena diacantha*.

Soils and Landforms: Red-orange clayey loam flats .

Outcropping: Absent.

Total Area: 1.7 ha

Proportion of total survey area: 0.25 %

Number of Quadrats: 2

Species richness: 12.5 ± 0.5 (s.e.)

Representative Photograph



Quadrat SC13

APPENDIX H: A SUMMARY OF VEGETATION COMMUNITIES RECORDED WITHIN THE SCOTIA SURVEY
AREA, APRIL 2020

Vegetation Community Description

Vegetation map code: S1

Structural

Shrubland of *Allocasuarina campestris*, *Acacia neurophylla* subsp. *neurophylla*, *Melaleuca ?hamata* and *Cryptandra graniticola* over mixed Asteraceae sp. and *Lepidosperma* sp.

Associated species

Dodonaea microzyga.

Soils and Landforms: Red-brown clayey loam and ironstone outcropping on upper slopes.

Outcropping: Moderate.

Total Area: 14.0 ha

Proportion of survey area: 1.99 %

Number of Quadrats: 2

Species richness: 8.0 ± 1.0 (s.e.)

Representative Photograph



Quadrat SC31

APPENDIX H: A SUMMARY OF VEGETATION COMMUNITIES RECORDED WITHIN THE SCOTIA SURVEY AREA, APRIL 2020

Vegetation Community Description

Vegetation map code: S2

Structural

Sparse shrubland of *Scaevola spinescens*, *Exocarpos aphyllus* and *Grevillea acuaria* over *Atriplex* spp. and *Maireana* spp.

Associated species

Rhagodia drummondii, *Santalum spicatum*, ?*Geijera linearifolia*.

Soils and Landforms: Orange clay flats on salt lake margins.

Outcropping: Absent.

Total Area: 8.3 ha

Proportion of total survey area: 1.18 %

Number of Quadrats: 2

Species richness: 14.5 ± 0.5 (s.e.)

Representative Photograph



Quadrat SC26

APPENDIX H: A SUMMARY OF VEGETATION COMMUNITIES RECORDED WITHIN THE SCOTIA SURVEY AREA, APRIL 2020**Vegetation Community Description****Vegetation map code:** S3**Structural**

Open woodland of *Eucalyptus ?salicola* over open shrubland of *Bossiaea barbarae*, *Acacia assimilis* subsp. *assimilis* and *Melaleuca lanceolata* over *Lepidosperma* sp.

Associated species

Melaleuca lanceolata, *Conostephium drummondii*.

Soils and Landforms: Pale orange sand flats on salt lake margins.**Outcropping:** Absent.**Total Area:** 0.2 ha**Proportion of total survey area:** 0.02 %**Number of Quadrats:** 1**Species richness:** 13.0 ± 0.0 (s.e.)**Representative Photograph**

Quadrat SC14

APPENDIX H: A SUMMARY OF VEGETATION COMMUNITIES RECORDED WITHIN THE SCOTIA SURVEY
AREA, APRIL 2020

Vegetation Community Description

Vegetation map code: SC4

Structural

Open shrubland of *Grevillea nematophylla* subsp. *nematophylla* over *Hibbertia pungens*, *Allocasuarina acutivalvis* subsp. *acutivalvis* and *Dampiera latealata*.

Associated species

Dodonaea microzyga, *Alyxia buxifolia*.

Soils and Landforms: Orange clay loam and ironstone outcropping.

Outcropping: Moderate.

Total area: 2.4 ha

Proportion of total survey area: 0.09 %

Number of Quadrats: 1

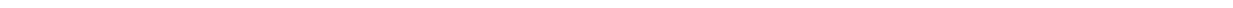
Species richness: 7.0 ± 0.0 (s.e.)

Representative Photograph



Quadrat SC24

**APPENDIX 3: FLORA AND VEGETATION
ASSESSMENT - SPRING (MATTISKE 2020B)**



FLORA & VEGETATION ASSESSMENT – SPRING 2020

NORSEMAN GOLD PROJECT, NORSEMAN, WA



Prepared By



Mattiske Consulting Pty Ltd

Prepared For
Pantoro Ltd

Date
December 2020



DOCUMENT STATUS				
DOCUMENT REFERENCE: CNG2003/30/20				
VERSION	TYPE	AUTHOR/S	REVIEWER/S	DATE DISTRIBUTED
V1	Internal review	E. Chetwin	E.M. Mattiske	-
V2	Draft for client	E. Chetwin	E.M. Mattiske	09/12/2020
V3	Final	E. Chetwin/S. Ruoss	E.M. Mattiske	17/12/2020



(ACN 063 507 175, ABN 39 063 507 175)

PO Box 437
Kalamunda WA 6926
Phone: +61 8 9257 1625
Email: admin@mattiske.com.au

Photo Cover: Low-lying vegetation at the northern edge of the Gladstone survey area, Norseman Gold Project, Spring 2020

COPYRIGHT AND DISCLAIMER

Copyright

The information contained in this report is the property of Mattiske Consulting Pty Ltd. The use or copying of the whole or any part of this report without the written permission of Mattiske Consulting Pty Ltd is not permitted.

Disclaimer

This report has been prepared on behalf of and for the exclusive use of Pantoro Ltd, and is subject to and issued in accordance with the agreement between Pantoro Ltd and Mattiske Consulting Pty Ltd. This report is based on the scope of services defined by Pantoro Ltd, the budgetary and time constraints imposed by Pantoro Ltd, and the methods consistent with the preceding.

Mattiske Consulting Pty Ltd has utilised information and data supplied by Pantoro Ltd (and its agents), and sourced from government databases, literature, departments and agencies in the preparation of this report. Mattiske Consulting Pty Ltd has compiled this report on the basis that any supplied or sourced information and data was accurate at the time of publication. Mattiske Consulting Pty Ltd accepts no liability or responsibility whatsoever for the use of, or reliance upon, the whole or any part of this report by any third party.

TABLE OF CONTENTS

	Page
EXECUTIVE SUMMARY	1
1. INTRODUCTION	3
1.1. Location and Scope of Project	3
1.2. Environmental Legislation and Guidelines	3
2. OBJECTIVES	5
3. METHODS	6
3.1. Field Survey	6
3.2. Survey Timing	7
3.3. Analysis of Site Data	8
3.4. Vegetation Descriptions	8
3.5. Survey Limitations	9
4. FIELD SURVEY RESULTS	11
4.1. Flora	11
4.1.1. Threatened and Priority Flora	18
4.1.2. Other Significant Flora	25
4.1.3. Introduced (Weed) Species and Declared Pest (Plant) Organisms	27
4.2. Vegetation	27
4.2.1. Statistical Analysis	27
4.2.2. Vegetation Communities	29
4.2.3. Threatened and Priority Ecological Communities	34
4.2.4. Vegetation Condition	41
5. DISCUSSION	42
5.1. Flora	42
5.2. Vegetation	43
5.2.1. <i>Eucalyptus</i> woodlands	43
5.2.2. Other vegetation communities	44
5.2.3. Species Richness	44
5.2.4. Comparison with previous mapping	44
5.3. Local and regional context and impact	45
6. CONCLUSION	46
7. ACKNOWLEDGEMENTS	48
8. PERSONNEL	48
9. REFERENCES	49

TABLES

- 1: Potential limitations affecting the conclusions made in this report
- 2: Location and extent of priority species within the Norseman Gold Project Spring survey areas
- 3: Location and extent of *Eremophila parvifolia* ?subsp. *auricampi* within the Norseman Gold Project Spring survey areas
- 4: Taxa recorded within the Norseman Gold Project survey area in Spring 2020 representing an extension to currently known distributions
- 5: Introduced (weed) taxa recorded within the Norseman Gold Project survey areas, Spring 2020
- 6: Vegetation communities in the Hills survey areas, Spring 2020
- 7: Vegetation communities in the Flats survey areas, Spring 2020
- 8: Vegetation Condition by Vegetation Community in the Hills and Flats survey areas, Spring 2020

FIGURES

- 1: Locality of the Norseman Gold Project and Spring survey areas
- 2: Rainfall and temperature data for Norseman Aero WA (012009)
- 3.1-3.5: Survey Site Locations and Tracks, Spring 2020, with Autumn 2020 Mattiske Consulting Pty Ltd Vegetation Mapping, Sites and Tracks
- 4.1-4.2: Average randomised Species Accumulation Curves for the Hills and Flats survey areas, Spring 2020
- 5.1-5.2: Dendrograms for the Hills and Flats survey areas, Spring 2020
- 6.1-6.3: Vegetation Mapping for the Hills survey areas, Spring 2020
- 7.1-7.3: Vegetation Mapping for the Flats survey areas, Spring 2020

PLATES

- 1a, 1b: *Allocasuarina eriochlamys* subsp. *grossa* (P3) (Photos: E. Chetwin)
- 2: *Eremophila purpurascens* (P3) (Photo: S. Ruoss)
- 3a, 3b, 3c: *Eucalyptus brockwayi* (P3) (Photos: M. Behn)
- 4a, 4b: *Eucalyptus websteriana* subsp. *norsemanica* (P1) (Photo: S. Ruoss)
- 5a, 5b: *Goodenia laevis* subsp. *laevis* (P3) (Photo: S. Ruoss)
- 6: *Melaleuca coccinea* (P3) (Photo: E. Chetwin)
- 7a, 7b: *Micromyrtus papillosa* (P1) (Photos: S. Ruoss)
- 8: *Philotheca apiculata* (P1) (Photo: S. Ruoss)
- 9: *Eremophila parvifolia* ?subsp. *auricampi* (Photo: S. Ruoss)

APPENDICES

A1:	Threatened and priority flora definitions
A2:	Threatened and priority ecological community definitions
A3:	Categories and control measures of declared pest (plant) organisms in Western Australia
A4:	Other definitions
A5:	NVIS structural formation terminology
A6:	Definition of vegetation condition scale for the South West and Interzone Botanical Provinces
B:	Survey site locations, Spring 2020
C:	Vascular plant species recorded by Survey Site, Spring 2020
D:	Summary of Vegetation Communities in the Hills survey areas, Spring 2020
E:	Summary of Vegetation Communities in the Flats survey area, Spring 2020

LIST OF ABBREVIATIONS

BAM Act:	<i>Biosecurity and Agriculture Management Act 2007</i> (WA)
BC Act:	<i>Biodiversity Conservation Act 2016</i> (WA)
BOM:	Bureau of Meteorology
CLUSTER:	Hierarchical clustering
DAWE	Department of Agriculture, Water and the Environment
DBCA:	Department of Biodiversity, Conservation and Attractions
DPaW:	Department of Parks and Wildlife (now under DBCA)
EP Act:	<i>Environmental Protection Act 1986</i> (WA)
EPA:	Environmental Protection Authority
EPBC Act:	<i>Environment Protection and Biodiversity Conservation Act 1999</i> (Commonwealth)
MCPL:	Mattiske Consulting Pty Ltd
NVIS:	National Vegetation Information System
Pantoro:	Pantoro Limited
PEC:	Priority Ecological Community
PRIMER:	Plymouth Routines in Multivariate Ecological Research
SIMPER:	Similarity percentages
SIMPROF:	Similarity profile
TEC:	Threatened Ecological Community
WAH:	Western Australian Herbarium (PERTH)

EXECUTIVE SUMMARY

Mattiske Consulting Pty Ltd was commissioned in March 2020 by Pantoro Limited to undertake a flora and vegetation assessment of the Norseman Gold Project areas located around Norseman, WA. A desktop assessment of flora and vegetation of the greater Norseman Gold Project area was carried out in March 2020, followed in March April by a five day detailed flora and vegetation field survey ('Autumn' survey) in five survey areas. A further detailed flora and vegetation field survey was carried out over ten days in September and October 2020 ('Spring' survey), covering the nine survey areas survey areas Camp, Cobbler, Gladstone extensions, Maybell, North Royal extension, OK, Scotia extensions, Slippers and TSF. This report describes the methodology and results of that survey, and discusses their significance.

A total of 79 quadrats were surveyed, along with several km of foot traverses during which opportunistic collections were made, and local searches in order to define populations of potential priority-listed flora species. **The field survey found the following, recorded in 48 quadrats in the 'Hills' area** (comprising the Cobbler, Maybell and Scotia extensions survey areas) **and 31 quadrats in the 'Flats' area** (Camp, Gladstone extensions, North Royal extension, OK, Slippers and TSF), plus several opportunistic records:

- Over all nine survey areas, 168 vascular plant taxa, representative of 85 genera and 40 families, were recorded. In the Hills area, 145 taxa were recorded and in the Flats area, 100 taxa. The most common families overall, and within each of the Hills and Flats areas, were Myrtaceae, Chenopodiaceae, and Scrophulariaceae, and the most common genera were *Eucalyptus*, *Eremophila* and *Acacia*.
- Species accumulation analysis shows that approximately 70% in the Hills area and 65% in the Flats area of taxa potentially present in the survey areas were recorded during the field survey. These values are lower than those recorded than in the Autumn survey areas (73%), possibly due both to the smaller area covered in Spring than that in Autumn and because the Spring survey covered a less diverse range of landforms and soils than those in Autumn.
- No threatened flora species were recorded within the nine Spring survey areas.
- Eight priority flora species were recorded in the Spring survey that were not recorded in the Autumn survey. These are: *Allocasuarina eriochlamys* subsp. *grossa* (P3), *Eremophila purpurascens* (P3), *Eucalyptus brockwayi* (P3), *Eucalyptus websteriana* subsp. *norsemanica* (P1), *Goodenia laevis* subsp. *laevis* (P3), *Melaleuca coccinea* (P3), *Micromyrtus papillosa* (P1) and *Philotheca apiculata* (P1). All of these taxa were found within the Hills survey areas; one taxon was also recorded in the TSF and Camp areas.
- The shrub *Eremophila parvifolia* ?subsp. *parvifolia* (P4), collected in Autumn as a potential priority species, was re-collected and re-identified as the non priority listed subspecies *Eremophila parvifolia* ?subsp. *auricampi*.
- Six taxa recorded within the Spring survey areas represent extensions to their current known distributions based on known data; however, three of these have been found in previous surveys in the Norseman Gold Project area, but are not listed in official records. Five of the six taxa are ranked as being Low range extensions and one as Moderate.
- Five introduced (weed) species, **Asphodelus fistulosus* (Onion Weed), **Carrichtera annua* (Ward's weed), **Gazania linearis*, **Salvia verbenaca* (Wild sage) and **Sonchus oleraceus* (Common sowthistle) were recorded within the Norseman Gold Project survey areas in Spring 2020. Under the Department of Parks and Wildlife Weed Prioritisation Process, **Gazania linearis* is considered to be one of the 17 Goldfields Region priority alert weeds and therefore the locations should be reported to the local regional office of the Department of Biodiversity, Conservation and Attractions.
- Nine vegetation communities were mapped across the Hills survey areas: five *Eucalyptus* woodland communities, four shrubland communities as well as cleared land and salt lakes. Two of these are newly defined using the Spring survey data. Two *Eucalyptus* woodland communities, W2 and W4, made up most of the vegetation of the Hills survey area.

- In the Flats survey areas twelve vegetation communities were mapped, comprising eight *Eucalyptus* woodland communities, one *Casuarina* woodland, three shrubland communities as well as cleared land and salt lakes. Three of these are newly defined using the Spring survey data. The *Eucalyptus* woodland community NW10 made up most of the vegetated areas of the Flats survey area.
- The Hills area vegetation communities S1 and W4 are host to seven of the eight priority-listed species encountered in the Spring survey, and the newly defined shrubland community S5 (also in the Hills area) is dominated by one of those seven species. The eighth priority-listed species was recorded in Hills community W2 and Flats community NW10, both widespread in their respective areas.
- No Threatened or Priority ecological communities were recorded as occurring in the Norseman Gold survey areas.
- Approximately 57% of the survey sites were assessed as being in Pristine condition and 43% in Excellent condition. The vegetation condition in the Hills area is generally better than that in the Flats areas, although both areas have very little disturbance within the areas of native vegetation. The east-facing hillslope at Cobbler had been burnt within the previous year; quadrats were moved slightly to avoid burnt vegetation.
- Mean values of species richness for vegetation communities in the Spring survey were greater than those in Autumn survey, possibly as a result of greater familiarity with the local flora in the Spring survey. In the Spring survey, species richness was greater in the Hills area vegetation communities than those in the Flats area, although it varied more widely in the Flats area.
- Vegetation in the Norseman Gold Project survey areas was found to be predominantly Eucalypt woodlands, with minor shrublands on rocky upper slopes and ridges, and narrow strips of chenopod shrubland along salt lake margins, similar to that encountered in the Autumn survey and consistent with regional vegetation. The communities mapped in the Spring survey are all broadly similar to those mapped in previous local surveys in the area.

As the vegetation of the Norseman Gold Project survey areas is common at statewide and regional levels, clearing should not have significant detrimental effects at those levels. However, the presence of Priority listed flora species within the survey areas is of local importance with regard to clearing of vegetation. Extra care must be taken when conducting operations within the vegetation communities that are known to be host to these species.

1. INTRODUCTION

Mattiske Consulting Pty Ltd (MCPL) was commissioned in March 2020 by Pantoro Limited (Pantoro) to undertake a flora and vegetation assessment of the Norseman Gold Project areas. A desktop assessment of flora and vegetation of the entire Norseman Gold Project area was carried out in March 2020. This was followed from 29th March to 3rd April 2020 by a detailed flora and vegetation field survey (**'Autumn' survey**) in five survey areas: Gladstone, North Royal, Gladstone-North Royal Haul Roads, **Jimberlana Pipeline (within the larger 'Northern' study area), and Scotia (within the 'Scotia' study area)**. The desktop and Autumn field survey report were completed in July 2020 (MCPL 2020). That report should be referred to for background information and previous results, although some of the content will be summarised here to provide context.

A further detailed flora and vegetation field survey was completed over ten days, from 21st to 25th September and 5th to 9th October 2020, **collectively known as the 'Spring' survey**. The Spring survey covered the survey areas Camp, Cobbler, Gladstone extensions, Maybell, North Royal extension, OK, Scotia extensions, Slippers and TSF. This report covers the methodology and results for the Spring field survey, and discusses their significance.

1.1. Location and Scope of Project

The Norseman Gold Project lies within the *Coolgardie 3-Eastern Goldfields* subregion of the Coolgardie Bioregion within the Southwestern Interzone botanical district (Cowan 2001, Department of Agriculture, Water and the Environment [DAWE] 2020a), surrounding the town of Norseman, Western Australia. The overall Norseman Gold Project area along with its smaller survey areas is presented in Figure 1.

The results of the Spring field survey, in terms of flora recorded and vegetation communities mapped, **are grouped in two larger survey areas: 'Hills' (comprising the survey areas on hills to the west of significant salt lakes; Cobbler, Maybell and Scotia extensions) and 'Flats' (Camp, Gladstone extensions, North Royal extension, OK, Slippers and TSF)**.

1.2. Environmental Legislation and Guidelines

The following key Commonwealth (federal) legislation relevant to this survey is the:

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

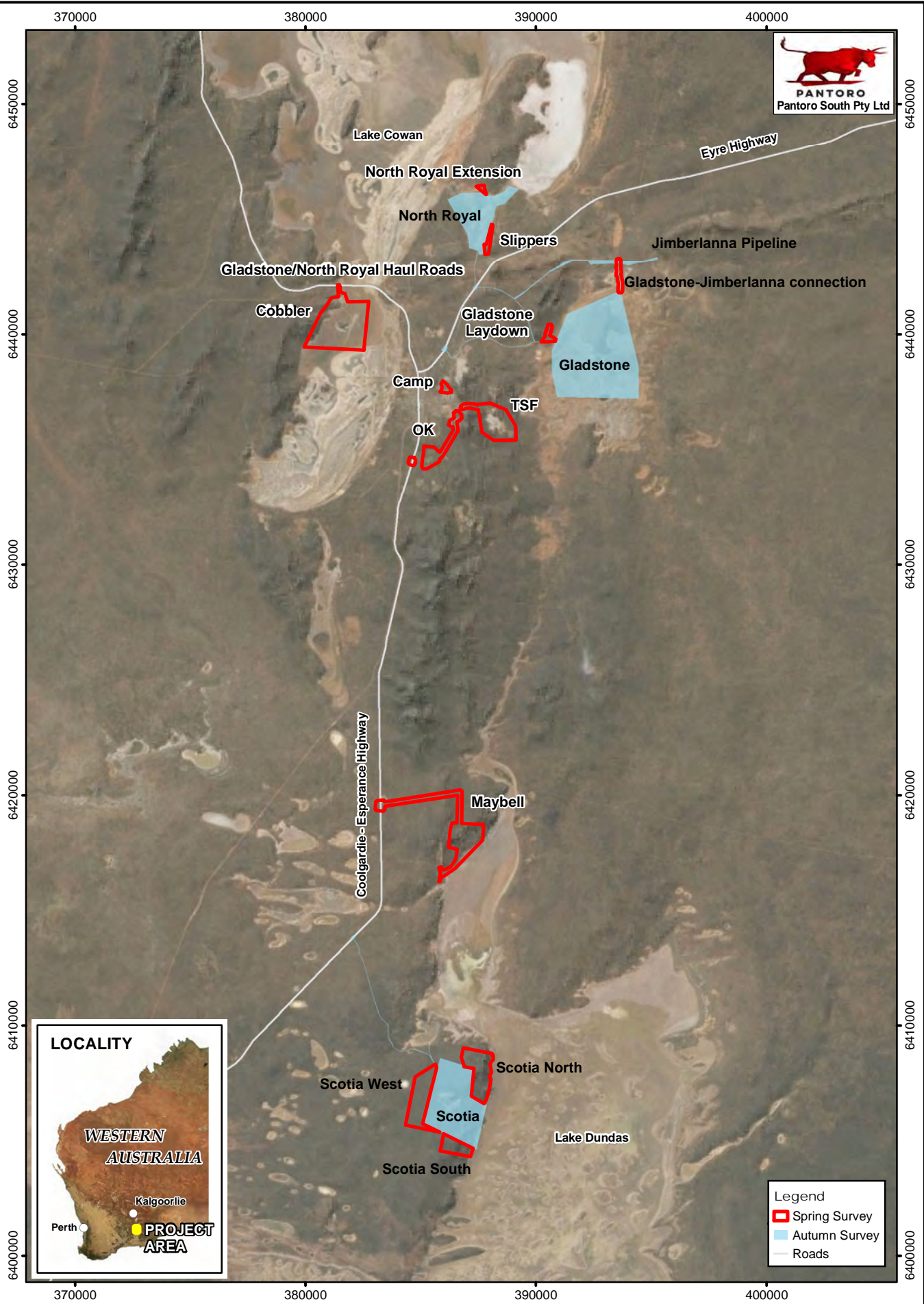
The following key Western Australian (state) legislation relevant to this survey include the:

- *Biodiversity Conservation Act 2016* (BC Act);
- *Biosecurity and Agriculture Management Act 2007* (BAM Act); and
- *Environmental Protection Act 1986* (EP Act);

Furthermore, key Western Australian guidelines relevant to this survey are the:

- *Environmental Factor Guideline: Flora and Vegetation* (Environmental Protection Authority [EPA] 2016a); and
- *Technical Guidance – Flora and vegetation surveys for environmental impact assessment* (EPA 2016b).

Definitions of flora and vegetation terminology commonly used throughout this report are provided in Appendix A1-6.



Legend

- ▭ Spring Survey
- ▭ Autumn Survey
- Roads

Notes: Image: DigitalGlobe (27/11/2016)

N

0 4 km

Scale: 1:0
MGA94 (Zone 50)

CAD Ref: a2764_f06_01
Date: December 2020

Rev: A A4

Mattiske Consulting Pty Ltd

28 Central Road, Kalamunda WA 6076 - Tel: 9257 1625 - Fax: 9257 1640

Author: E M Mattiske MCPL Ref: CNG2002-03

Drawn: CAD Resources - www.cadresources.com.au
Tel: (08) 9246 3242 - Fax (08) 9246 3202

Norseman Gold Project Locality - Spring Survey Areas

Figure:
1

2. OBJECTIVES

The objective of this survey was to undertake a flora and vegetation assessment of nine of the Norseman Gold Project survey areas, including to:

- Undertake a detailed field survey of those areas, and collect and identify the vascular plant species present;
- Review the conservation status of the vascular plant species recorded by reference to current literature and listings by the Department of Biodiversity, Conservation and Attractions (DBCA) and plant collections held at the Western Australian State Herbarium (WAH), and listed by the DAWE under the EPBC Act;
- Define and map the vegetation communities in the nine Norseman Gold Project survey areas;
- Define and map the location of any threatened and priority flora located within the nine Norseman Gold Project survey areas;
- Define any management issues related to flora and vegetation values;
- Provide recommendations on the local and regional significance of the vegetation communities; and
- Prepare a report summarising the findings.

3. METHODS

3.1. Field Survey

A detailed field assessment of the flora and vegetation of the Camp, Gladstone extensions, Scotia extensions, Slippers and TSF survey areas was undertaken by one botanist and one experienced botanist from MCPL from the 21st to the 25th September 2020. The assessment for the Cobbler, Maybell, North Royal extension and OK survey areas was performed by two experienced botanists (including one that worked during September) from the 5th to 9th October 2020. All assessments were conducted in accordance with methods outlined in *Technical Guidance – Flora and vegetation surveys for environmental impact assessment* (EPA 2016b). All three botanists held valid collection licences to collect flora for scientific purposes, issued under the BC Act.

The geographic co-ordinates defining the Norseman Gold Project Spring survey areas were supplied by Pantoro. Aerial photographic maps of the survey areas were prepared and supplied by CAD Resources. Survey sites were selected prior to the field survey using aerial photographic maps and locations were modified in the field where observation or availability of time deemed changes to be necessary. A total of 79 survey sites, 31 in the 'Flats' survey areas and 48 in the 'Hills' areas, were selected to sample all vegetation types, with replication, within the Spring survey areas.

Survey sites consisted of un-marked 20 x 20 metre quadrats. The GPS location of the northwest corner of each quadrat was recorded and a photo taken from that point looking to the southeast.

Flora and vegetation were described and sampled systematically at each survey site, and additional opportunistic collections were undertaken wherever previously unrecorded plants were observed. At each quadrat the following floristic and environmental parameters were recorded:

- GPS location (GDA94 datum, zone 51);
- Local site topography;
- Soil type and colour;
- Outcropping rocks and their type;
- Percentage litter cover and percentage bare ground;
- Approximate time since fire;
- Vegetation condition (based on Keighery 1994); and
- For each vascular plant species, the average height and the percentage cover (of both alive and dead material) over the survey site.

The location of any plant or population of plants thought to potentially be a Threatened or Priority taxon was recorded, along with the height of the plant (or average height of the population), the area which **the population occupied, the plant or population's condition, and its reproductive status**. Photographs were taken to aid in identification.

All plant specimens collected during the field surveys were dried and processed in accordance with the requirements of the WAH. The plant species were identified based on taxonomic literature and through comparison with pressed specimens housed at the WAH. Where appropriate, plant taxonomists with specialist skills were consulted. Nomenclature of the species recorded is in accordance with the WAH (1998-).

3.2. Survey Timing

According to Table 3 in the *Technical guidance – Flora and vegetation surveys for environmental impact assessment* (EPA 2016b), the primary survey timing for the Southwestern Interzone is Spring (September-November). Climate data for the Norseman area are presented in Figure 2. Monthly rainfall data averaged over the last 20 years show that the Norseman area receives most of its rainfall in two periods, late winter and late summer-autumn, with late summer-autumn usually having more rain. Autumn is the timing recommended by the EPA (2016b) for supplementary flora and vegetation surveys in this area.

Few species were in flower or fruit at the time of the Autumn field survey; making it difficult to definitively identify many of the plants collected. There was a marginal improvement in the number of species flowering during the Spring survey. The number of annual or short-lived perennial species recorded was much the same in the Spring survey (14) as in Autumn (19). During both the Autumn and Spring surveys, trees and mallees of the genus *Eucalyptus* (which often dominated the canopy) were mostly found with buds and fruit, making identification to species level possible.

The rainfall for the three months prior to the Spring survey (48.2 mm for June to August 2020 against 63.1 mm as the 20-year long-term average for those months) and the 12 months (170.6 mm for the previous 12 months against 280.6 mm for the annual long-term average) was below average (Bureau of Meteorology [BOM] 2020) (Figure 2). March 2020 was the last month prior to the Spring field survey in which rainfall was above average (BOM 2020). Annual rainfall has been less than the 20-year long term average for 14 of the last 20 years, including 2015-2019.

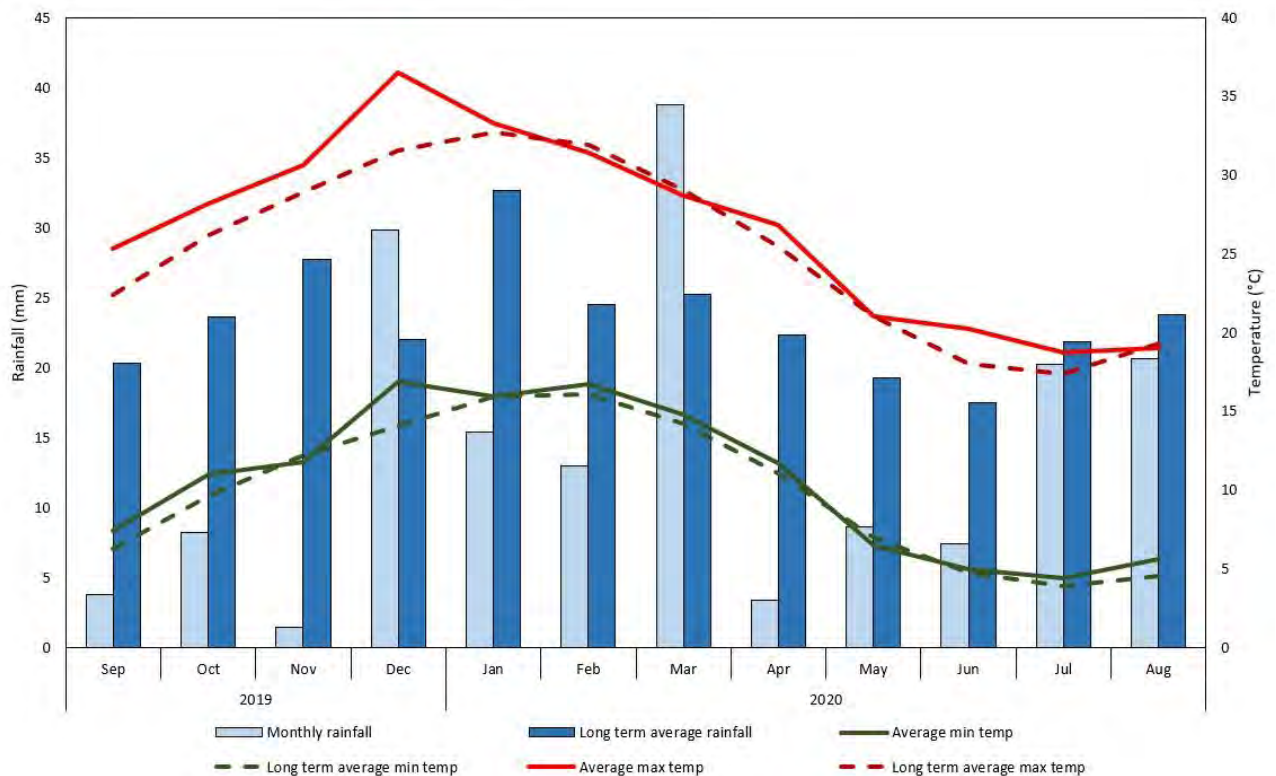


Figure 2: Rainfall and temperature data for Norseman Aero WA (012009)

Note: Long-term average monthly rainfall (2000-2020) and temperature (2000-2020) data, together with monthly rainfall and temperature data for the period of September 2019 to August 2020 (BOM 2020).

3.3. Analysis of Site Data

A species accumulation curve for each of the 'Hills' and 'Flats' survey areas, based on accumulated species versus sites surveyed, was prepared to provide an indication of the level of adequacy of the survey effort (*EstimateS* – Colwell 2013). As the number of survey sites increases, and correspondingly the size of the area surveyed increases, there should be a diminishing number of new species recorded. At some point, the number of new species recorded becomes essentially asymptotic. The asymptotic value was determined using Michaelis-Menten modelling and provided an incidence-based coverage estimator of species richness (Chao 2004). When the number of new species being recorded for survey effort expended approaches this asymptotic value, the survey effort can be considered to be adequate.

Plymouth Routines in Multivariate Ecological Research v7 (PRIMER) statistical analysis software was used to analyse species-by-site data and discriminate survey sites on the basis of their species composition (Clarke and Gorley 2015). The data were split into Hills and Flats survey areas, with a very similar treatment in both areas. To down-weight the relative contributions of quantitatively dominant species (in particular *Eucalyptus* trees and mallees), a fourth root transformation was applied to the data set. Introduced species, annual species and singletons (species recorded at a single quadrat and not forming a dominant structural component, i.e. <1% foliage cover) were excluded from the data set prior to analysis. Specimens not identified to species level were also removed, aside from *Atriplex* sp., *Lepidosperma* sp. and *Tecticornia* sp., as these taxa either form significant structural components or are very difficult to find with material suitable for identifying to species level, or have issues with classification of the genus (*Lepidosperma*; M. Hislop 2020, personal communication, 11 May). One taxon which was only tentatively identified to the subspecies level (*Eucalyptus oleosa* subsp. *?oleosa*) was revised to the specific level to reduce the tendency to create further statistical variation in the analysis that was considered unwarranted. Computation of similarity matrices was based on the Bray-Curtis similarity measure. Data were analysed using a series of multivariate analysis routines including Similarity Profile (SIMPROF), Hierarchical Clustering (CLUSTER) and Similarity Percentages (SIMPER). Results were used to inform and support interpretation of aerial photography, quadrat data and delineation of individual plant communities.

Previous vegetation mapping by MCPL over the TSF and parts of the OK survey areas (MCPL 2005) was of a much broader scale than the vegetation mapping performed during the Spring survey, but was used qualitatively to assist with mapping in the TSF and OK areas. Between the Scotia and Maybell survey areas, MCPL (2013a, 2013b) had carried out vegetation mapping over the Mt Henry mine and surrounds (for another client). This work was also used qualitatively to assist with mapping in the Scotia and Maybell areas.

Where Spring survey areas abutted Autumn survey areas (Gladstone extensions, Scotia extensions), vegetation mapping boundaries were mapped consistently and, where required by the data, minor modifications were made to the Autumn mapping boundaries.

3.4. Vegetation Descriptions

Vegetation descriptions were based on Aplin's (1979) modification of the vegetation classification system of Specht (1970), to align with the National Vegetation Information System (NVIS) (see Appendix A5). Vegetation communities were described at the association level of the NVIS classification framework, as defined by the Executive Steering Committee for Australian Vegetation Information (2003). Vegetation condition of each of the mapping sites was assessed as per the criteria developed by Keighery (1994) (see Appendix A6).

3.5. Survey Limitations

A general assessment was made of the current survey against a range of factors that may have limited the outcomes and conclusions of this report (Table 1).

Table 1: Potential limitations affecting the conclusions made in this report

POTENTIAL SURVEY LIMITATION	IMPACT ON CURRENT SURVEY
Availability of contextual information at a regional and local scale	Not a limitation: Historical studies including Beard's work (1970, 1975, 1990) and Keighery, Newbey & Hall (1993), covering flora and vegetation of the region, were reviewed. The results of twenty-one previous field surveys in the greater Norseman Gold Project area, including six performed by MCPL, were analysed (MCPL 2020).
Competency/experience of team carrying out survey; experience in the bioregion surveyed	Not a limitation: Three botanists in total worked on the Spring survey; two were experienced botanists, one having worked on the Autumn survey as well as other surveys in the Goldfields region, and the other with extensive experience throughout Western Australia, including the Goldfields. The third botanist had worked on the Autumn survey. MCPL has carried out several surveys in the Norseman area (MCPL 2020).
Proportion of flora collected and identification issues	Minor limitation: The species accumulation curves for each of the Hills and Flats survey areas (Figures 5.1-5.2) show that 70% of the taxa potentially present in the Hills survey areas and 65% of those in the Flats survey areas were recorded during this survey. This was lower than the proportion of species recorded in the Autumn survey (73% in each of the Northern and Scotia study areas) and is possibly due to the smaller area covered in Spring (1,695 ha vs. 2,665 ha in the Autumn survey). Few of the plants were in flower at the time of the survey, making it difficult to definitively identify some of the plants collected. Trees and mallees of the genus Eucalyptus (which often dominated the canopy) were an exception to this, as most were found with buds and fruit, making identification to species level possible.
Effort and extent of survey	Not a limitation: The survey was designed to be a reconnaissance assessment in degraded areas and a detailed flora and vegetation assessment in less disturbed environments. This was deemed to be an appropriate approach based on its effectiveness in the Autumn survey. An attempt was made to ensure that three or more quadrats were surveyed in each vegetation community in order to obtain statistically valid data. Of the five new communities defined in the Spring survey, two contained only two quadrats each and two communities contained only one quadrat. It is not clear that these four communities are restricted in areal extent within the survey areas, as they are difficult to define on aerial photographs and their landforms and soils are not unique. It was not obvious in the field that these communities were unusual; they are a more subtle variation of other communities in the area known to be more extensive (see section 4.2.1 for further detail).
Access restrictions within survey area	Not a limitation: There were no restrictions to access encountered during the survey. Most sites could be reached by vehicle on pre-existing tracks followed by a short foot traverse. A small number of sites, particularly those in the Scotia extensions, required walks of several km length to access.
Survey timing, rainfall, season of survey	Minor Limitation: The survey was carried out in the primary survey window for the region (section 3.2). Rainfall for 12 months prior to the Spring survey was lower than average. Whilst posing some difficulties for identification of species, given that the area has received lower than average rainfall for the last five years, a change in survey timing would make little difference.

Table 1: Potential limitations affecting the conclusions made in this report (continued)

POTENTIAL SURVEY LIMITATION	IMPACT ON CURRENT SURVEY
Disturbances (fire/flood/clearing)	<p>Minor limitation: The vegetation at all survey sites was assessed as being Pristine or Excellent (Keighery 1994). However, some sites were in areas which had been cleared or disturbed (tracks, rubbish) in the past. Field observations indicated that these sites generally a lower diversity of shrub species and the <i>Eucalyptus</i> species present were often juveniles.</p> <p>A major hillslope in the Cobbler area had burnt in December 2019. Site CO09 was immediately adjacent to the burnt area, and the shape of the quadrat was modified in order to avoid burnt vegetation and/or regrowth. The planned locations of sites CO08 and CO10 were burnt, and the sites were moved to patches of vegetation thought to be representative of the vegetation that had been at the original site location.</p>
Data and statistical analysis	<p>Minor limitation:</p> <p>Flora identification issues made it more difficult to distinguish between vegetation communities, as a number of specimens could not be identified to species level.</p> <p>A significant number of vegetation communities newly identified in this survey (two of five) contained only one survey quadrat, and two another contained only two quadrats, thereby reducing the validity of the statistical analysis.</p>

4. FIELD SURVEY RESULTS

A total of 79 quadrats were surveyed in nine of the Norseman Gold Project survey areas (Camp, Cobbler, Gladstone extensions, Maybell, North Royal extension, OK, Scotia extensions, Slippers and TSF) by one botanist and one experienced botanist from the 21st to the 25th September 2020 and two experienced botanists from the 5th to 9th October 2020 in accordance with methods outlined in *Technical Guidance – Flora and vegetation surveys for environmental impact assessment* (EPA 2016b). The survey site locations are listed in Appendix B and the sites, along with survey tracks, are shown in Figures 3.1-3.5.

4.1. Flora

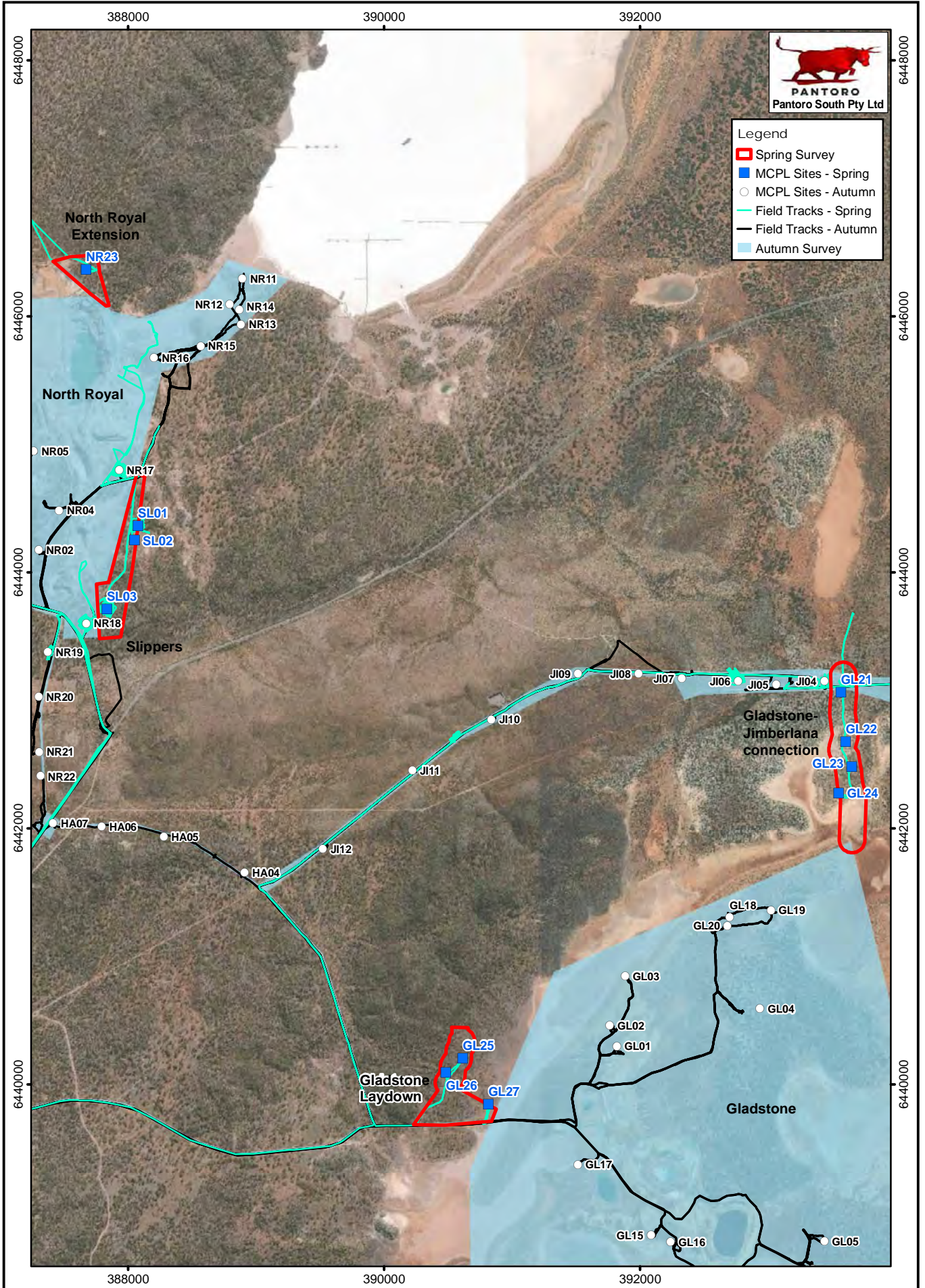
A total of 168 vascular plant taxa, representative of 85 genera and 40 families, were recorded within the nine Norseman Gold Project areas covered in the Spring survey. Three of these taxa (*Lepidium platypetalum*, *Goodenia laevis* subsp. *laevis* (P3) and *Melaleuca coccinea* (P3)) were recorded opportunistically only. The majority of taxa recorded were representative of the Myrtaceae (31 taxa), Chenopodiaceae (19 taxa) and Scrophulariaceae (17 taxa) families (see Appendix C for a complete species list). The most common genera were *Eucalyptus* (18 taxa), *Eremophila* (13 taxa) and *Acacia* (12 taxa). Seven taxa have an annual life-form, whilst seven are either annuals or short-lived perennials.

In the Hills survey areas (Cobbler, Maybell and Scotia extensions), 145 vascular plant taxa were recorded, representative of 77 genera and 37 families. Most taxa were part of the Myrtaceae (26 taxa), Chenopodiaceae (17 taxa) and Scrophulariaceae (14 taxa) families. The most common genera were *Eucalyptus* (14 taxa), *Eremophila* (10 taxa) and *Acacia* (8 taxa).

In the Flats survey area (Camp, Gladstone extensions, North Royal extension, OK, Slippers and TSF), 100 vascular plant taxa were recorded, representative of 56 genera and 29 families. Most taxa were part of the Myrtaceae (17 taxa), Chenopodiaceae (14 taxa) and Scrophulariaceae (13 taxa) families. The most common genera were *Eucalyptus* (12 taxa), *Eremophila* (10 taxa) and *Acacia* (6 taxa).

Much of the vegetation was neither flowering nor fruiting, making identification to specific or subspecific level difficult. Five taxa were identified to family level only, and 19 to genus level. One taxon was question-marked at genus level, twelve were identified to genus level but were question-marked at species level and one was identified at species level but was question-marked at subspecies level. Only one *Tecticornia* genus specimen of the four collected in the field had suitable material for identification; this specimen was referred to a taxonomic expert at the WAH and was identified as *Tecticornia undulata*. **The three other collected specimens of the genus are all listed here as '*Tecticornia* sp.'** Owing to issues with classification of the genus *Lepidosperma* (M. Hislop 2020, personal communication, 11 May), no attempt was made to identify any of the plants in the genus to species level; all were **recorded in the field as '*Lepidosperma* sp.'** Unfortunately, of the four collected specimens of the genus *Atriplex*, which was widespread throughout the Spring survey areas, three were unable to be identified **to species level due to lack of fruiting material; these are all listed as '*Atriplex* sp.'** The identifiable specimen was *Atriplex nummularia* subsp. *spathulata*.

Species accumulation curves were used to evaluate the sampling adequacy for each of the Hills and Flats survey areas and are presented in Figures 4.1 and 4.2. In the Hills survey area the incidence-based coverage estimator of species richness was 206.3. Based on this value and the total of 145 taxa recorded, approximately 70% of the flora species potentially present within this survey area were recorded. In the Flats survey area, 100 taxa were recorded and the incidence-based coverage estimator of species richness was 153.3, resulting in an estimate of approximately 65% of the flora species potentially present within this survey area being recorded during this survey.



- Legend**
- ▭ Spring Survey
 - ▣ MCPL Sites - Spring
 - MCPL Sites - Autumn
 - Field Tracks - Spring
 - Field Tracks - Autumn
 - Autumn Survey

Image: DigitalGlobe (May 2019)

Scale: 1:40,000
 MGA94 (Zone 50)
 CAD Ref: a2764_f06_02
 Date: December 2020 Rev: A A4

Mattiske Consulting Pty Ltd
 28 Central Road, Kalamunda WA 6076 - Tel: 9257 1625 - Fax: 9257 1640
 Author: E M Mattiske MCPL Ref: CNG2002-03
 Drawn: CAD Resources - www.cadresources.com.au
 Tel: (08) 9246 3242 - Fax (08) 9246 3202

Norseman Gold Project
Sites and Tracks
 Sheet 1 of 5

Figure:
3.1

38000

38200

38400



Legend

- Spring Survey
- MCPL Sites - Spring
- Field Tracks - Spring

6444000

6444000

6442000

6442000

6440000

6440000

6438000

6438000

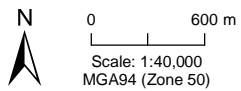
6436000

6436000

38000

38200

38400



28 Central Road, Kalamunda WA 6076 - Tel: 9257 1625 - Fax: 9257 1640

Author: E M Mattiske MCPL Ref: CNG2002-03

Drawn: CAD Resources ~ www.cadresources.com.au

Tel: (08) 9246 3242 ~ Fax (08) 9246 3202

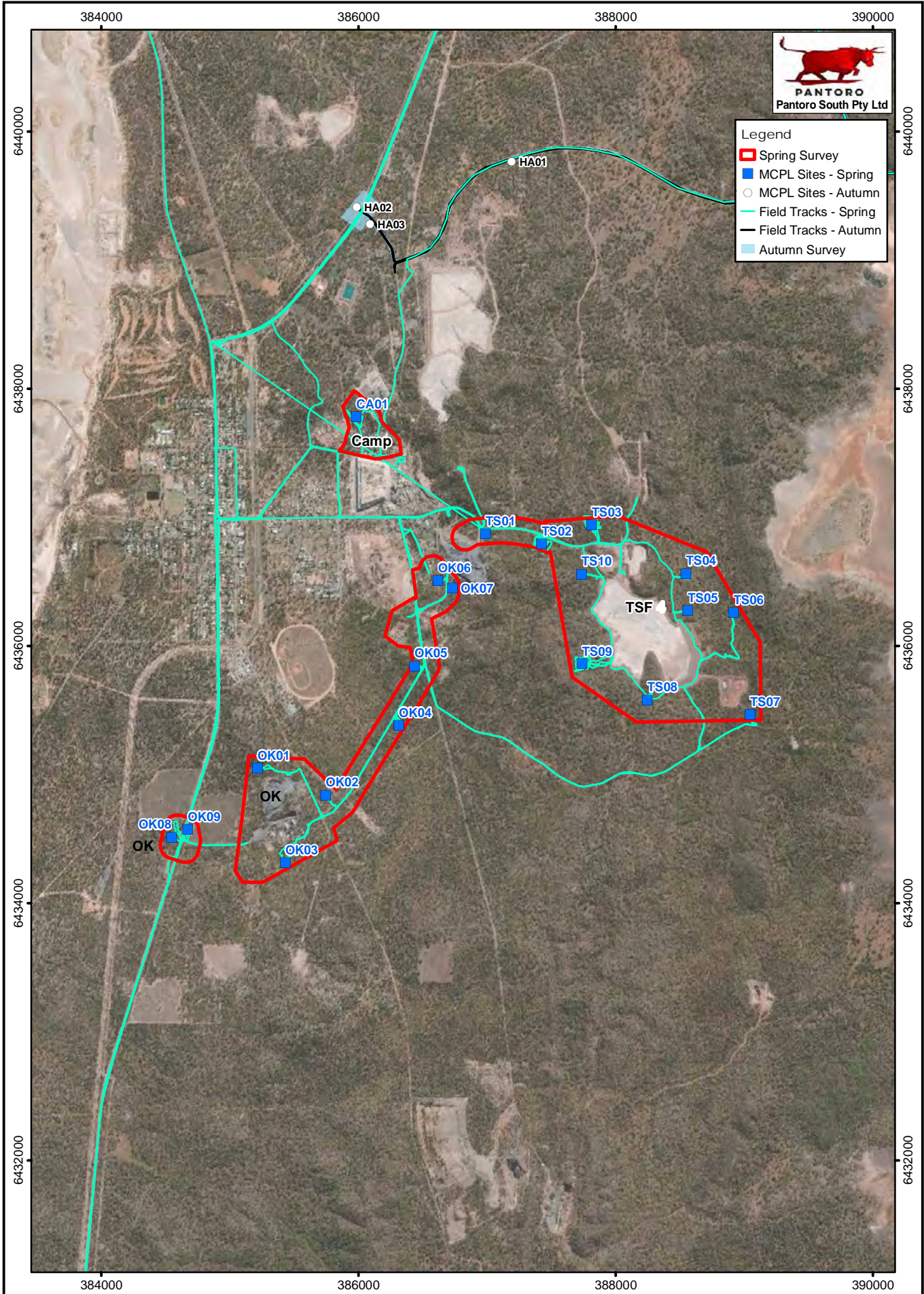
Norseman Gold Project
 Sites and Tracks
 Sheet 2 of 5

Figure:

3.2

Image: DigitalGlobe (May 2019)

CAD Ref: a2764_f06_02
 Date: December 2020 Rev: A A4



- Legend**
- ▭ Spring Survey
 - MCPL Sites - Spring
 - MCPL Sites - Autumn
 - Field Tracks - Spring
 - Field Tracks - Autumn
 - ▭ Autumn Survey

Image: DigitalGlobe (May 2019)

0 600 m
 Scale: 1:40,000
 MGA94 (Zone 50)

Mattiske Consulting Pty Ltd
 28 Central Road, Kalamunda WA 6076 - Tel: 9257 1625 - Fax: 9257 1640
 Author: E M Mattiske MCPL Ref: CNG2002-03
 Drawn: CAD Resources - www.cadresources.com.au
 Tel: (08) 9246 3242 - Fax (08) 9246 3202

Norseman Gold Project
Sites and Tracks
Sheet 3 of 5

Figure:
3.3



- Legend**
- Spring Survey
 - MCPL Sites - Spring
 - MCPL Sites - Autumn
 - Field Tracks - Spring
 - Field Tracks - Autumn
 - Autumn Survey

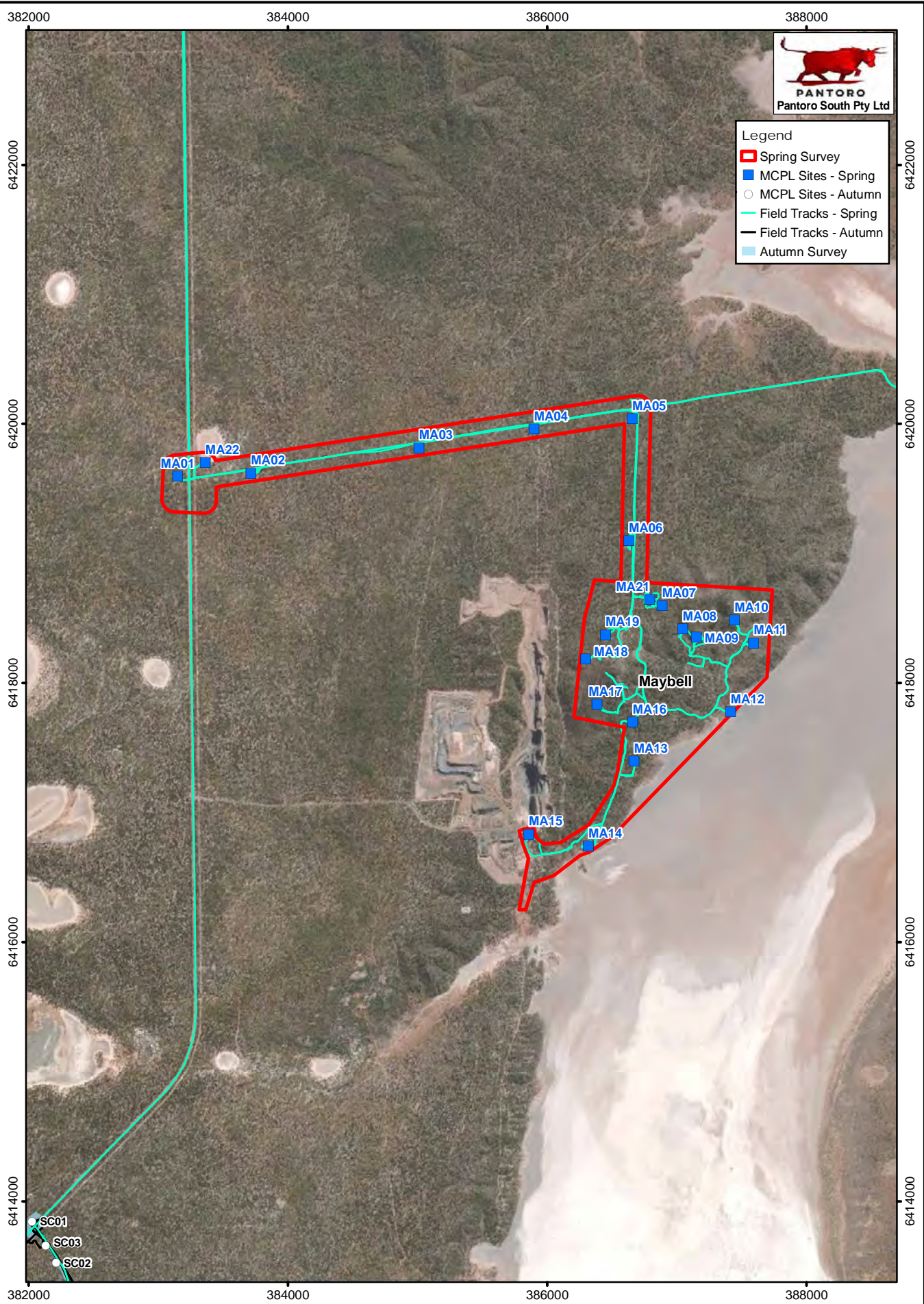


Image: DigitalGlobe (May 2019)

N
 0 600 m
 Scale: 1:40,000
 MGA94 (Zone 50)

CAD Ref: a2764_f06_02
 Date: December 2020 Rev: A A4

Mattiske Consulting Pty Ltd
 28 Central Road, Kalamunda WA 6076 - Tel: 9257 1625 - Fax: 9257 1640
 Author: E M Mattiske MCPL Ref: CNG2002-03
 Drawn: CAD Resources - www.cadresources.com.au
 Tel: (08) 9246 3242 - Fax (08) 9246 3202

**Norseman Gold Project
 Sites and Tracks
 Sheet 4 of 5**

Figure:
3.4

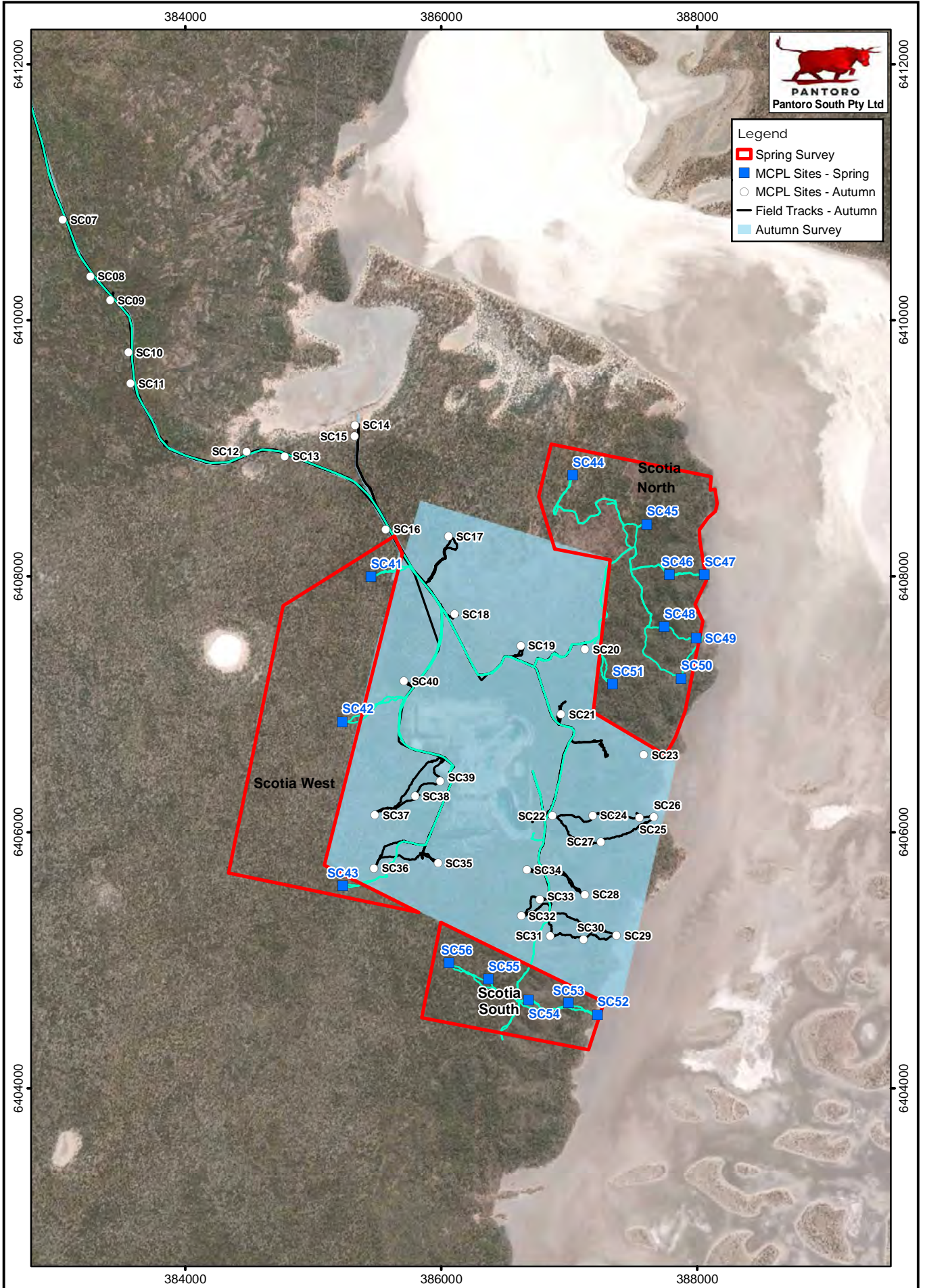



Image: DigitalGlobe (May 2019)


 0 600 m
 Scale: 1:40,000
 MGA94 (Zone 50)

CAD Ref: a2764_f06_02
 Date: December 2020 Rev: A A4


Mattiske Consulting Pty Ltd
 28 Central Road, Kalamunda WA 6076 - Tel: 9257 1625 - Fax: 9257 1640
 Author: E M Mattiske MCPL Ref: CNG2002-03
 Drawn: CAD Resources - www.cadresources.com.au
 Tel: (08) 9246 3242 - Fax (08) 9246 3202

Norseman Gold Project
Sites and Tracks
Sheet 5 of 5

Figure:
3.5

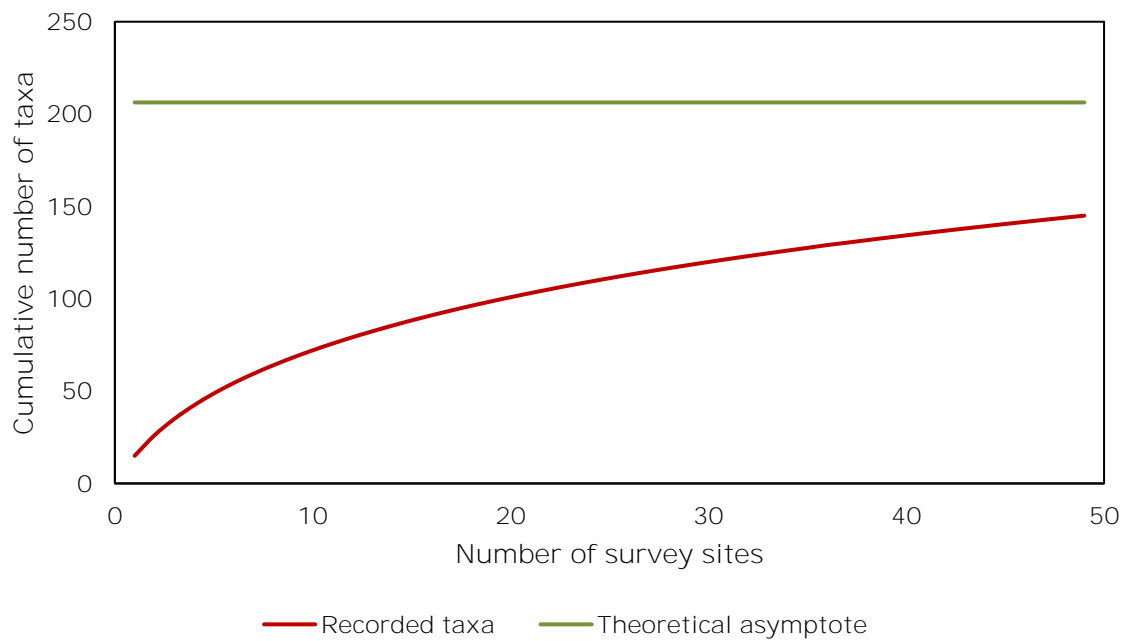


FIGURE 4.1: Average randomised Species Accumulation Curve for the Hills survey areas, Spring 2020

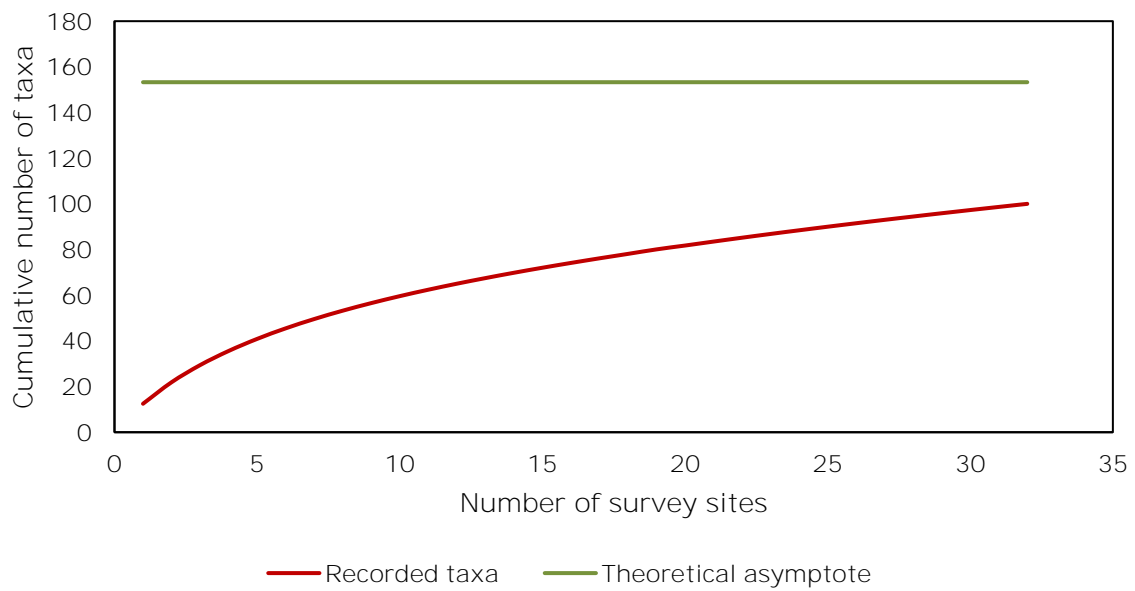


FIGURE 4.2: Average randomised Species Accumulation Curve for the Flats survey area, Spring 2020

4.1.1. Threatened and Priority Flora

No threatened flora species pursuant to Part 2, Division 1, Subdivision 2 of the BC Act and as listed by DBCA (2018a), or pursuant to section 179 of the EPBC Act or listed by the DAWE (2020b), were recorded within the nine Norseman Gold Project areas covered in the Spring survey.

Eight priority flora species as listed by DBCA (2018b) were recorded in the Spring survey that were not recorded in the Autumn survey. Definitions of the priority rankings are given in Appendix A1. The species are:

- *Allocasuarina eriochlamys* subsp. *grossa* (P3)
- *Eremophila purpurascens* (P3)
- *Eucalyptus brockwayi* (P3)
- *Eucalyptus websteriana* subsp. *norsemanica* (P1)
- *Goodenia laevis* subsp. *laevis* (P3)
- *Melaleuca coccinea* (P3)
- *Micromyrtus papillosa* (P1)
- *Philothea apiculata* (P1)

All of these taxa were found within the Hills survey areas; one taxon was also recorded in the TSF and Camp areas (Table 2). The identities of these priority taxa were confirmed by taxonomic experts at the WAH.

Two populations of *Acacia kerryana* (P2) identified in the Autumn survey along the Jimberlana pipeline access road (MCPL 2020) were revisited in Spring in order to find flowering material and to further delineate their populations (Table 2). Whilst the plants were in a vegetative state in Spring, they were easily identifiable in the field due to their distinctive habit. The first population listed in Table 2 was recorded as having approximately 460 individuals in a 1 ha area; it did however continue for another 300 m westwards along the Jimberlana pipeline access road. The second population was much smaller.

A brief description of the eight priority flora species recorded in the Spring survey only is provided below.

Table 2: Location and extent of priority taxa within the Norseman Gold Project Spring survey areas

SPECIES	SCC	SURVEY AREA	No. INDIVIDUALS	AREA OF POPN (m)	COND	REPRO STAT E	LOCATION (GDA94 Z51)	
							EASTING (mE)	NORTHING (mN)
<i>Acacia kerryana</i>	P2	Jimberlana	460 ^a	100 x 100	-	V	392758	6443187
	P2	Jimberlana	7	80 x 40	-	V	390560	6442708
<i>Allocasuarina eriochlamys</i> subsp. <i>grossa</i>	P3	Cobbler	27	20 x 10	SS	V / Fr	380160	6440338
	P3	Cobbler	50	20 x 20	-	-	381285	6441573
<i>Eremophila purpurascens</i>	P3	Maybell	87	100 x 100	S	V / FI	386318	6416743
	P3	Maybell	8	10 x 10	SS	V / FI	387030	6418370
	P3	Maybell	11	10 x 10	SS	V / FI	386355	6418205
	P3	Maybell	7	10 x 10	S	V / FI	386457	6418400
	P3	Maybell	2	2 x 2	S	V / FI	386445	6418376
	P3	Maybell	10	10 x 5	S	V / FI	386473	6418347
	P3	Cobbler	1	50 x 20	SS	V	380642	6440276
	P3	Cobbler	3	10 x 10	S	FI	380633	6440170
	P3	Cobbler	4	10 x 10	S	FI	380612	6440091
	P3	Cobbler	5	10 x 10	SS	FI	380582	6440040
	P3	Cobbler	2	100 x 100	SS	FI	381285	6441573
	P3	Cobbler	4	20 x 20	SS	V / FI	381622	6441743
	P3	Scotia	-	20 x 20	-	-	388059	6408013
	P3	Cobbler	5	20 x 20	S	-	380546	6440006
	P3	Scotia	1	20 x 20	-	V	387784	6408013
	P3	Scotia	-	20 x 20	-	-	387875	6407202
	P3	Scotia	1	20 x 20	-	-	386685	6404689
P3	Cobbler	3	20 x 20	-	-	381285	6441572	
<i>Eucalyptus brockwayi</i>	P3	Maybell	11	100 x 100	H	V / Fr	387151	6418355
	P3	Maybell	18	50 x 50	H	V / Fr	387133	6418280
	P3	Maybell	21	75 x 50	H	V / Fr	387117	6418237
	P3	Maybell	23	100 x 50	H	V / Fr	386636	6419037
	P3	Maybell	1	1 x 1	H	Fr	386620	6417961
	P3	Maybell	21	100 x 100	SS	V / Fr	386791	6418644
	P3	Cobbler	9	100 x 50	SS	V / Fr	380968	6441249
	P3	TSF	8	20 x 20	-	FI / Fr	387425	6436794
	P3	TSF	1	20 x 20	-	FI / Fr	387816	6436945
	P3	TSF	-	20 x 20	-	FI / Fr	387740	6435862
	P3	Camp	6	250 x 40	-	FI / Fr	385977	6437748
	P3	Camp	4	250 x 40	-	-	386170	6437712
P3	Maybell	3	20 x 20	-	-	386631	6419102	
<i>Eucalyptus websteriana</i> subsp. <i>norsemanica</i>	P1	Cobbler	16	100 x 100	S	V	381285	6441573
<i>Goodenia laevis</i> subsp. <i>laevis</i>	P3	Maybell	12	5 x 5	H	V / FI	386593	6417976
<i>Melaleuca coccinea</i>	P3	Maybell	29	30 x 20	S	Fr	386413	6418210
<i>Micromyrtus papillosa</i>	P1	Cobbler	6	100 x 100	SS	FI	381285	6441573
	P1	Cobbler	54	20 x 20	SS	V / FI	381574	6441707
	P1	Cobbler	2	20 x 20	SS	FI	381618	6441742
<i>Philotheca apiculata</i>	P1	Maybell	35	25 x 25	SS	V / FI	386461	6418406
	P1	Maybell	33	50 x 50	SS	V / FI	386442	6418362
	P1	Maybell	13	12 x 12	SS	V / FI	386835	6418647
	P1	Maybell	10	20 x 20	-	-	386452	6418375
	P1	Maybell	3	20 x 20	-	-	386300	6418188

^a – This population continued ~400 m to the west along the Jimberlana pipeline access road, with plants more numerous on the north side of the road than the south.

- *Allocasuarina eriochlamys* subsp. *grossa* (P3) - CASUARIACEAE

This species is a tall shrub or tree (1.5-3 m). It is often found growing in shallow soils including stony loam, lateritic clay and breakaways, and at the base of granite outcroppings. This *Allocasuarina* is known from a number of collections within 15 km of Norseman and between Norseman and Kalgoorlie. It has also been recorded in the locality of Caiguna approximately 300 km east of Norseman. This species was first collected in Norseman in 1935 and formally described in 1989. It has also been known as *Allocasuarina campestris* subsp. *grossa*.

Allocasuarina eriochlamys subsp. *grossa* (P3) was found on the mid slope of a prominent granite ridge within the Cobbler survey area (site CO03) in red sandy clay with many surface rocks (Table 2). The plant was in fruit (Plates 1a, 1b). Another population was found within the Cobbler area on a rocky hill slope. Both populations were found in vegetation community S1.



Plates 1a & 1b: *Allocasuarina eriochlamys* subsp. *grossa* (P3) (Photos: E. Chetwin)

- *Eremophila purpurascens* (P3) - SCROPHULARIACEAE

This species is an erect, bushy shrub (30 cm to 1.5 m) with pink, purple red flowers found August through October. *Eremophila purpurascens* grows in shallow soil including sandy clay and stony loam over greenstone as well as on granite hills and outcroppings. This species was first collected in 1904 and is limited to the rocky outcrops in the immediate vicinity (less than 10 km) of Norseman.

All populations were found within the Hills survey area, on rocky slopes and ridges in red-brown sandy gravel and sandy clay: six populations were recorded in the Maybell area, eight in the Cobbler area and four in the Scotia extensions area (Table 2). The populations were found in communities S1, W4 and W5. Most plants were in flower (Plate 2).



Plate 2: *Eremophila purpurascens* (P3) (Photo: S. Ruoss)

- *Eucalyptus brockwayi* (P3) - MYRTACEAE

A small endemic tree 5-20 m tall with white-cream flowers which have been recorded March to June. The bark of this *Eucalyptus* is smooth throughout, shiny, mottled light grey, salmon pink and creamy white. *Eucalyptus brockwayi* is recognisable within its natural range due to basally dilated buds (Plate 3b), small globular-urceolate fruit (Plate 3c) and distinctive, densely reticulate, glandless adult leaves. This species grows on low rocky hills in gravelly sandy loam, but is restricted to an area within 30 km of Norseman.

Seven populations of *Eucalyptus brockwayi* were recorded in the Maybell survey area and one in the Cobbler area. Within the Flats survey area, three populations were recorded in the TSF area and two in the Camp survey area (Table 2). Landforms varied from flats to hill slopes and soil was generally sandy clay or clay loam, with little surface gravel. The plants were often in bud and/or fruit (Plates 3a, 3b, 3c). The populations were found in the widespread vegetation communities W2 (in the Hills survey area) and NW10 (in the Flats survey area).



Plates 3a, 3b, 3c: *Eucalyptus brockwayi* (P3) (Photos: M. Behn)

- *Eucalyptus websteriana* subsp. *norsemanica* (P1) - MYRTACEAE

This species is a small mallee to 3 m tall, with cream or lemon yellow flowers September to November. The bark of this mallee is red brown 'minni-ritchi' and it grows in skeletal soils on rocky rises. This species was only known from one location near Norseman when it was described in 1992 and differs from the more widespread form of *E. websteriana* in the lack of visible white wax (not pruinose), sometimes shorter pedicels, and narrowish leaves. A second smaller population has recently been recorded south-west of Coolgardie.

Only one population of this species was found, on the mid slope of a granite ridge in the Cobbler survey area, in red sandy clay with many surface rocks, in community S1 (Table 2). The plant was in a vegetative state but was recognisable in the field due to its distinctive bark and leaf shape (Plates 4a, 4b).



Plates 4a & 4b: *Eucalyptus websteriana* subsp. *norsemanica* (P1) (Photos: S.Ruoss)

- *Goodenia laevis* subsp. *laevis* (P3) - GOODENIACEAE

This *Goodenia* is an erect or scrambling herb or woody shrub to 25 cm tall with yellow flowers from August to December. Growing on sandy loam or laterite, this species is found infrequently south of Norseman and east until Esperance. This species was also called *Goodenia* sp. Gibson (A. Strid 21263).

Only one small population was found on a rocky hill slope in the Maybell survey area, in deep leaf litter at the edge of a disturbed area (old mining operations) (Table 2). One plant was in flower (Plates 5a, 5b). The population was found in vegetation community W4.



Plates 5a & 5b: *Goodenia laevis* subsp. *laevis* (P3) (Photo: S.Ruoss)

- *Melaleuca coccinea* (P3) - MYRTACEAE

A many branched shrub that grows to 2.6 m tall with red flowers from September to November or January. This *Melaleuca* is found growing in sandy loam over granite and has been found on granite outcrops, sandplains and river valleys. It was first collected in 1961 and described in 1966, and has been found widespread in the Coolgardie region between Kalgoorlie and Norseman with another population north of Ravensthorpe.

Only one population of *Melaleuca coccinea* (P3) was recorded, on an ironstone hill slope in the Maybell survey area (Table 2). No flowering plants were found but the persistent fruit enabled recognition in the field (Plate 6). The population was within the shrubland vegetation community S1.



Plate 6: *Melaleuca coccinea* (P3) (Photo: E.Chetwin)

- *Micromyrtus papillosa* (P1) - MYRTACEAE

An erect or low, spreading shrub that grows to 1.2 m tall with white flowers in April or August to October. This species occurs on hills, from near the base to the summit, in sandy or clay soil with ironstone or granite rocks, most commonly found on rocky sites and outcrops. It is restricted to the Norseman area, having been found on only three hills within a range of less than 30 km. This species was first collected in 1953 and described in 2002.

Three populations of *Micromyrtus papillosa* (P1) were recorded in the Cobbler survey area (Table 2). All populations contained plants in flower (Plates 7a, 7b). One population was on the mid slope of a granite ridge in red sandy clay with many surface rocks, in shrubland community S1. The other two populations were near each other, within 400m of the first population, in brown-red sandy clay with surface rocks on a rocky granite headland at the edge of a salt lake in *Eucalyptus* woodland community W6.



Plates 7a, 7b: *Micromyrtus papillosa* (P1) (Photos: S.Ruoss)

- *Philothea apiculata* (P1) - RUTACEAE

An erect shrub growing to 1.5 m tall with white flowers found August to November. This species grows in skeletal soils including stony clay loam on rocky hillsides and outcropping. It was first collected in 1965 and called *Eriostemon apiculatus* but was reclassified in 1998 to *Philothea apiculata*. This species is known to occur in a restricted area around Norseman with several populations further away which may be reclassified at a later date (Wilson 1998).

Five populations of *Philothea apiculata* (P1) were recorded within the Maybell survey, generally in red-brown clay soil with surface rocks on ironstone slopes and ridges (Table 2). Flowering plants were found in each population (Plate 8). Four of the populations were found within vegetation community W4 and one within W4, all near patches of shrubland community S1.



Plate 8: *Philotheca apiculata* (P1) (Photo: S.Ruoss)

4.1.2. Other Significant Flora

- *Eremophila purpurascens* x *E. alternifolia* - SCROPHULARIACEAE

One collection was made of *Eremophila purpurascens* x *E. alternifolia* (Plate 9) from the Cobbler survey area (site CO05), and it was recorded at one another location (site CO07) in the Cobbler area. The plants ranged from 50-170 cm tall, and were growing in *Eucalyptus* woodland. This hybrid has been poorly collected in the past, with only one specimen currently lodged at the WAH. The specimen collected at Cobbler in this survey will be vouchered with the WAH.



Plate 9: *Eremophila purpurascens* x *E. alternifolia* (Photo: S.Ruoss)

- *Eremophila parvifolia* - SCROPHULARIACEAE

Eight populations of *Eremophila parvifolia* recorded throughout the Northern survey areas in Autumn and identified as potentially the priority-listed subspecies *Eremophila parvifolia* ?subsp. *parvifolia* (P4) were revisited in Spring in order to obtain a fruiting sample for identification purposes (as fruit is required to be confidently identify a specimen to a sub-species level) and to further delineate the populations. Four populations in Gladstone extension, two in Slippers and one in North Royal extension were newly identified and delineated in Spring (Table 3). No flowering or fruiting plants were found during the Spring survey. However, one collection (without fruit) was submitted to the WAH for identification by a taxonomic expert and was identified as *Eremophila parvifolia* ?subsp. *auricampi*, the non priority-listed

subspecies. Non-fruit characteristics determining the subspecies are habit and distribution, where subsp. *auricampi* is an erect shrub with distribution known to include Norseman and subsp. *parvifolia* is a low, spreading shrub with a distribution over 200 km to the east of Norseman. Whilst most of the plants observed in the Norseman Gold Project areas were low and spreading, if they were to be subsp. *parvifolia* they would be a major range extension to that taxon's known distribution. Given this, any occurrences of *Eremophila parvifolia* will be treated here and should be for references made previously in MCPL 2020 as potentially the non priority-listed *Eremophila parvifolia* ?subsp. *auricampi*.

Table 3: Locations of *Eremophila parvifolia* ?subsp. *auricampi* recorded within the Norseman Gold Project Spring survey areas

SURVEY AREA	SITE	No. INDIVIDUALS	AREA OF POPN (m)	VEGETATION COMMUNITY	LOCATION (GDA94 Z51)	
					EASTING (mE)	NORTHING (mN)
Gladstone	GL21	11	20 x 20	NW9	393571	6443066
	GL22	4	20 x 20	NW9	393609	6442678
	GL23	3	20 x 20	NW9	393656	6442484
	GL24	10	20 x 20	NW11	393555	6442279
North Royal	NR23	2	20 x 20	NW5	387672	6446366
Slippers	SL01	81	20 x 20	NW5	388078	6444367
	SL03	1	20 x 20	NW10	387835	6443715

- *Range extensions*

Six taxa recorded within the Norseman Gold Project survey areas represent extensions to their current known distributions based on WAH data in FloraBase (WAH 1998-). Two of these, *Austrostipa ?nullarborensis* and *Daviesia ?benthamii* could not definitively be identified to species level due to lack of either fruiting or flowering material, but are listed here as tentative range extensions. A list of species representing a range extension for this area and the approximate distance from their currently known distribution is presented below (Table 4). Three of the taxa listed below, *Maireana sedifolia* (1995, 2001 and 2003; see MCPL 2020 Appendix C), *Rhagodia ulicina* (Autumn 2020 survey; MCPL 2020) and *Sida calyxhymenia* (1996 and 2013; see MCPL 2020 Appendix C) have been found in previous surveys in the area, but these records do not appear in Florabase (WAH 1998-). In this report 100 km has been used as a basis to determine an extension to the currently known range for a species. A rating has also been applied to each species, of Low (100-149 km), Moderate (150-199 km) or High (200+ km) range extension.

Table 4: Taxa recorded within the Norseman Gold Project survey areas in Spring 2020 representing an extension to currently known distributions (WAH 1998-)

SPECIES	DISTANCE (km)	RATING
<i>Austrostipa ?nullarborensis</i>	120 km	Low
<i>Daviesia ?benthamii</i>	175 km	Moderate
<i>Eragrostis australasica</i>	100 km	Low
<i>Maireana sedifolia</i>	110 km	Low
<i>Rhagodia ulicina</i>	110 km	Low
<i>Sida calyxhymenia</i>	100 km	Low

4.1.3. Introduced (Weed) Species and Declared Pest (Plant) Organisms

Five introduced (weed) species, **Asphodelus fistulosus* (Onion Weed), **Carrichtera annua* (Ward's weed), **Gazania linearis*, **Salvia verbenaca* (Wild sage) and **Sonchus oleraceus* (Common sowthistle) were recorded within the Norseman Gold Project survey areas (Table 5). None of these are declared pest organisms pursuant to section 22 of the BAM Act (both are permitted under section 11 of the BAM Act).

Table 5: Introduced (weed) taxa recorded within the Norseman Gold Project survey areas, Spring 2020

^ Ecological Impact and Invasiveness rankings are from Department of Parks and Wildlife (DPaW) 2014

SPECIES	LIFE FORM	BAM ACT STATUS	ECOLOGICAL IMPACT [^]	INVASIVENESS [^]	LOCATIONS (SURVEY SITES)
<i>*Asphodelus fistulosus</i>	Annual	Permitted (s11)	Unknown	Rapid	GL27, OK08
<i>*Carrichtera annua</i>	Annual	Permitted (s11)	High	Rapid	GL27, MA05
<i>*Gazania linearis</i>	Perennial	Permitted (s11)	-	-	CO07, OK08
<i>*Salvia verbenaca</i>	Perennial	Permitted (s11)	Unknown	Unknown	GL27
<i>*Sonchus oleraceus</i>	Annual	Permitted (s11)	Unknown	Rapid	MA01

Under the DPaW 2013 Weed Prioritisation Process (DPaW 2013), **Gazania linearis* is considered to be one of the 17 Goldfields Region priority alert weeds; in 2014 it was not found within the DBCA estate (DPaW 2014) and should be reported to the local DBCA office.

Two sites, GL27 and OK08, had more than one weed species recorded, although foliage cover of these species was small (0.13% for GL27 and 0.07% for OK08). Site GL27 is located in a micro-channel on a lower slope at the edge of a salt lake; this site had high species diversity (28 taxa) and a high proportion of annual species (six taxa were annual or short-lived perennials). Site OK08 is on flats at the edge of a highway; the general area was quite disturbed, although the survey quadrat itself was not.

**Asphodelus fistulosus* was previously recorded by MCPL (2001a) in the Gladstone area and along the North Royal pipeline (MCPL 2020); **Carrichtera annua* has been recorded throughout the Norseman Gold Project area in the past (see MCPL 2020); **Gazania linearis* was recorded by MCPL (2020) in the Gladstone area; and **Sonchus oleraceus* was recorded by MCPL (2001a) in the Gladstone area and the North Scotia, Mt Henry and Maybell areas in the past (MCPL 2013a, 2013b). **Salvia verbenaca* has not been recorded in the Norseman Gold Project area in the past (see MCPL2020).

4.2. Vegetation

4.2.1. Statistical Analysis

Several approaches to analysing the foliage cover data were tried in order to and define vegetation communities that were both meaningful and not overly complex. In the Autumn survey, statistical analyses for the Northern and Scotia survey areas were conducted separately due to distinct differences between the areas in species composition, vegetation communities, landforms and hydrology observed in the field. The best grouping of survey areas for the Spring survey was determined by trialling different combinations of survey areas and relating the results to field observations. **One group, 'Hills'** (comprising Scotia extensions, Maybell and Cobbler survey areas) was defined clearly by its landforms, which are dominated by east-facing ironstone slopes adjacent to salt lakes. **The second group, 'Flats'** (Camp, Gladstone extensions, North Royal extension, OK, Slippers and TSF survey areas) is situated on gentler slopes and lower lying areas. Species composition and vegetation communities of the two groups were observed in the field to be different.

4.2.1.1. Hills Survey Area

SIMPROF analysis identified eight significantly associated groups of survey quadrats in the Hills survey area (Figure 5.1). Outliers and small groupings (e.g., communities NS3, S5, S6, W3, W5 and W6) were usually unable to be assigned to broader comparative vegetation units due to their very distinctive species composition; however, some of these small groups of sites often aligned well with communities defined in the Autumn survey (communities NS3, W3 and W5). For the purposes of vegetation mapping (i.e. extrapolating quadrat data to generalise vegetation communities over broad areas), an inclusive rather than exclusive approach was adopted (e.g., two large PRIMER groupings were combined in their entirety to form the community W2). Based on this approach, nine vegetation communities were delineated within the Hills survey area (Table 6), with the remainder of the survey area consisting of non-vegetated salt lake and cleared land.

The two outliers recognised were communities S5 and W5. Community S5, a newly defined community, was located on the edge of a salt lake in the Maybell area (site MA14) but, despite its proximity to the lake, was not dominated by chenopod shrubs. The most dominant shrub in this area is *Eremophila purpurascens* (P3). Whilst this species was recorded in two other communities (at three sites in each), nowhere else was it so clearly dominant. There are three other sites that are located near salt lakes on lower slopes with sandy clay soil, but none have the dense mid shrub coverage of this site. This community is difficult to define using aerial photographs; it may be present elsewhere in the Norseman Gold Project area, but would require further fieldwork to define its extent. The woodland community W3 had only one quadrat within it in Spring (SC44), but five quadrats in the Autumn survey. Whilst the upper stratum of the quadrat surveyed in Spring comprised *Eucalyptus delicata*, those in the Autumn survey all contained *E. longicornis* and the understorey species composition was very similar. These two *Eucalyptus* species are closely related and very similar, aside from slight differences in the size of adult leaves, buds and fruit (Centre for Australian National Biodiversity Research 2020). This community is not considered to be restricted. The *Eucalyptus* woodland W5, with its shrub layer dominated by *Olearia* spp. low shrubs, occurs on the western side of a highway in the Maybell area (site MA01) at the extreme of a narrow survey area. This community is not considered to be restricted; rather, the survey area covered only a small area on the western side of the highway, reducing the ability for site replication in this community.

W5 had two sites within it in the Autumn survey, both in the Scotia area. Community group NS3 contains two survey quadrats (CO11 and MA12), both on *Tecticornia* spp. low shrublands at the immediate edge of salt lakes. This community is not restricted; rather it was adequately defined in the Autumn survey (seven quadrats) and has easily recognisable topography and vegetation assemblages, so there was little need to further define it in the Spring survey.

Newly defined low open woodland community W6, comprising three quadrats (CO01, CO02, CO04) was defined on the basis of its singular canopy species *Eucalyptus concinna*, which was seen in only one other site, where it formed only a very minor component of the upper stratum. This community may be restricted to small promontories at the edge of salt lakes and was seen only in the Cobbler area. The other three vegetation communities in the Hills survey area contained from eight to 22 quadrats.

4.2.1.2. Flats Survey Area

SIMPROF analysis identified eight significantly associated groups of survey quadrats in the Flats survey area (Figure 5.2). The PRIMER statistical analysis identified three outlier quadrats and one group of two quadrats). Several of the groups assigned by PRIMER were altered to reflect field observations, aerial photographs and previous mapping. For the purposes of vegetation mapping (i.e. extrapolating quadrat data to generalise vegetation communities over broad areas), an inclusive rather than exclusive approach was attempted. Three of the mid-sized PRIMER groupings were combined in their entirety to form the community NW10 (16 sites). However, the largest PRIMER group (10 quadrats) was split to form parts of 6 different communities. Based on this approach, twelve vegetation communities were

delineated within the Flats survey area (Table 7), with the remainder of the survey area consisting of non-vegetated salt lake and cleared land.

One of the initial outliers remained as an outlier after qualitative analysis. The woodland community NW8 was recorded at the accommodation camp (site CA01). Whilst several other *Eucalyptus* species were recorded around the survey area, *Eucalyptus torquata* was dominant in the canopy, with *Atriplex* spp. most common in the understorey. This community was recorded in Autumn, at two quadrats in the Gladstone-North Royal Haul Roads survey area. It is not considered to be restricted. The mid shrubland community NS4 was recorded at one site (GL27) in the Gladstone area. This community was recorded at four quadrats in the Autumn survey, and likely occurs in many similar settings at the edge of salt lakes and salty drainage lines. Community S4, a mid-tall shrubland, was recorded in the TSF survey area at one site (TS08) on a rocky ridge. It was initially recognised in the Autumn survey at one site in the Scotia area in a similar setting. This community may be restricted to banded iron formation ridges. *Casuarina* woodland community NW11, recorded at three quadrats on low dunes in powdery pale clay at the edge of salt lakes in the Gladstone area in Autumn, was recorded at one site (GL24) in Spring, also in the Gladstone area on flats. This community is likely restricted to these landforms, soil types and hydrology. Newly defined community NW15 is defined by one quadrat (TS05) on the basis of its dominant understorey species *Trymalium myrtillus* subsp. *myrtillus* and *Halgania andromedifolia* along with the canopy *Eucalyptus lesouefii*. This area may have been disturbed in the past by mining, as it has a proliferation of juvenile Eucalypts, and it may evolve into another, more established, community over time.

The newly documented *Eucalyptus* woodland community NW13 is defined by two sites (OK03, OK09) in the OK survey area and has a distinct lack of low shrubs and herbs, essentially being *Eucalyptus* spp. over *Eremophila scoparia* tall shrubs. This community occurs in areas with some significant previous disturbance (roads, mining activities) and hence may be an altered version of the surrounding community NW10. Community NW14 is a *Eucalyptus urna* woodland in drainage lines recorded in the Gladstone and TSF areas at two quadrats (GL26, TS08). Few creek lines were encountered in the Spring survey, and it is likely that this community would occur in other well defined drainage lines. Two communities, NW5 and NW9, were recorded in Spring at three sites each. The *Eucalyptus lesouefii* and *E. salubris* woodland NW5, mapped in the Gladstone, North Royal and Slippers areas was also recorded in the Autumn survey at nine quadrats in the Gladstone and North Royal survey areas. Community NW9, a low woodland of *Eucalyptus spreata*, was recorded in Spring at three sites near salt lakes in the Gladstone area, and one site in Autumn, also in the Gladstone area.

The most extensive vegetation community in the Flats survey area, NW10, a woodland of mixed *Eucalyptus* spp., was recorded at 16 quadrats in the Spring survey, and five in the Autumn survey.

4.2.2. Vegetation Communities

A summary of the vegetation communities mapped in both the Hills and Flats survey areas is presented in the sections below and in Tables 6 and 7 and details, along with representative photos are given in Appendices D and E. Maps of the vegetation communities in the Hills survey areas are shown in Figures 6.1-6.3 and the communities in the Flats survey area are shown in Figures 7.1-7.3. A total of 1695.5 ha mapped area is represented in Figures 6.1-6.3 and 7.1-7.3; 1262.6 ha in the Hills survey areas and 429.9 ha in the Flats survey area.

Norseman Gold Project Spring 2020 Survey: Hills Survey Areas Hierarchical Cluster of Floristic Community Types

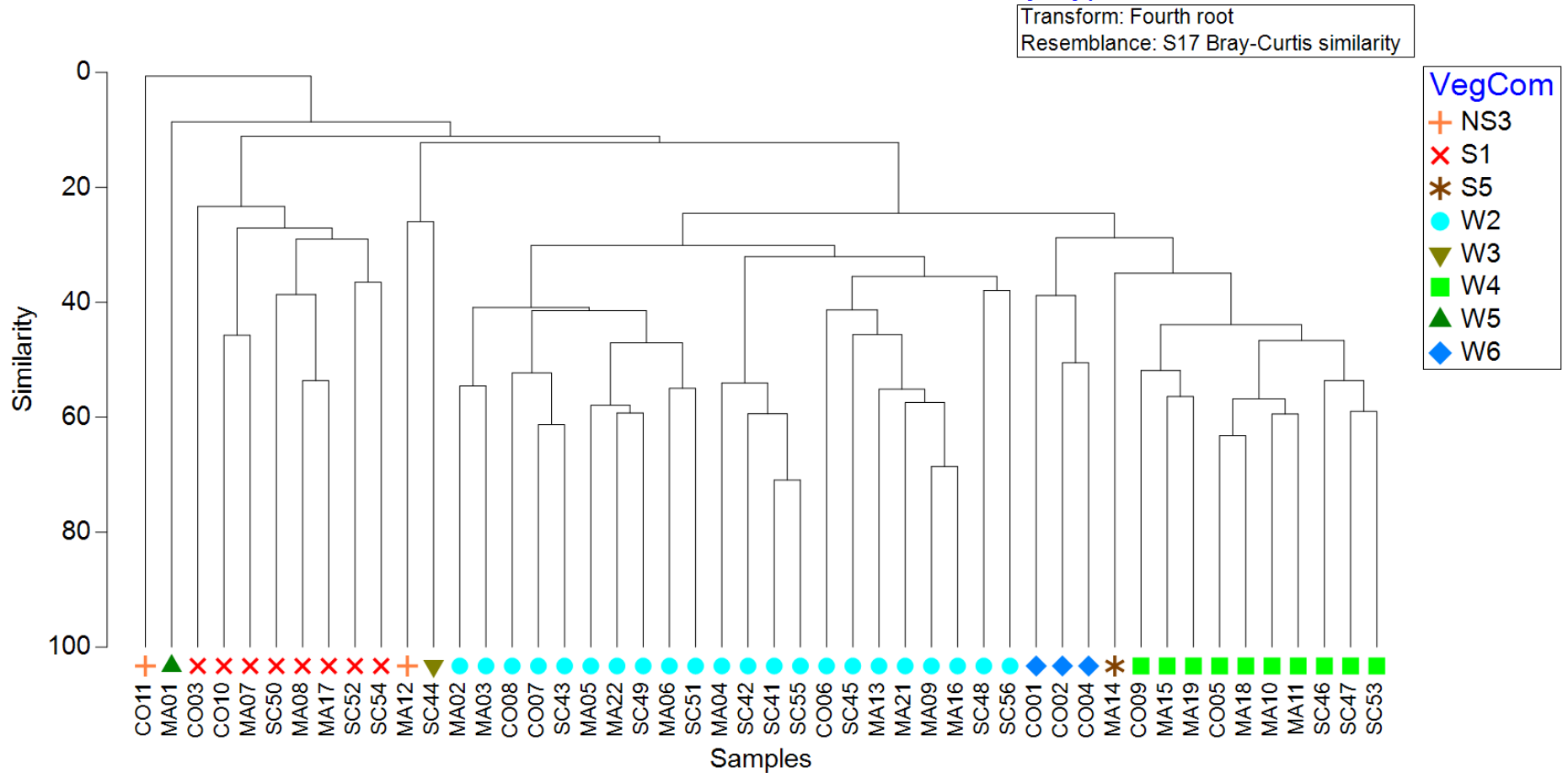


Figure 5.1: Dendrogram of Vegetation Communities for the Hills survey areas

Norseman Gold Project Spring 2020 Survey: Flats Survey Areas Hierarchical Cluster of Floristic Community Types

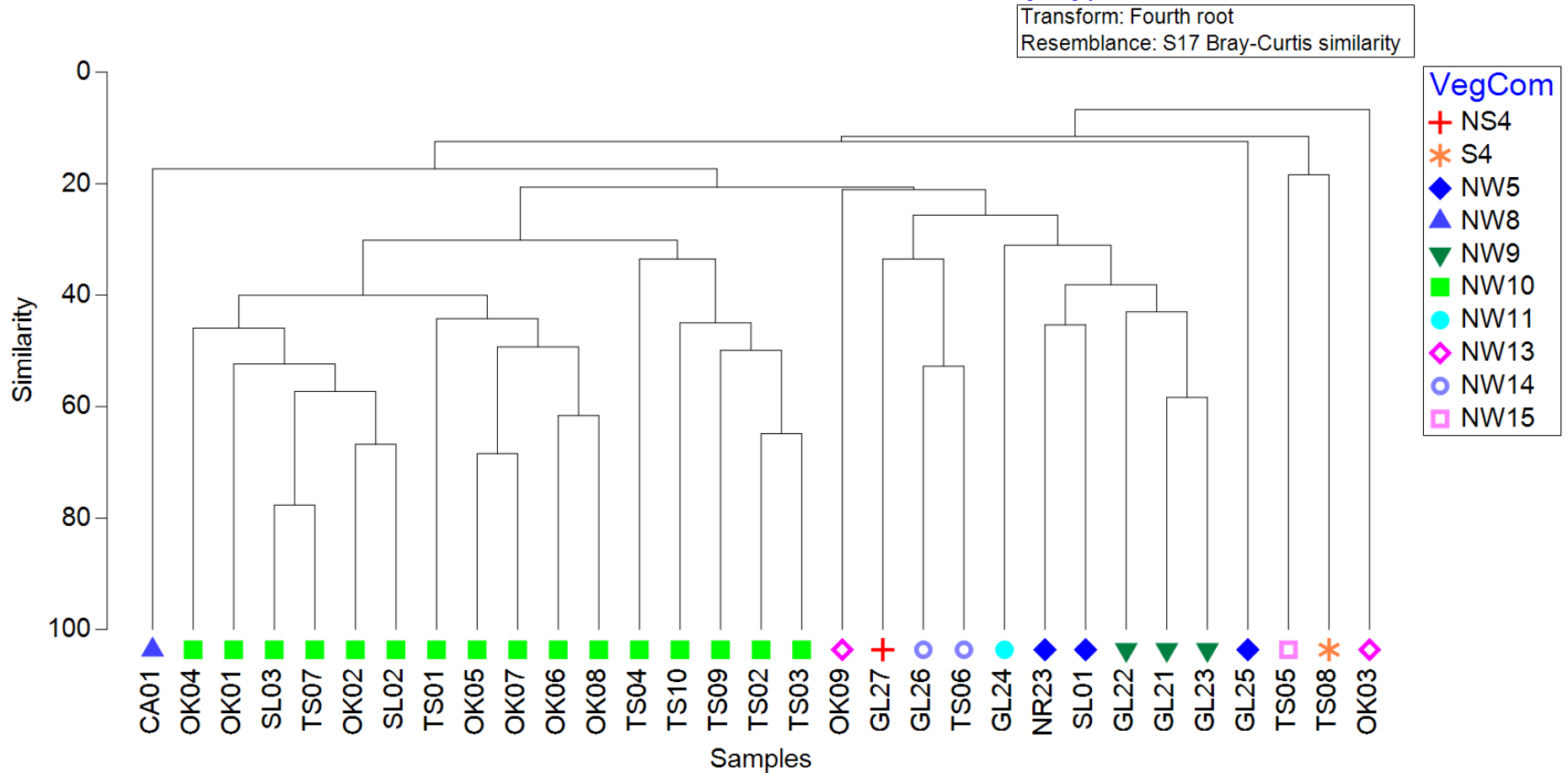


Figure 5.2: Dendrogram of Vegetation Communities for the Flats survey areas

4.2.2.1. Hills Survey Area

Nine vegetation communities were mapped across the Hills survey areas: five Eucalypt woodland (W) communities, four shrubland (NS and S) communities as well as cleared land (CL) and salt lakes (SL) (Table 6). Two of these, S5 and W6, are newly defined using the Spring survey data. Five communities have been slightly revised since Autumn (MCPL 2020). Community S1 has been broadened to include *Allocasuarina* spp. (not just *Allocasuarina campestris*), *Cryptandra* spp. (rather than just *Cryptandra graniticola*) and *Dodonaea microzyga* var. *acrolobata* (previously not included) and ridges and rocky headlands (not just upper slopes). The woodland community W2 now explicitly mentions *Eucalyptus urna* (rather than including it in *E. flocktoniae* complex) and now includes *Eremophila scoparia* (previously not included). Community W3 now includes *Eucalyptus delicata*, which is very similar to *E. longicornis*. Woodland W4 is expanded to include the shrubs *Beyeria* spp., *Eremophila* spp., *Scaevola spinescens* and *Ptilotus obovatus*. Community W5 also now explicitly mentions *Eucalyptus urna* and generalises the *Olearia* species to *Olearia* spp. The S6 community is inferred from previous mapping in the Cobbler survey area (Mattiske 2002).

Table 6: Vegetation communities in the Hills survey areas, Spring 2020

*Vegetation community inferred from Mattiske 2002

VEG. COMM.	DESCRIPTION	AREA (ha)	% of HILLS SURVEY AREA
NS3	Low open chenopod shrubland of <i>Maireana amoena</i> , <i>Atriplex</i> spp. and <i>Tecticornia</i> spp. on cream to red sandy clay on flats on the edge of salt lakes and salty drainages.	21.7	1.7
S1	Shrubland of <i>Allocasuarina</i> spp., <i>Acacia neurophylla</i> subsp. <i>neurophylla</i> , <i>Melaleuca</i> ? <i>hamata</i> , <i>Dodonaea microzyga</i> var. <i>acrolobata</i> and <i>Cryptandra</i> spp. over mixed Asteraceae sp. and <i>Lepidosperma</i> sp. on red-brown clayey loam and ironstone outcropping on upper slopes and ridges and rocky headlands at the edges of salt lakes.	46.7	3.7
S5	Mid shrubland of <i>Eremophila purpurascens</i> (P3), <i>Senna artemisioides</i> subsp. <i>filifolia</i> , <i>Pomaderris forrestiana</i> , <i>Scaevola spinescens</i> and <i>Dodonaea microzyga</i> var. <i>acrolobata</i> over low sparse shrubland of <i>Cratystylis conocephala</i> and <i>Hibbertia pungens</i> on red-brown sandy clay with scattered surface gravel on lower slopes near salt lakes.	2.5	0.2
S6*	Tall open shrubland of <i>Eremophila alternifolia</i> over <i>Dodonaea lobulata</i> and <i>Eremophila glabra</i> over <i>Atriplex vesicaria</i> over <i>Austrostipa scabra</i> with emergent <i>Eucalyptus torquata</i> on slopes in clay loam in association with ultramafic outcropping with quartz pebbles.	10.1	0.8
W2	Woodland to open woodland of <i>Eucalyptus flocktoniae</i> , <i>E. urna</i> , <i>E. lesouefii</i> and <i>E. dundasii</i> over sparse shrubland of <i>Melaleuca sheathiana</i> , <i>Eremophila scoparia</i> , <i>Scaevola spinescens</i> , <i>Beyeria sulcata</i> and <i>Exocarpos aphyllus</i> over isolated shrubs of <i>Olearia muelleri</i> on orange-red to brown clayey loam on flats and slopes.	580.1	45.9
W3	Open woodland of <i>Eucalyptus longicornis</i> or <i>E. delicata</i> over open shrubland of <i>Melaleuca sheathiana</i> and <i>Cratystylis conocephala</i> over mixed sparse chenopod shrubland on pale brown clayey loam flats.	51.6	4.1
W4	Open woodland of <i>Eucalyptus torquata</i> over <i>Melaleuca sheathiana</i> , <i>Dodonaea microzyga</i> , <i>Alyxia buxifolia</i> , <i>Beyeria</i> spp. and <i>Eremophila</i> spp. over <i>Scaevola spinescens</i> and <i>Ptilotus obovatus</i> on red-brown clayey loam with surface rocks on slopes and ridges.	145.3	11.5
W5	Open woodland of <i>Eucalyptus gracilis</i> , <i>E. flocktoniae</i> and <i>E. urna</i> over sparse shrubland of <i>Olearia</i> spp. on red-orange clayey loam and sandy clay flats.	8.1	0.6
W6	Low open woodland of <i>Eucalyptus concinna</i> over isolated clumps of <i>Melaleuca</i> spp. and <i>Santalum acuminatum</i> mid-tall shrubs over isolated clumps of <i>Scaevola spinescens</i> low shrubs on sandy clay with some outcropping on low ridges near salt lakes.	6.2	0.5
CL	Cleared or disturbed.	16.4	1.3

SL	Salt lake or non-vegetated lake bed.	373.9	29.6
----	--------------------------------------	-------	------

The *Eucalyptus* woodland communities W2 (45.8%) and W4 (11.5%) made up the major part of the vegetation of the Hills survey area, with the remaining three woodland communities (W3, W5, W6) comprising 5.2% in total and the shrubland communities (NS3, S1 and S4) also making up 5.2% of the survey area. Only 1.3% of the Hills survey areas was disturbed (CL). Salt lake (SL) forms 31%, the bulk of it (393 ha) in the Cobbler area.

4.2.2.2. Flats Survey Area

Twelve vegetation communities were mapped in the Flats survey areas: eight *Eucalyptus* woodland (NW) communities, one *Casuarina* woodland (NW11), three shrubland (NS and S) communities as well as cleared land (CL) and salt lakes (SL) (Table 7). Three of these, NW13, NW14 and NW15, are newly defined using the Spring survey data. Four communities have been slightly revised since Autumn (MCPL 2020). The shrubland S4 has had emergent *Eucalyptus stricklandii* added (previously not included). Community NW5 now has *Eremophila parvifolia* ?subsp. *auricampi* (instead of ?subsp. *parvifolia* (P4)), and the previously listed *Tecticornia* and *Atriplex* species have been generalised to *Tecticornia* spp. and *Atriplex* spp. Community NW9 has had the shrub species *Cratystylis conocephala* and *Lawrencia squamata* added to the description. The *Eucalyptus* woodland NW10 has been broadened to include *Atriplex* spp. (rather than individual taxa). The *Casuarina* woodland NW11 has been made more general, with Chenopodiaceae and Aizoaceae spp. shrubs in place of individual taxa, and the topography expanded to include flats. No quadrats from the Spring survey were assigned to communities NS3 and NW7, but small areas of these were mapped in the Flats area where they were adjacent to Autumn survey mapping (these communities are not included in Appendix E).

The *Eucalyptus* woodland community NW10 (39.5%) made up most of the vegetated areas of the Flats survey area, with all other woodland communities in total comprising 21.1% of the Flats area and shrublands 6.2%. Non-vegetated lake bed (SL) covered only a very small part (1.7%) of this area. Previously disturbed areas (CL) covered significant parts of the Flats survey areas (31.5%), reflecting the location of many of the survey areas around old operational areas.

Table 7: Vegetation communities in the Flats survey area, Spring 2020

VEG. COMM	DESCRIPTION	AREA (ha)	% of FLATS AREAS
NS3	Low open chenopod shrubland of <i>Maireana amoena</i> , <i>Atriplex</i> spp. and <i>Tecticornia</i> spp. on cream to red sandy clay on flats on the edge of salt lakes and salty drainages.	5.5	1.3
NS4	Sparse mid shrubland of <i>Dodonaea viscosa</i> subsp. <i>angustissima</i> over open low shrubland of <i>Eremophila</i> ? <i>decipiens</i> , <i>Scaevola spinescens</i> , <i>Atriplex</i> ? <i>vesicaria</i> , <i>Rhagodia</i> ? <i>drummondii</i> , mixed Chenopodiaceae spp. and <i>Frankenia</i> sp. on red-brown sandy clay on low rises at the edge of salt lakes and salty drainages.	1.0	0.2
S4	Open shrubland of <i>Grevillea nematophylla</i> subsp. <i>nematophylla</i> with emergent <i>Eucalyptus stricklandii</i> over <i>Hibbertia pungens</i> , <i>Allocasuarina acutivalvis</i> subsp. <i>acutivalvis</i> and <i>Dampiera latealata</i> on orange clay loam with outcropping ironstone on ridges.	20.4	4.7
NW5	Mid woodland of <i>Eucalyptus lesouefii</i> and <i>Eucalyptus salubris</i> over mid isolated shrubs of <i>Eremophila scoparia</i> and occasional low <i>E. parvifolia</i> ?subsp. <i>auricampi</i> shrubs over open low chenopod shrubland of <i>Tecticornia</i> spp. and <i>Atriplex</i> spp. on orange to brown sandy clay with some surface gravel on flats and gentle slopes.	12.1	2.8
NW7	Low woodland of <i>Eucalyptus salubris</i> and <i>E. lesouefii</i> over tall sparse shrubland of <i>Melaleuca</i> ? <i>sheathiana</i> or <i>M. lanceolata</i> over mid-low sparse shrubland of <i>Atriplex</i> ? <i>nummularia</i> and <i>Atriplex</i> ? <i>vesicaria</i> on red to brown sandy clay with scattered surface rocks on flats and lower slopes.	12.1	2.8
NW8	Open low woodland of <i>Eucalyptus torquata</i> over mid sparse shrubland of <i>Beyeria sulcata</i> var. <i>brevipes</i> and <i>Eremophila</i> spp. over low isolated clumps of shrubs of <i>Scaevola spinescens</i> , <i>Atriplex</i> ? <i>vesicaria</i> and <i>Olearia muelleri</i> on red to brown clayey loam on lower to mid slopes.	5.7	1.3
NW9	Low woodland of <i>Eucalyptus spreta</i> over isolated clumps of mid <i>Cratystylis conocephala</i> shrubs, isolated low mixed chenopod and <i>Lawrencia squamata</i> shrubs and isolated tussock grassland of Poaceae sp. 3 on dry, powdery pale orange clayey loam on low dune ridges near salt lakes.	11.3	2.6
NW10	Mid woodland of mixed <i>Eucalyptus</i> spp. over tall sparse shrubland of <i>Melaleuca</i> ? <i>sheathiana</i> over open mid-low shrubland of <i>Atriplex</i> spp. on brown clayey loam with some surface rocks on gentle mid to upper slopes.	169.7	39.5
NW11	Open low woodland of <i>Casuarina obesa</i> over low isolated clumps of Chenopodiaceae sp. and Aizoaceae sp. shrubs and isolated tussock grassland on dry, powdery pale orange clay on low dune ridges and flats at the edge of salt lakes.	3.3	0.8
NW13	Low open forest of mixed <i>Eucalyptus</i> spp. over mid sparse shrubland of <i>Eremophila scoparia</i> and other mixed mid shrubs on pale brown clay on gentle lower slopes and flats in areas disturbed in the past.	33.7	7.8
NW14	Low-mid woodland of <i>Eucalyptus urna</i> over mid-tall shrubland of <i>Eremophila</i> ? <i>ionantha</i> , <i>Ricinocarpos stylosus</i> and <i>Santalum acuminatum</i> over mixed low shrubs on red clayey soils with some surface gravel in drainage lines.	7.4	1.7
NW15	Mid woodland of <i>Eucalyptus lesouefii</i> and <i>E. dundasii</i> over open mid shrubland of <i>Trymalium myrtillus</i> subsp. <i>myrtillus</i> and <i>Halgania</i> ? <i>andromedifolia</i> on red-brown clay-gravel on mid slopes with some outcropping granite in areas disturbed in the past.	4.2	1.0
CL	Cleared or disturbed.	135.3	31.5
SL	Salt lake or non-vegetated lake bed.	7.4	1.7

4.2.3. Threatened and Priority Ecological Communities

No Threatened or Priority Ecological Communities were recorded as occurring in the Norseman Gold survey areas. The Priority 1 ecological community, 'Allocasuarina globosa assemblages on greenstone rock' (Esperance District), which is known to exist approximately 3 km north of the Maybell area, was not observed in any of the areas surveyed in Spring 2020.

380000

382000

6442000

6442000

6440000

6440000

6438000

6438000

380000

382000

Legend

Spring Survey

Vegetation

- CL
- NS3
- S1
- S6
- SL
- W2
- W4
- W6

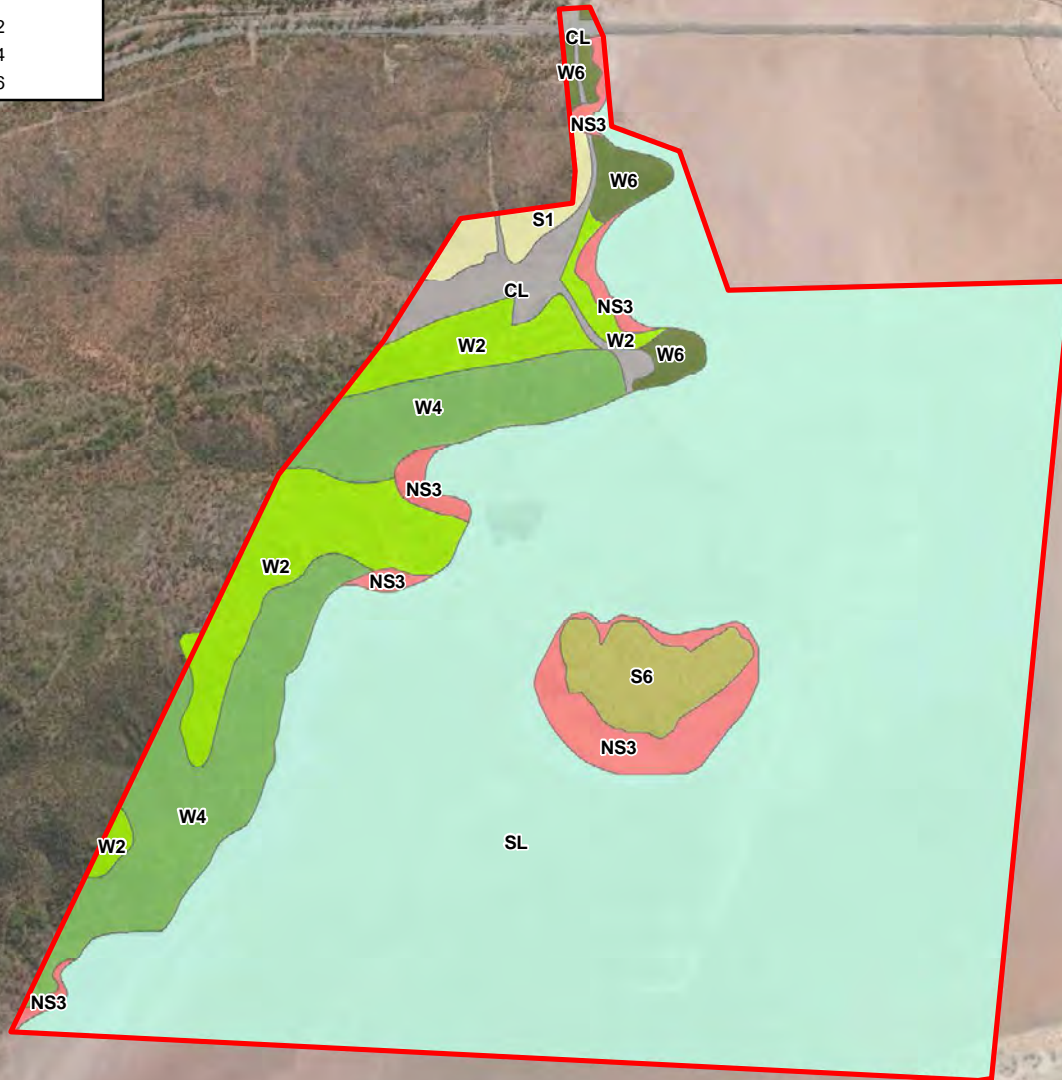


Image: DigitalGlobe (May 2019)

N

0 300 m

Scale: 1:20,000
MGA94 (Zone 51)

Mattiske Consulting Pty Ltd

28 Central Road, Kalamunda WA 6076 - Tel: 9257 1625 - Fax: 9257 1640

Author: E M Mattiske MCPL Ref: CNG2002-03

Drawn: CAD Resources ~ www.cadresources.com.au
Tel: (08) 9246 3242 ~ Fax (08) 9246 3202

**Norseman Gold Project
Vegetation
Cobler**

Figure:

6.1

CAD Ref: a2764_f06_03
Date: December 2020 Rev: A A4

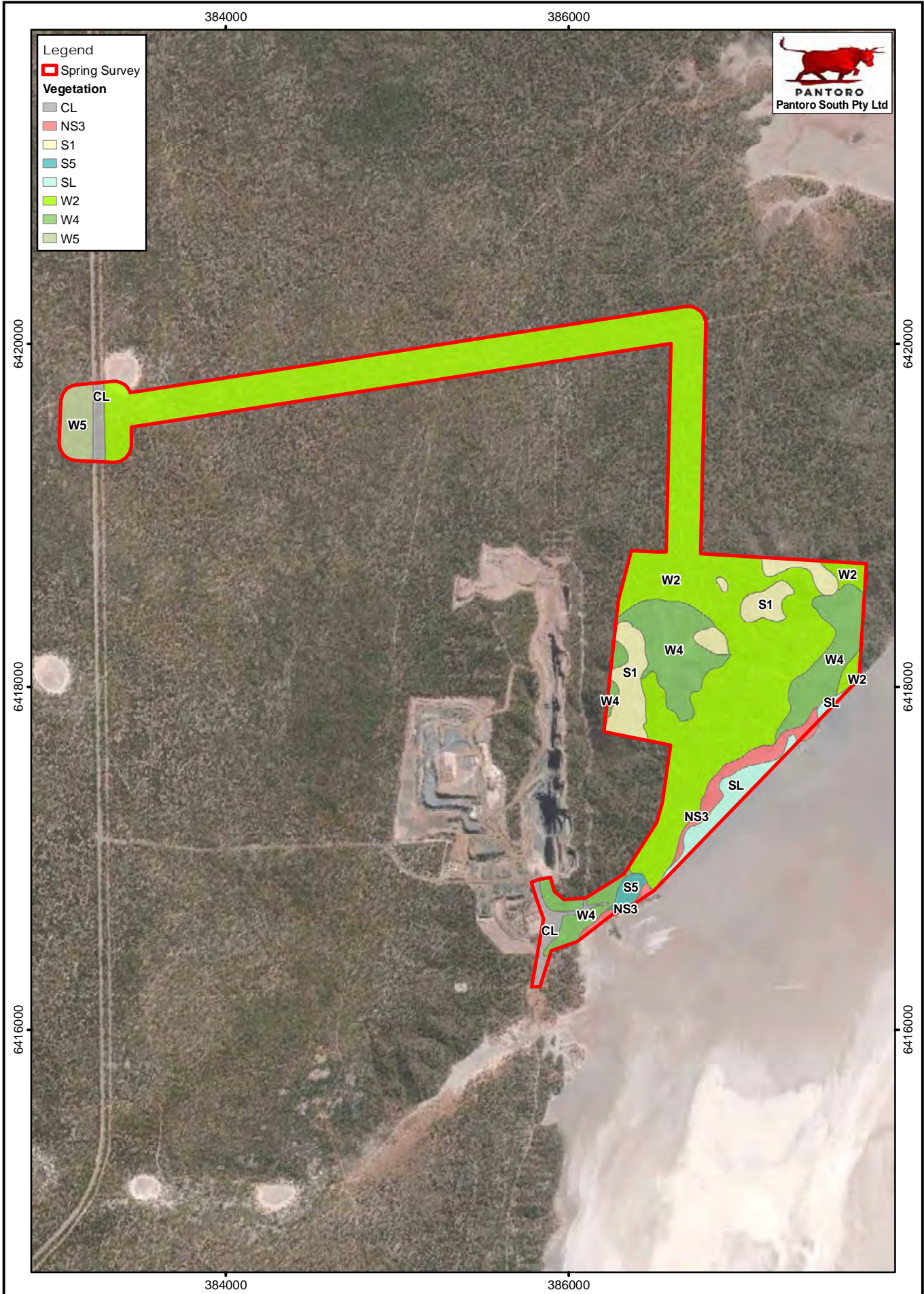


Image: DigitalGlobe (May 2019)

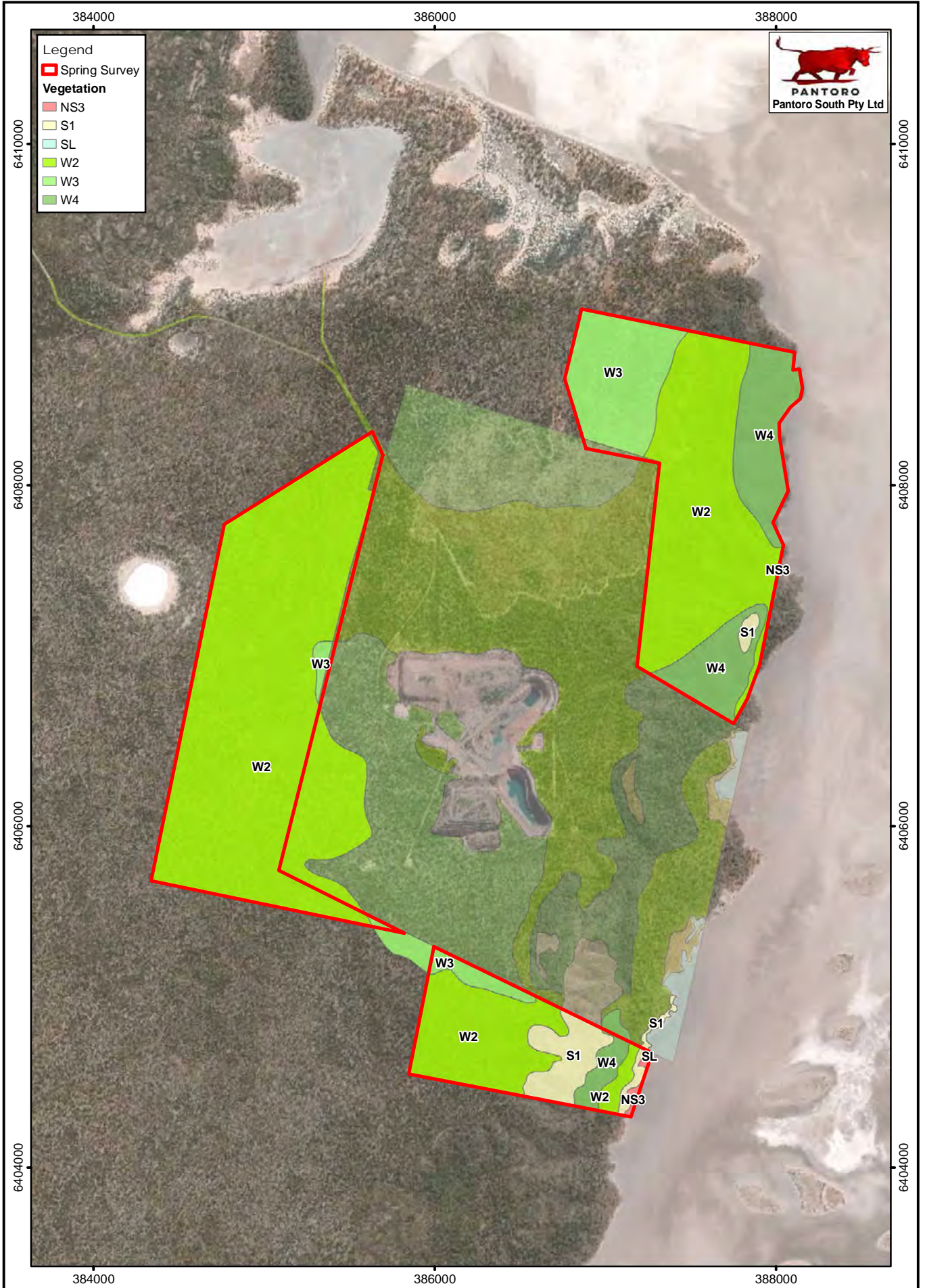
N
 0 450 m
 Scale: 1:30,000
 MGA94 (Zone 51)


Mattiske Consulting Pty Ltd
 28 Central Road, Kalamunda WA 6076 - Tel: 9257 1625 - Fax: 9257 1640
 Author: E M Mattiske MCPL Ref: CNG2002-03
 Drawn: CAD Resources ~ www.cadresources.com.au
 Tel: (08) 9246 3242 ~ Fax (08) 9246 3202

Norseman Gold Project
Vegetation
Maybell

Figure:
6.2

CAD Ref: a2764_f06_03
 Date: December 2020 Rev: A A4



Legend

Spring Survey

Vegetation

- NS3
- S1
- SL
- W2
- W3
- W4



Image: DigitalGlobe (May 2019)

N

0 450 m

Scale: 1:30,000
MGA94 (Zone 51)

Mattiske Consulting Pty Ltd

28 Central Road, Kalamunda WA 6076 - Tel: 9257 1625 - Fax: 9257 1640

Author: E M Mattiske MCPL Ref: CNG2002-03

Drawn: CAD Resources - www.cadresources.com.au

Tel: (08) 9246 3242 - Fax (08) 9246 3202

**Norseman Gold Project
Vegetation
Scotia**

Figure:
6.3

CAD Ref: a2764_f06_03
Date: December 2020 Rev: A A4

388000

Legend

- ▭ Spring Survey
- Vegetation**
- CL
- NW10
- NW5



6446000

6446000

6444000

6444000

388000

N

0 220 m

Scale: 1:15,000
MGA94 (Zone 51)

CAD Ref: a2764_f06_03
Date: December 2020

Rev: A A4

Mattiske Consulting Pty Ltd

28 Central Road, Kalamunda WA 6076 - Tel: 9257 1625 - Fax: 9257 1640

Author: E M Mattiske MCPL Ref: CNG2002-03

Drawn: CAD Resources ~ www.cadresources.com.au
Tel: (08) 9246 3242 ~ Fax (08) 9246 3202

**Norseman Gold Project
Vegetation
North Royal, Slippers**

Figure:
7.1

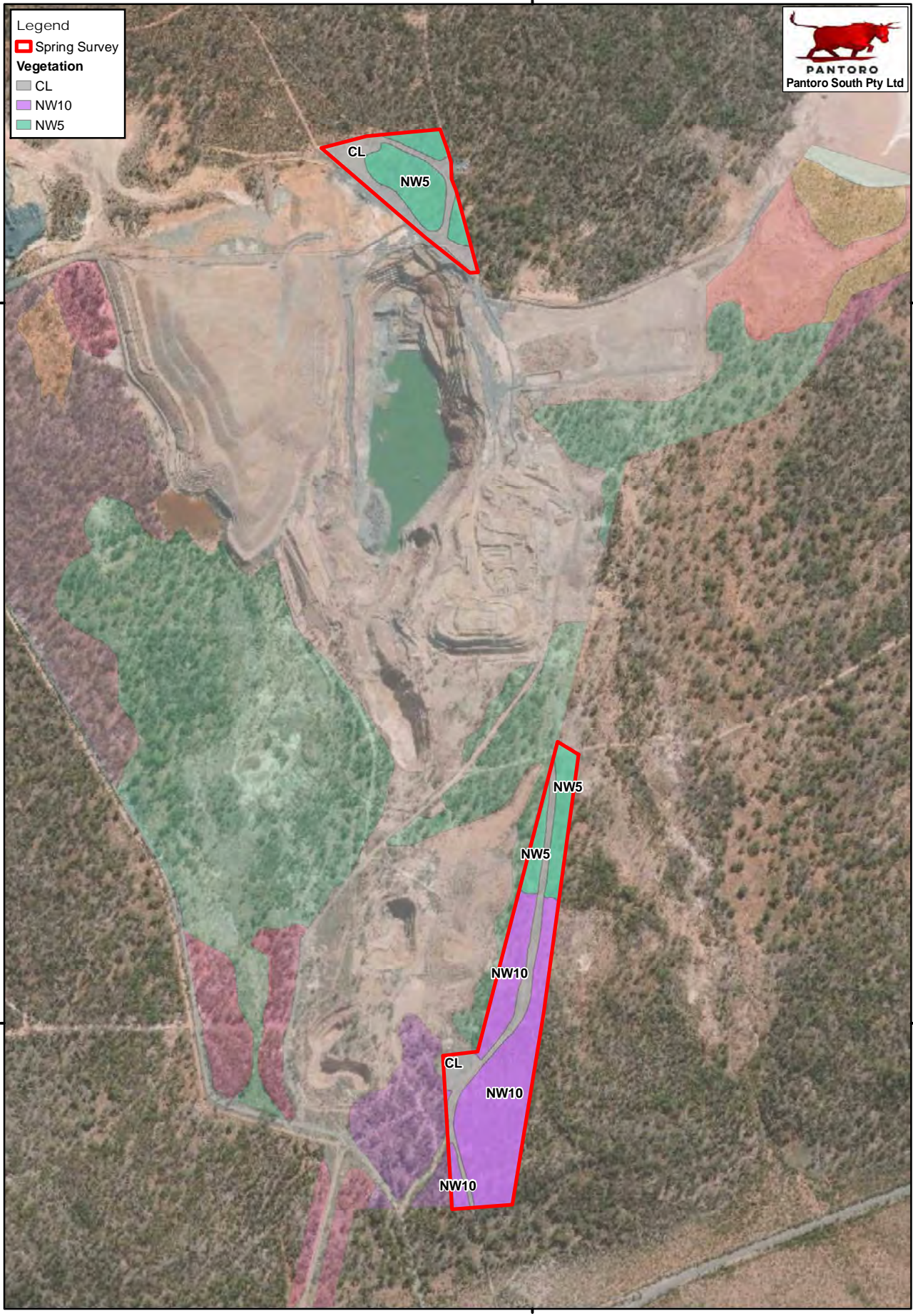


Image: DigitalGlobe (May 2019)

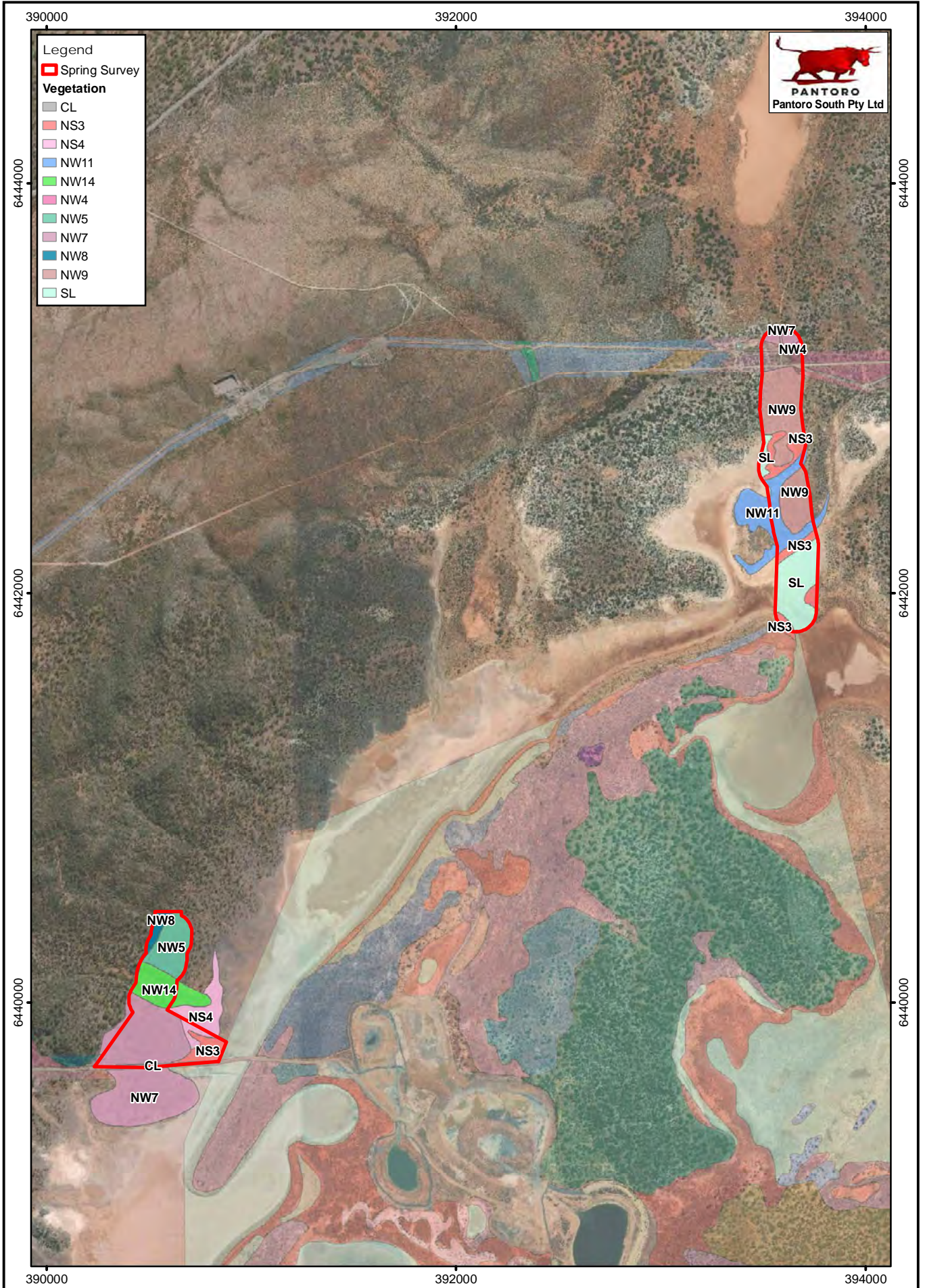


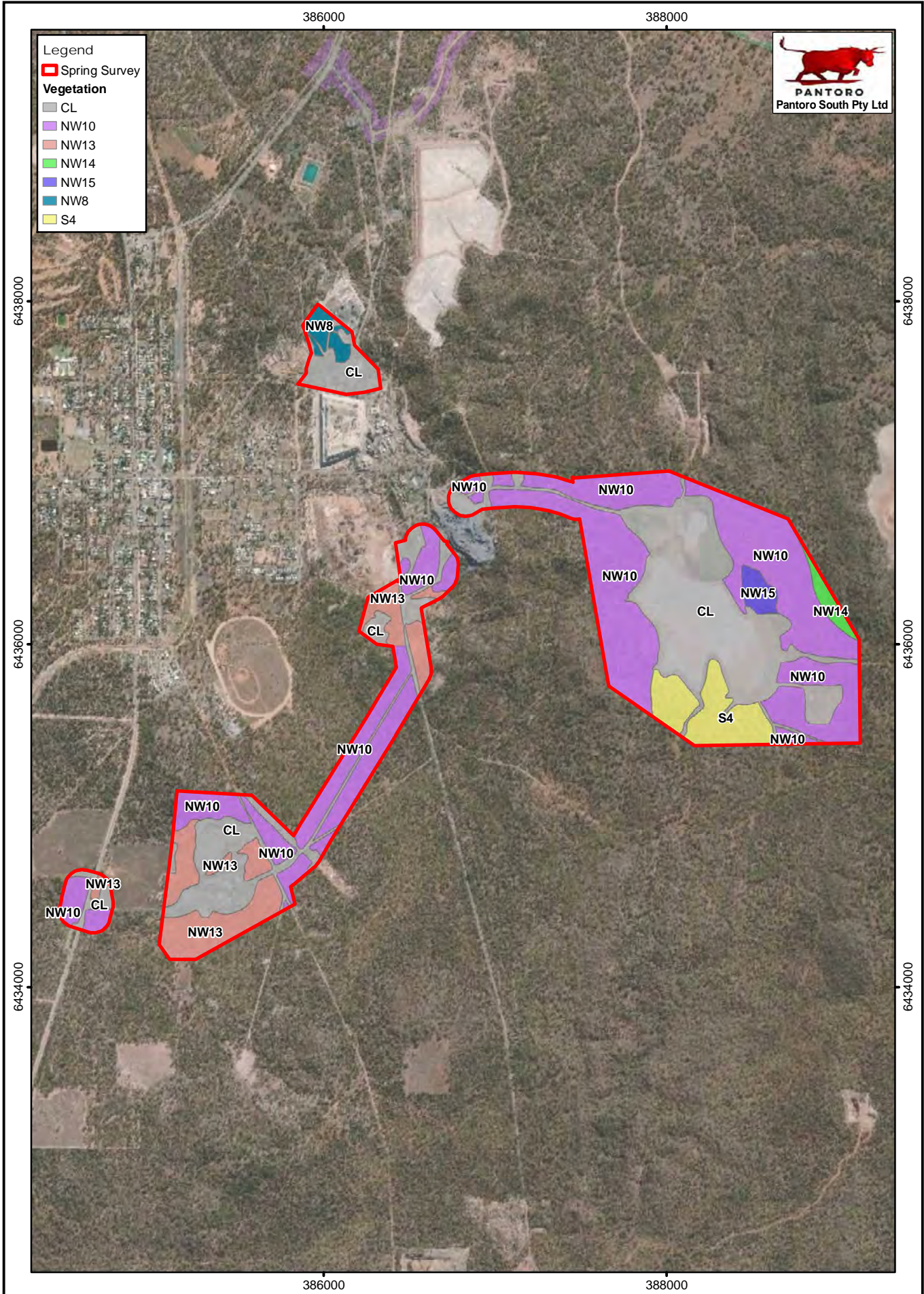
Image: DigitalGlobe (May 2019)

N
 0 380 m
 Scale: 1:25,000
 MGA94 (Zone 51)
 CAD Ref: a2764_f06_03
 Date: December 2020 Rev: A A4

Mattiske Consulting Pty Ltd
 28 Central Road, Kalamunda WA 6076 - Tel: 9257 1625 - Fax: 9257 1640
 Author: E M Mattiske MCPL Ref: CNG2002-03
 Drawn: CAD Resources - www.cadresources.com.au
 Tel: (08) 9246 3242 - Fax (08) 9246 3202

Norseman Gold Project
Vegetation
Gladstone & Maybell

Figure:
7.2



- Legend
- Spring Survey
 - Vegetation
 - CL
 - NW10
 - NW13
 - NW14
 - NW15
 - NW8
 - S4



Image: DigitalGlobe (May 2019)

N

0 450 m

Scale: 1:30,000
MGA94 (Zone 51)

CAD Ref: a2764_f06_03
Date: December 2020

Rev: A A4

28 Central Road, Kalamunda WA 6076 - Tel: 9257 1625 - Fax: 9257 1640

Author: E M Mattiske MCPL Ref: CNG2002-03

Drawn: CAD Resources - www.cadresources.com.au
Tel: (08) 9246 3242 - Fax (08) 9246 3202

Norseman Gold Project Vegetation OK, Camp & TSF

Figure:
7.3

4.2.4. Vegetation Condition

Of the 79 survey sites, 45 had a condition ranking of Pristine and 34 Excellent. The vegetated areas themselves were relatively undisturbed, with few introduced species, a very small amount of grazing (likely by kangaroos or camels as no signs of stock were observed). Only a few areas had signs of recent fire, in particular the east-facing hillslope at Cobbler. Three sites were planned for this slope; two were both relocated, one (CO08) into a nearby patch of relatively unscathed vegetation, and the other (CO10) ~200 m upslope to an area assumed to be representative of the downslope burnt vegetation. The third site (CO09) was altered in shape (to 10m x 40m) in order to sample a strip of unburnt vegetation along a lake edge. Other disturbance included vehicle tracks, rubbish (often many decades old), old mine workings (e.g., spoil heaps) and cut or broken stumps.

When the condition of each vegetation community is considered (as an average of the condition ranking of the survey sites within the community), throughout all survey areas eleven vegetation communities had a condition of completely Pristine (25.7% of the overall survey area, excluding salt lake and cleared areas), six communities had a condition of Excellent only (71.3% of the overall survey area, excluding salt lake and cleared areas) and one had a condition of either Pristine in the Hills survey areas and Excellent in the Flats areas (1.9% of the overall survey area, excluding salt lake and cleared areas). The large proportion of the area ranked as having Excellent condition (compared to the proportion of sites ranked as such is due to the average condition of the largest community, W2, being ranked as Excellent, although some sites in this community had a Pristine ranking).

Table 8 lists the condition ranking for each vegetation community within the Hills and Flats survey areas. It can be seen that the vegetation condition in the Hills area is generally better than that in the Flats areas, although both areas have very little disturbance within the areas of native vegetation.

Table 8: Vegetation Condition by Vegetation Community in the Hills and Flats survey areas, Spring 2020

*Not including salt lake (SL) and cleared or disturbed areas (CL).

HILLS SURVEY AREAS			FLATS SURVEY AREA		
VEGETATION CONDITION	VEGETATION COMMUNITY	% OF TOTAL AREA*	VEGETATION CONDITION	VEGETATION COMMUNITY	% OF TOTAL AREA*
Pristine	NS3, S1, S5, W3, W4, W6	23.4	Pristine	NS4, NW9, NW11, NW14, NW15, S4	4.1
Excellent	W2, W5	51.3	Excellent	NS3, NW5, NW8, NW10, NW13	21.2

5. DISCUSSION

5.1. Flora

A total of 168 vascular plant taxa were recorded in the Norseman Gold Project survey areas in Spring 2020 (section 4.1), compared with 178 taxa in the Autumn survey. The most common families and genera were very similar, with Myrtaceae being the most common and Chenopodiaceae the second most common family in both Spring and Autumn surveys. Scrophulariaceae was the third most common in the Spring survey, whilst in Autumn it was Fabaceae. The most common genus in both surveys was *Eucalyptus*, with *Eremophila* being second in Spring and third in Autumn, and *Acacia* third in Spring and second in Autumn. It is notable that the desktop study (MCPL 2020) included Asteraceae in its three most common families for the area; this significant difference likely reflects both the seasonal timing of past surveys and the drier climate in the short to mid-term past (section 3.2). There were more taxa with a distinctly annual life-form recorded in the Spring survey (seven) than the Autumn survey (none), although nineteen taxa in the Autumn survey could be either annuals or short-lived perennials versus seven taxa in the Spring survey.

Whilst fewer taxa were recorded in the Spring survey than the Autumn survey, a greater average number of taxa per survey quadrat was recorded in Spring, with 2.1 taxa/quadrat in Spring against 1.8 taxa/quadrat in the Autumn survey. This may be the result of greater familiarity with the local flora in the Spring survey, resulting in fewer repeated specimen collections, and less generalising in the field to genus level. Species accumulation analysis shows that approximately 70% of taxa potentially present in the Hills survey area and 65% of those in the Flats survey area were recorded. This is lower than the 73% recorded for both the Northern and Scotia areas surveyed in Autumn and is possibly due both to the smaller area covered in Spring (1,695 ha) versus that in Autumn (2,665 ha) and because the Spring survey covered a less diverse range of landforms and soils than those in Autumn.

More vascular plant taxa listed as priority at State level (see Appendix A for definitions) were recorded in the Spring survey (three Priority 1 and five Priority 3 species; section 4.1.1) than were recorded in the Autumn survey (one Priority 1 and one Priority 2 species). All of the priority-listed taxa recorded in Spring were found in the Hills survey area, with only one, *Eucalyptus brockwayi* (P3), also being recorded in the Flats survey area. The rocky hill slopes and ridges common in the Hills area are, in general, less disturbed than the terrain of the Flats survey area and appear to provide landforms and soils conducive to harbouring less common species.

The shrub *Eremophila parvifolia* was recollected in Spring, again without the fruiting material necessary to provide confirmation of the correct subspecies. In Autumn this taxon was identified by MCPL taxonomists as *Eremophila parvifolia* subsp. *parvifolia* (P4), but the specimen collected in the Spring survey was identified tentatively by experts at the WAH as *Eremophila parvifolia* subsp. *auricampi*, which is not priority-listed. Whilst treated here as the non-priority taxon, a specimen with fruit is still necessary to definitely identify the correct priority or non-priority subspecies.

Of the six taxa recorded in the field survey representing extensions to their known range (section 4.1.2), one, *Daviesia ?benthamii*, is ranked as Moderate and the remainder as Low range extensions. Three of the Low ranked taxa have actually been recorded previously in the area (MCPL 2020). *Daviesia ?benthamii* is question-marked at species level because of this apparent Moderate range extension; the collected specimen was sterile and hence identification was not certain.

Five introduced species (section 4.1.3) were recorded at five different survey sites (some with multiple weed taxa) in the Spring survey; two of these species, **Asphodelus fistulosus* and **Gazania linearis* were recorded in the Autumn survey in different areas to where they were recorded in Spring. One species, **Salvia verbenaca*, has not been recorded in the Norseman area before.

5.2. Vegetation

Vegetation in the Norseman Gold Project areas surveyed in Spring 2020 is predominantly *Eucalyptus* woodlands, with minor shrublands on rocky upper slopes and ridges, and narrow strips of chenopod shrubland along salt lake margins. This is very similar to the vegetation encountered in the Autumn survey, but has a greater proportion of the upland shrubland communities.

Data were found to be most clearly analysed in two distinct areas, Hills and Flats, with differing landforms and species composition. This is similar to the approach taken for analysis of the Autumn survey data, with areas there divided into a Northern group (similar to the Flats area in Spring) and a Scotia area (similar to the Hills area used in Spring). Whilst grouping the data in this manner made defining vegetation communities easier, it would still be possible to define the communities with slightly different combinations of quadrats. As for the Autumn survey, field observations and the results of the statistical analysis of the vegetation show that the woodlands in the Norseman Gold Project survey area comprise a mosaic of various *Eucalyptus* species over slowly varying understorey species. Due to the complex nature of the woodland communities and the difficulty in identifying many species without flowering and fruiting material, definition of distinct vegetation communities was difficult. Fine scale changes in the landscape and species composition and cover were often unable to be observed from the aerial photographs. In areas where the landscape was flat or gently sloping (much of the survey area), gradients into adjacent communities were gradual. This was particularly a problem in the Flats survey area. In the Hills survey area, where slopes are steeper and ridges and rocky outcroppings were observed community boundaries were more defined.

Two new vegetation communities, the mixed mid shrubland community S5 and the *Eucalyptus concinna* woodland community W6, were defined in the Hills survey area. The remaining six communities in the Hills area, two shrublands (NS3 and S1) and four *Eucalyptus* woodlands (W2, W3, W4 and W5) were defined during the Autumn survey. Three new *Eucalyptus* woodland communities were defined in the Flats survey area; two of these, NW13 and NW15, are in areas disturbed some time in the past, and the third, NW14, occurs in drainage lines. The seven other communities, comprising two shrublands (NS3 and S4), four *Eucalyptus* woodland communities (NW5, NW8, NW9 and NW10) and one *Casuarina* woodland (NW11), were defined in the Autumn survey.

The vegetation communities found in the survey areas are discussed below.

5.2.1. *Eucalyptus* woodlands

Eucalyptus woodlands in Norseman Gold Project survey areas comprise a mosaic of vegetation communities, with continual slight changes in canopy *Eucalyptus* species, the mid stratum species and the lower stratum.

Dominant tree species of the *Eucalyptus* woodlands in both the Hills and Flats survey areas were *Eucalyptus dundasii*, *E. lesouefii*, *E. torquata* and *E. urna*, either singly or in combination. Other tree species that form part of the definition of vegetation communities include *Eucalyptus concinna*, *E. gracilis*, *E. longicornis*, *E. salubris* and *E. spreata*.

The mid stratum was often dominated by *Melaleuca* species (particularly *M. ?sheathiana*) and/or *Eremophila* species (particularly *E. scoparia*), with contributions from *Alyxia buxifolia*, *Beyeria* spp., *Dodonaea microzyga*, *Exocarpos aphyllus*, *Santalum acuminatum*, *Senna artemisioides* subsp. *fillifolia* and *Trymalium myrtillus* subsp. *myrtillus*. The most common species in the lower stratum were the low shrubs *Cratystylis conocephala*, various *Eremophila* species, *Olearia muelleri*, *Scaevola spinescens* and *Westringia rigida*, the grass *Austrostipa ?platychaeta*, along with Chenopodiaceae of the genera *Atriplex*, *Maireana*, *Rhagodia* and *Tecticornia*. The Flats survey areas appeared to have more salt-tolerant species in the lower stratum, reflecting the larger low-lying areas there.

Distinguishing separate vegetation communities in this continuum of *Eucalyptus* woodland vegetation proved difficult, and several survey sites were on what could be considered (in hindsight) to be ecotones, so there are very likely several approaches to defining the vegetation communities in this vegetation.

5.2.2. Other vegetation communities

In the Flats survey area there is one non-*Eucalyptus* woodland vegetation community, NW11, an open *Casuarina* woodland on low dune ridges and flats near salt lakes. This has an understorey of chenopod shrubs and tussock grasses. There are two shrublands: the sparse *Dodonaea* mid shrubland over chenopod shrubs of community NS4, occurring in sandy clay on low rises at the edge of salt lakes; and the open shrubland community S4, comprising *Allocasuarina* over mixed mid shrubs on outcropping ironstone on ridges.

The three shrubland communities in the Hills area are quite different. The low chenopod shrubland community NS3 is found on a narrow strip along salt lake margins. The *Allocasuarina*, *Acacia* and *Melaleuca* tall shrubland community S1 occurs on rocky upper slopes and ridges; in the Spring survey, this community was also observed on rocky headlands at the edge of salt lakes. The mid shrubland community S5, whilst defined by one quadrat only, has a fairly dense mid shrub layer distinctively dominated by the priority species *Eremophila purpurascens* (P3) and is found on lower slopes near salt lakes.

5.2.3. Species Richness

Average species richness (per quadrat) within each of the vegetation communities varied from 8.0 (no standard error as there was only one quadrat) in community NW15 to 28.0 (no standard error as there was only one quadrat) in NS4 (Appendices D and E). This is much greater than the values seen in the Autumn survey, which ranged from 2.0 to 16.0. In general, average species richness in the vegetation communities of the Hills survey area (15.2 ± 0.7) was greater than in the Flats survey area (12.9 ± 1.0), but values varied more widely in the Flats areas (8.0 to 28.0, as mentioned above) than in the Hills area (10.0 in communities NS3 and W3 to 23.7 ± 3.0 in community W6). As per the Autumn survey, the greater range in the Flats area may reflect the wider variety of ecosystems surveyed there, from areas of seasonal inundation with low chenopod shrubs through to rocky ridges with *Eucalyptus* woodlands, versus those in the Hills area. The mean values for the Hills and Flats areas are both larger than those calculated for the Northern (10.3 ± 0.5) and Scotia (11.3 ± 0.5) survey areas in Autumn. Again, this may be the result of greater familiarity with the local flora in the Spring survey.

5.2.4. Comparison with previous mapping

Vegetation mapping carried out following the Autumn survey was used to guide mapping of the Spring survey data, and small adjustments were made to both where necessary so that community boundaries are contiguous and sensible.

Previous mapping by MCPL (2002) covered the northern quarter of the Cobbler survey area. That survey defined eight vegetation communities; five *Eucalyptus* woodlands, one mixed shrubland and two chenopod shrublands. These communities are broadly similar to those mapped in Spring 2020, which comprise three *Eucalyptus* woodlands, one mixed shrubland and one chenopod shrubland. The survey recorded the (currently-listed) priority species *Eucalyptus websteriana* subsp. *norsemanica* (P1), *Eremophila purpurascens* (P3) and *Micromyrtus papillosa* (P1).

Part of the Gladstone extension (Laydown) survey area had been mapped previously (MCPL 2005). The area inside the Spring 2020 survey area contained: (H1) Low open shrubland of *Tecticornia* spp., *Lawrenzia squamata* and *Frankenia* spp. on fringes of salt lakes - equivalent to the current community

NS3; (M1) Low open woodland of *Eucalyptus calycogona* over *Melaleuca lateriflora*, *Eremophila deserti*, *Lawrencina squamata*, *Olearia muelleri*, *Scaevola spinescens* and *Tecticornia* spp. on rocky breakways near salt lakes – not consistent with any current communities; and (S2) Closed heath to tall mixed shrubland over mixed mid and low shrubland with emergent *Eucalyptus stricklandii* on sandy gravel with outcropping on mid to upper slopes – corresponds with current community S4. The last two listed previously mapped communities, whilst broadly consistent with communities found throughout the greater Norseman Gold Project area, are not what was mapped in the current survey.

The OK and TSF survey areas were previously mapped by MCPL (2005), though at a much larger scale than in the Spring 2020 survey. Those mapped in the current TSF survey area were: (E2) Open woodland of *Eucalyptus lesouefii*, *E. salubris*, and *E. urna* over *Melaleuca sheathiana*, *Atriplex* spp., *Eremophila* spp. and *Atriplex* spp. on clay-loams on lower slopes and extensive flats – corresponds to current community NW10; and (E4) Open woodland of *Eucalyptus salubris*, *E. dundasii*, *E. lesouefii* and *E. urna* over *Geijera linearifolia*, *Santalum acuminatum*, *Eremophila scoparia*, *Eremophila glabra* and *Exocarpos aphyllus* over mixed low shrubs and chenopod shrubs on clay-loams on valley floors – corresponds to current community NW5 or NW10.

Between the Maybell and Scotia survey areas, the mapping over the Mt Henry area (MCPL 2013a, 2013b) resulted in the definition of 11 vegetation communities; three *Eucalyptus* woodlands and eight shrublands. The three communities from the 2013 mapping that correspond reasonably closely to those defined in the current Hills survey area are: (W1) Woodland to open woodland of *Eucalyptus dundasii*, *Eucalyptus torquata* and other mixed *Eucalyptus* spp. over *Melaleuca sheathiana*, *Exocarpos aphyllus*, *Scaevola spinescens*, *Alyxia buxifolia*, *Eremophila glabra* subsp. *glabra* and *Pomaderris forrestiana* over *Westringia rigida* and *Ptilotus obovatus* on orange-brown clayey loam with gravel on slopes and ridges – corresponds to current community W4; (W2) Woodland of *Eucalyptus urna*, *Eucalyptus lesouefii* and *Eucalyptus oleosa* subsp. *oleosa* and other mixed *Eucalyptus* spp. over *Melaleuca sheathiana*, *Exocarpos aphyllus*, *Scaevola spinescens* and *Eremophila scoparia* over *Olearia muelleri* and *Westringia rigida* on orange sandy clayey loam on flats and slopes – W2; (S4) Open scrub to scrub of *Acacia ?burkittii* and *Allocasuarina campestris* with occasional *Acacia neurophylla* subsp. *neurophylla* and occasional emergent *Eucalyptus griffithsii* over *Dodonaea microzyga* var. *acrolobata*, *Trymalium myrtillus* subsp. *myrtillus*, *Scaevola spinescens* and *Dampiera latealata* over *Lepidosperma* sp. aff. *lyonsii* and small annual and perennial herbs on red to brown clayey loam on flats, slopes, valleys and micro channels - S1.

5.3. Local and regional context and impact

The vegetation communities mapped within both the Hills and Flats survey areas by MCPL in Spring 2020 fit broadly within the Pre-European vegetation associations of the area, are typical of the regional vegetation of the Great Western Woodlands, and show the same gradation from salt lake vegetation with low chenopod shrublands on salt lake fringes into woodlands with mixed *Eucalyptus* species as noted for the area by previous authors (MCPL 2020). The communities are all similar to those mapped in previous surveys in the area. As the vegetation of the Norseman Gold Project survey areas is common at statewide and regional levels, clearing should not have significant detrimental effects at those levels.

Of local importance with regard to clearing is the presence of priority-listed flora species within the survey areas. The vegetation communities S1 and W4 are host to seven of the eight priority-listed species encountered in the Spring survey (*Allocasuarina eriochlamys* subsp. *grossa* (P3), *Eremophila purpurascens* (P3), *Eucalyptus websteriana* subsp. *norsemanica* (P1), *Goodenia laevis* subsp. *laevis* (P3), *Melaleuca coccinea* (P3), *Micromyrtus papillosa* (P1) and *Philothea apiculata* (P1). *Eucalyptus brockwayi* (P3) was recorded in the *Eucalyptus* woodland communities W2 and NW10, and the newly defined shrubland community S5 is dominated by *Eremophila purpurascens* (P3).

6. CONCLUSION

A detailed flora and vegetation field survey of nine areas within the Norseman Gold Project area was carried out **over ten days in September and October of 2020, collectively known as the 'Spring' survey.** The Spring survey follows a desktop assessment of the greater Norseman Gold Project area, completed in March 2020, and a detailed flora and vegetation field survey performed across five survey areas in March-April 2020 ('Autumn' survey).

The Spring field survey took place from the 21st to 25th September and 5th to 9th October 2020 and involved three botanists, two in each week. A total of 79 quadrats were surveyed, along with several km of foot traverses during which opportunistic collections were made, and local searches in order to define populations of potential priority-listed flora species. For the purposes of data analysis, survey areas **were grouped into 'Hills', comprising** the survey areas on hills to the west of significant salt lakes (Cobbler, Maybell and Scotia extensions) **and 'Flats',** (Camp, Gladstone extensions, North Royal extension, OK, Slippers and TSF), with 48 quadrats surveyed in the Hills area and 31 in the Flats area.

Over all nine survey areas, 168 vascular plant taxa, representative of 85 genera and 40 families, were recorded. Most of these taxa were representative of the Myrtaceae (31 taxa), Chenopodiaceae (19 taxa) and Scrophulariaceae (17 taxa) families, with the most common genera being *Eucalyptus* (18 taxa), *Eremophila* (13 taxa) and *Acacia* (12 taxa). When grouped into Hills and Flats survey areas, the most common families and genera remained the same as for the overall Spring survey. Fewer taxa were recorded in the Spring survey than the Autumn survey (178 taxa). Additionally, species accumulation analysis shows that a smaller proportion of the taxa potentially present in the Spring survey areas (70% in the Hills area and 65% in the Flats area) were recorded than in the Autumn survey areas (73% for each of the Northern and Scotia areas). This is possibly due both to the smaller area covered in Spring than that in Autumn and because the Spring survey covered a less diverse range of landforms and soils than those in Autumn.

However, a greater average number of taxa per survey quadrat was recorded in Spring (2.1 taxa/quadrat) than in Autumn (1.8 taxa/quadrat). Mean values of species richness/quadrat for vegetation communities in the Spring survey (15.2 ± 0.7 for Hills areas and 12.9 ± 1.0 in Flats areas) were greater than those in Autumn (10.3 ± 0.5 for the Northern areas and 11.3 ± 0.5 for the Scotia areas). This may be the result of greater familiarity with the local flora in the Spring survey.

No threatened flora species pursuant to Part 2, Division 1, Subdivision 2 of the BC Act and as listed by DBCA (2018a), or pursuant to section 179 of the EPBC Act or listed by the DAWE (2020b), were recorded within the nine Norseman Gold Project areas covered in the Spring survey.

Eight priority flora species as listed by DBCA (2018b) were recorded in the Spring survey that were not recorded in the Autumn survey. These are: *Allocasuarina eriochlamys* subsp. *grossa* (P3), *Eremophila purpurascens* (P3), *Eucalyptus brockwayi* (P3), *Eucalyptus websteriana* subsp. *norsemanica* (P1), *Goodenia laevis* subsp. *laevis* (P3), *Melaleuca coccinea* (P3), *Micromyrtus papillosa* (P1) and *Philotheca apiculata* (P1). All of these taxa were found within the Hills survey areas; one taxon was also recorded in the TSF and Camp areas. The rocky hill slopes and ridges common in the Hills area are, in general, less disturbed than the terrain of the Flats survey area and appear to provide landforms and soils conducive to harbouring less common species. The Hills area vegetation communities S1 and W4 are host to seven of the eight priority-listed species encountered in the Spring survey, and the newly defined shrubland community S5 (also in the Hills area) is dominated by *Eremophila purpurascens* (P3). *Eucalyptus brockwayi* (P3) was recorded in Hills community W2 and Flats community NW10, both widespread in their respective areas.

A hybrid taxon, *Eremophila purpurascens* x *E. alternifolia*, was recorded twice in the Cobbler area. This taxon has been poorly collected in the past. Eight populations of *Eremophila parvifolia* recorded throughout the Northern survey areas in Autumn and identified as potentially the priority-listed

subspecies *Eremophila parvifolia* ?subsp. *parvifolia* (P4) were revisited in Spring in order to obtain a fruiting sample for identification purposes and to further delineate the populations. A (non-fruiting) collected specimen of this was identified at the WAH as potentially the non priority-listed *Eremophila parvifolia* ?subsp. *auricampi*, and it is treated here and should be for references made previously in MCPL 2020 as this subspecies. However, further attempts should be made to collect a fruiting specimen of this taxon to enable definitive identification.

Six taxa recorded within the Spring survey areas represent extensions to their current known distributions based on known data. Three of the taxa have been found in previous surveys in the Norseman Gold Project area, but are not recorded in official records. Five of the six taxa are ranked as being Low range extensions and one as Moderate.

Five introduced (weed) species, **Asphodelus fistulosus* (Onion Weed), **Carrichtera annua* (Ward's weed), **Gazania linearis*, **Salvia verbenaca* (Wild sage) and **Sonchus oleraceus* (Common sowthistle) were recorded within the Norseman Gold Project survey areas in Spring 2020. None of these are declared pest organisms, but under the Department of Parks and Wildlife Weed Prioritisation Process, **Gazania linearis* is considered to be one of the 17 Goldfields Region priority alert weeds. **Salvia verbenaca* has not been recorded in the Norseman Gold Project area in the past.

Nine vegetation communities were mapped across the Hills survey areas: five *Eucalyptus* woodland communities, four shrubland communities as well as cleared land and salt lakes. Two of these (S5 and W6) are newly defined using the Spring survey data and five communities have been slightly revised since the Autumn survey. The *Eucalyptus* woodland communities W2 (45.8%) and W4 (11.5%) made up the major part of the vegetation of the Hills survey area. Only 1.3% of the Hills survey areas was disturbed. Salt lakes form 31%, the bulk of it in the Cobbler area.

In the Flats survey areas twelve vegetation communities were mapped, comprising eight *Eucalyptus* woodland communities, one *Casuarina* woodland, three shrubland communities as well as cleared land and salt lakes. Three of these (NW13, NW14 and NW15) are newly defined using the Spring survey data. Four communities have been slightly revised since Autumn. The *Eucalyptus* woodland community NW10 (39.5%) made up most of the vegetated areas of the Flats survey area. In contrast to the Hills survey area, salt lakes covered only a very small part (1.7%) of this area and disturbed areas covered significant parts (31.5%), reflecting the location of many of the survey areas around old operational areas.

No Threatened Ecological Communities or Priority Ecological Communities were recorded as occurring in the Norseman Gold survey areas.

Approximately 57% of the survey sites were assessed as being in Pristine condition and 43% in Excellent condition. The vegetation condition in the Hills area is generally better than that in the Flats areas. The east-facing hillslope at Cobbler had been burnt within the previous year; three quadrats were slightly moved or altered in order to survey representative unburnt vegetation. Whilst there was significant disturbance within the Norseman Gold Project survey areas as a whole, the vegetated areas themselves were little disturbed.

Vegetation in the Norseman Gold Project survey areas was found to be predominantly Eucalypt woodlands, with minor shrublands on rocky upper slopes and ridges, and narrow strips of chenopod shrubland along salt lake margins. This is very similar to the vegetation encountered in the Autumn survey, but has a greater proportion of the upland shrubland communities. Observations made during the field survey and the results of the statistical analysis of the vegetation show that the woodlands in the Norseman Gold Project survey area comprise a mosaic of various *Eucalyptus* species over slowly varying understorey species. Due to the complex nature of the woodland communities and the difficulty in identifying many species without flowering and fruiting material, distinguishing separate vegetation

communities was difficult. It is acknowledged that there are therefore very likely several approaches to defining the vegetation communities in this vegetation.

The vegetation communities defined within both the Northern and Scotia survey areas fit within the Pre-European vegetation associations of the area, are typical of the regional vegetation of the Great Western Woodlands, and show the same gradation from salt lake vegetation with low chenopod shrublands on salt lake fringes into woodlands with mixed *Eucalyptus* species as noted for the area in earlier regional studies. Although there are some minor local differences between the Spring mapping and previous mapping in the same areas, the communities mapped in Spring are all broadly similar to those mapped in previous local surveys in the area. As the vegetation of the Norseman Gold Project survey areas is common at statewide and regional levels, clearing should not have significant detrimental effects at those levels.

However, the presence of Priority listed flora species within the survey areas is of local importance with regard to clearing of vegetation. Extra care must be taken when conducting operations within the vegetation communities that are known to be host to these species.

7. ACKNOWLEDGEMENTS

The authors would like to thank Karen de Roer and Paul Androvic from Pantoro Ltd for their assistance with this project. The authors would also like to thank taxonomists from the Western Australian Herbarium for their plant identification support.

8. PERSONNEL

The following Matiske Consulting Pty Ltd personnel were involved in this project:

NAME	POSITION	PROJECT INVOLVEMENT	FLORA COLLECTION PERMITS
Dr EM Matiske	Managing Director & Principal Ecologist	Planning, managing, reporting	N/A
Ms E Chetwin	Project Leader, Experienced Botanist	Planning, fieldwork, plant identification, data analysis, reporting	FB62000026-2
Ms M Behn	Botanist	Fieldwork	FB62000264
Dr S Ruoss	Experienced Botanist	Fieldwork, reporting	FB62000031-2
Mr B Ellery	Taxonomist	Plant identification	N/A
Dr R Dayrell de Lima Campos	Experienced Botanist	Plant identification	N/A

9. REFERENCES

- Aplin, TEH 1979, 'The flora' in *Environment and Science*, ed. BJ O'Brien, University of Western Australia Perth, Nedlands, pp. 53-76.
- Beard, JS 1970, *Vegetation Survey of Western Australia - Western Australia Vegetation Series 1:1,000,000 Sheet 4 - Nullarbor*, University of Western Australia Press, Nedlands, WA.
- Beard, JS 1975, *Vegetation Survey of Western Australia - Western Australia Vegetation Series 1:1,000,000 Explanatory notes to Sheet 4 – Nullarbor*, University of Western Australia Press, Nedlands, WA.
- Beard, JS 1990, *Plant life of Western Australia*, Kangaroo Press, Kenthurst, NSW.
- Biodiversity Conservation Act 2016 (WA)*
- Biosecurity and Agriculture Management Act 2007 (WA)*
- Biosecurity and Agriculture Management Regulations 2013 (WA)*
- Bureau of Meteorology 2020, *Climate data online*, Commonwealth of Australia. Available from: <http://www.bom.gov.au/climate/data/?ref=fttr>. 06 November 2020.
- Centre for Australian National Biodiversity Research 2020, *EUCLID – Eucalypts of Australia*, 4th edition. Available from: <https://apps.lucidcentral.org/euclid/text/intro/index.html>. 07 December 2020.
- Chao, A 2004, 'Species richness estimation' in *Encyclopaedia of statistical sciences*, eds. N Balakrishnan, CB Read & B Vidakovic, Wiley, New York.
- Clarke, KR & Gorley, RN 2015, *PRIMER v7 - User Manual/Tutorial*, PRIMER-e, Devon, United Kingdom.
- Colwell, RK 2013, *EstimateS – Statistical estimation of species richness and shared species from samples*, Version 9. Available from: viceroy.colorado.edu/estimates.
- Cowan, M 2001, 'Coolgardie 3 (COO3 – Eastern Goldfields subregion)' in *A biodiversity audit of Western Australia's 53 biogeographical subregions in 2002*, eds. JE May & NL McKenzie, Department of Conservation and Land Management, Western Australia, pp. 156-169.
- Department of Agriculture, Water and the Environment 2020a, *Australia's bioregions (IBRA)*, Commonwealth of Australia. Available from: <http://www.environment.gov.au/topics/land/national-reserve-system/science-maps-and-data/australias-bioregions-ibra>. 06 November 2020.
- Department of Agriculture, Water and the Environment 2020b, *EPBC Act list of threatened flora*, Commonwealth of Australia. Available from: <http://www.environment.gov.au/cgi-bin/sprat/public/publicthreatenedlist.pl?wanted=flora>. 06 November 2020.
- Department of Biodiversity, Conservation and Attractions 2018a, *Wildlife conservation (rare flora) notice 2018, 11 September 2018*, Minister for the Environment. Available from: <https://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/threatened-plants>. 06 November 2020.
- Department of Biodiversity, Conservation and Attractions 2018b, *Threatened and Priority Flora List – 05 December 2018*. Available from: <https://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/threatened-plants>. 06 November 2020.
- Department of Biodiversity, Conservation and Attractions 2018c, *List of Threatened Ecological Communities endorsed by the Western Australian Minister for Environment - 28 June 2018*. Available from: <https://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/wa-s-threatened-ecological-communities>. 06 November 2020.

- Department of Biodiversity, Conservation and Attractions 2019, *Conservation codes for Western Australian flora and fauna, 03 January 2019*. Available from: <https://www.dpaw.wa.gov.au/images/documents/plants-animals/threatened-species/Listings/Conservation%20code%20definitions.pdf>. 06 November 2020.
- Department of Biodiversity, Conservation and Attractions 2020a, *Priority Ecological Communities for Western Australia Version 30 (28 July 2020)*. Available from: <https://www.dpaw.wa.gov.au/images/documents/plants-animals/threatened-species/Listings/Priority%20Ecological%20Communities%20list.pdf>. 06 November 2020.
- Department of Environment and Conservation 2013, *Definitions, categories and criteria for threatened and priority ecological communities*, Government of Western Australia. Available from: <http://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/wa-s-threatened-ecological-communities>. 06 November 2020.
- Department of Parks and Wildlife 2013, *Weed prioritisation process for DPaW (formerly DEC) – "An integrated approach to weed management on DPaW-managed lands in WA", November 2013*, Government of Western Australia. Available from: <https://www.dpaw.wa.gov.au/plants-and-animals/plants/weeds/156-how-does-dpaw-manage-weeds>. 06 November 2020.
- Department of Parks and Wildlife 2014, *Ecological impact and invasiveness rankings from the Department of Parks and Wildlife Goldfields Region species prioritisation process 2014*, Government of Western Australia. Available from: <https://www.dpaw.wa.gov.au/plants-and-animals/plants/weeds/156-how-does-dpaw-manage-weeds>. 06 November 2020.
- Department of Primary Industries and Regional Development 2020, *Western Australian Organism List*, Government of Western Australia. Available from: <https://www.agric.wa.gov.au/organisms>. 06 November 2020.
- Environmental Protection (Environmentally Sensitive Areas) Notice 2005* (WA)
- Environment Protection and Biodiversity Conservation Act 1999* (Cth)
- Environmental Protection Act 1986* (WA)
- Environmental Protection Authority 2016a, *Environmental Factor Guideline: Flora and Vegetation*, Environmental Protection Authority, Western Australia.
- Environmental Protection Authority 2016b, *Technical Guidance – Flora and vegetation surveys for environmental impact assessment*, Environmental Protection Authority, Western Australia.
- Executive Steering Committee for Australian Vegetation Information 2003, *Australian vegetation attribute manual: National vegetation information system, version 6.0*, Department of the Environment and Heritage, Canberra.
- Keighery, BJ 1994, *Bushland plant survey: a guide to plant community survey for the community*, Wildflower Society of WA (Inc.), Western Australia.
- Keighery, GJ, Newbey, KR and Hall, NJ 1993, *Vegetation and Flora*. In: Hall, NJ and McKenzie, NL, eds., **'The biological survey of the Eastern Goldfields of Western Australia – Part 9. Norseman-Balladonia study area', Records of the Western Australian Museum Supplement 42**, Western Australian Museum, Perth, WA.
- Mattiske Consulting Pty Ltd 2001a, *Flora and vegetation survey, Gladstone and Daisy project areas, Norseman*. Unpublished report prepared for Central Norseman Gold Corporation Ltd, August 2001.
- Mattiske Consulting Pty Ltd 2002, *Flora and vegetation survey, proposed mining area, Cobbler, Norseman*. Unpublished report prepared for Croesus Mining NL, August 2002.
- Mattiske Consulting Pty Ltd 2005, *Flora, vegetation and vertebrate fauna survey on proposed tailings dam area*. Unpublished report prepared for Croesus Mining NL by Mattiske Consulting Pty Ltd and Ninox Wildlife Consulting, April 2005.

- Mattiske Consulting Pty Ltd 2013a, *Flora and vegetation survey of the Mt Henry survey area*. Unpublished report prepared for Panoramic Resources Ltd, January 2013.
- Mattiske Consulting Pty Ltd 2013b, *Flora and vegetation survey of the Mt Henry survey area*. Unpublished report prepared for Panoramic Resources Ltd, September 2013.
- Mattiske Consulting Pty Ltd 2020, *Flora and Vegetation Assessment – Norseman Gold Project, Norseman, WA*. Unpublished report prepared for Pantoro Ltd, June 2020.
- Specht, RL 1970, 'Vegetation' in *Australian Environment*, 4th edn., ed. GW Leeper, Melbourne University Press, Melbourne, pp. 44-67.**
- Western Australian Herbarium 1998-, *FloraBase – the Western Australian Flora*, Department of Parks and Wildlife. Available from: <https://florabase.dpaw.wa.gov.au>. 06 November 2020.
- Wilson, PG 1998, *A taxonomic review of the genera Eriostemon and Philotheca (Rutaceae – Boronieae)*, *Nuytsia* 12: 239-265.

APPENDIX A1: THREATENED AND PRIORITY FLORA DEFINITIONS

Under section 179 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), **threatened flora** are categorised as extinct, extinct in the wild, critically endangered, endangered, vulnerable and conservation dependent (Table A1.1).

Table A1.1 Federal definition of threatened flora species

Note: Adapted from section 179 of the EPBC Act.

CODE	CATEGORY	DEFINITION
Ex	Extinct	Species which at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
ExW	Extinct in the Wild	Species which is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or 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.
CE	Critically Endangered	Species which 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.
E	Endangered	Species which is not critically endangered and it is facing a very high risk of extinction in the wild in the immediate or near future, as determined in accordance with the prescribed criteria.
V	Vulnerable	Species which is not critically endangered or endangered and is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
CD	Conservation Dependent	Species which at a particular time if, at that time, 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 within a period of 5 years.

The *Biodiversity Conservation Act 2016* (BC Act) provides for (amongst other things) the protection of flora that is facing an extremely high risk of extinction in the wild in the immediate, near or medium-term future in Western Australia under Part 10 (Division 2).

Threatened flora are listed in the *Wildlife Conservation (Rare Flora) Notice 2018* (under Part 2, Division 1, Subdivision 2 of the BC Act; Department of Biodiversity, Conservation and Attractions (DBCA) 2018a) and are categorised under Schedules 1-3. A flora species is defined as **threatened** if it is facing an extremely high risk of extinction in the wild in the immediate, near or medium-term future, pursuant to sections 20, 21 and 22 of the BC Act (DBCA 2019). Threatened species are categorised as critically endangered, endangered, and vulnerable (Table A1.2).

Table A1.2 State definition of threatened flora species

Note: Adapted from DBCA (2019).

CODE	CATEGORY	DEFINITION
CR	Critically endangered	Species considered to be facing an extremely high risk of becoming extinct in the wild (listed under Schedule 1 of the <i>Wildlife Conservation (Rare Flora) Notice 2018</i>).
EN	Endangered	Species considered to be facing a very high risk of becoming extinct in the wild (listed under Schedule 2 of the <i>Wildlife Conservation (Rare Flora) Notice 2018</i>).
VU	Vulnerable	Species considered to be facing a high risk of becoming extinct in the wild (listed under Schedule 3 of the <i>Wildlife Conservation (Rare Flora) Notice 2018</i>).

Priority flora species are defined as “possibly threatened species that do not meet the survey criteria, or are otherwise data deficient” or species that are “adequately known, are rare but not threatened, meet criteria for near threatened or have recently been removed from the threatened species list” for other than taxonomic reasons” (DBCA 2019). Priority species are not afforded the same level of protection under state or federal legislation as the listed Threatened species, however are considered significant under the Environmental Protection Authority’s *Environmental Factor Guideline: Flora and Vegetation* (Environmental Protection Authority 2016a). The Department of Biodiversity, Conservation and Attractions categorises priority flora into four categories: Priority 1; Priority 2, Priority 3 and Priority 4 (Table A1.3).

Table A1.3: State definition of priority flora species

Note: Adapted from DBCA (2019).

CODE	CATEGORY	DEFINITION
P1	Priority 1: Poorly-known species	Known from one or a few locations (< 5) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation; or are otherwise under threat of habitat destruction or degradation. In urgent need of further survey.
P2	Priority 2: Poorly-known species	Known from one or a few locations (< 5). Some occurrences are on lands managed primarily for nature conservation. In urgent need of further survey.
P3	Priority 3: Poorly-known species	Known from several locations and the species does not appear to be under imminent threat; or from few but widespread locations with either a large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. In need of further survey.
P4	Priority 4: Rare, Near Threatened, and other species in need of monitoring	<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 do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.</p> <p>c) Other - Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.</p>

APPENDIX A2: THREATENED AND PRIORITY ECOLOGICAL COMMUNITY DEFINITIONS

Under section 181 of the EPBC Act, **threatened ecological communities** are categorised as critically endangered, endangered and vulnerable (Table A2.1).

Table A2.1 Federal definition of threatened ecological communities

Note: Adapted from section 181 and section 182 of the EPBC Act.

CATEGORY	DEFINITION
Critically Endangered	If, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future.
Endangered	If, at that time, it is not critically endangered and is facing a very high risk of extinction in the wild in the near future.
Vulnerable	If, at that time, it is not critically endangered or endangered, and is facing a high risk of extinction in the wild in the medium-term future.

Threatened ecological communities (TECs) are listed in the *List of Threatened Ecological Communities endorsed by the Western Australian Minister for Environment (28 June 2018)* (under Part 2, Division 2, Subdivision 1 of the BC Act; DBCA 2018c). An ecological community is defined as **threatened** if it is facing an extremely high risk of collapse in the immediate, near or medium-term future, pursuant to sections 28, 29 and 30 of the BC Act. Threatened ecological communities are categorised as critically endangered, endangered, and vulnerable (Table A2.2).

Currently there is no Western Australian legislation covering the conservation of state listed **threatened ecological communities** (TECs), however, a non-statutory process is in place, whereby the DBCA (and former equivalent departments) have been identifying and informally listing TECs since 1994. Some of these TECs are also endorsed by the Federal Minister as threatened, and some of these are listed under the EPBC Act and therefore afforded legislative protection at the Commonwealth level.

Table A2.2 State definition of threatened ecological communities

Note: Adapted from Department of Environment and Conservation (2013).

CODE	CATEGORY	DEFINITION
CR	Critically Endangered	An ecological community will be listed as CR when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future, meeting any one or more of the following criteria: <ol style="list-style-type: none"> 1. The estimated geographic range and distribution has been reduced by at least 90% and is either continuing to decline with total destruction imminent, or is unlikely to be substantially rehabilitated in the immediate future due to modification; 2. The current distribution is limited i.e. highly restricted, having very few small or isolated occurrences, or covering a small area; or 3. The ecological community is highly modified with potential of being rehabilitated in the immediate future.
EN	Endangered	An ecological community will be listed as EN when it has been adequately surveyed and is not CR, but is facing a very high risk of total destruction in the near future. The ecological community must meet any one or more of the following criteria: <ol style="list-style-type: none"> 1. The estimated geographic range and distribution has been reduced by at least 70% and is either continuing to decline with total destruction imminent in the short term future, or is unlikely to be substantially rehabilitated in the short term future due to modification; 2. The current distribution is limited i.e. highly restricted, having very few small or isolated occurrences, or covering a small area; or 3. The ecological community is highly modified with potential of being rehabilitated in the short term future.
VU	Vulnerable	An ecological community will be listed as VU when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing high risk of total destruction in the medium to long term future. The ecological community must meet any one or more of the following criteria: <ol style="list-style-type: none"> 1. The ecological community exists largely as modified occurrences that are likely to be able to be substantially restored or rehabilitated; 2. The ecological community may already be modified and would be vulnerable to threatening process, and restricted in range or distribution; or 3. The ecological community may be widespread but has potential to move to a higher threat category due to existing or impending threatening processes.

Priority ecological communities (PECs) are defined as possible threatened ecological communities that do not meet the stringent survey criteria for the assessment of threatened ecological communities, and are listed by the DBCA (2020a) in the *Priority Ecological Communities for Western Australia – Version 30 (28 July 2020)*. Similarly to priority flora, PECs are not afforded legislative protection, however are considered significant under the Environmental Protection Authority's (2016a) *Environmental Factor Guideline: Flora and Vegetation*. The Department of Biodiversity, Conservation and Attractions categorises priority ecological communities into five categories: Priority 1; Priority 2, Priority 3, Priority 4 and Priority 5 (Table A2.3).

Table A2.3 State definition of priority ecological communities

Note: Adapted from Department of Environment and Conservation (2013).

CODE	CATEGORY	DEFINITION
P1	Priority 1 (Poorly known ecological communities)	Ecological communities that are known from very few, restricted occurrences (generally ≤ 5 occurrences or a total area of ≤ 100 ha). Most of these occurrences are not actively managed for conservation (e.g. located within agricultural or pastoral lands, urban areas, or active mineral leases) and for which immediate threats exist.
P2	Priority 2 (Poorly known ecological communities)	Communities that are known from few small occurrences (generally ≤ 10 occurrences or a total area of ≤ 200 ha). At least some occurrences are not believed to be under immediate threat of destruction or degradation.
P3	Priority 3 (Poorly known ecological communities)	<ol style="list-style-type: none"> 1. Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation; 2. Communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat; or 3. Communities made up of large, and/or widespread occurrences, that may or not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing and inappropriate fire regimes.
P4	Priority 4 (Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring)	<ol style="list-style-type: none"> 1. Rare – Communities known from few occurrences that are considered to have been adequately surveyed, sufficient knowledge is available, and are considered not to be currently threatened. 2. Near Threatened – Communities considered to have been adequately surveyed and do not qualify for Conservation Dependent, but are close to qualifying for Vulnerable. 3. Communities that have been removed from the list of threatened communities during the past five years.
P5	Priority 5 (Conservation Dependent ecological communities)	Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

APPENDIX A3: CATEGORIES AND CONTROL MEASURES OF DECLARED PEST (PLANT) ORGANISMS IN WESTERN AUSTRALIA

Section 22 of Western Australia's *Biosecurity and Agriculture Management Act 2007* (BAM Act) makes provision for a plant taxon to be listed as a declared pest organism in respect to parts of, or the entire State. According to the BAM Act, a declared pest is defined as a prohibited organism (section 12), or an organism for which a declaration under section 22 (2) of the Act is in force.

Under the *Biosecurity and Agriculture Management Regulations 2013* (WA), declared pest plants are placed in one of three control categories, C1 (exclusion), C2 (eradication) or C3 (management), which determines the measures of control which apply to the declared pest (Table A4.1). The current listing of declared pest organisms and their control category is through the Western Australian Organism List (Department of Primary Industries and Regional Development 2020).

Table A3.1 Categories and control measures of declared pest (plant) organisms

Note: Adapted from *Biosecurity and Agriculture Management Regulations 2013*.

CONTROL CATEGORY	CONTROL MEASURES
<p style="text-align: center;">C1 (Exclusion)</p> <p>'(a) Category 1 (C1) — Exclusion: if in the opinion of the Minister introduction of the declared pest into an area or part of an area for which it is declared should be prevented.'</p> <p>Pests will be assigned to this category if they are not established in Western Australia and control measures are to be taken, including border checks, in order to prevent them entering and establishing in the State.</p>	<p>In relation to a category 1 declared pest, the owner or occupier of land in an area for which an organism is a declared pest or a person who is conducting an activity on the land must take such of the control measures specified in subregulation (1) as are reasonable and necessary to destroy, prevent or eradicate the declared pest.</p>
<p style="text-align: center;">C2 (Eradication)</p> <p>'(b) Category 2 (C2) — Eradication: if in the opinion of the Minister eradication of the declared pest from an area or part of an area for which it is declared is feasible.'</p> <p>Pests will be assigned to this category if they are present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still a possibility.</p>	<p>In relation to a category 2 declared pest, the owner or occupier of land in an area for which an organism is a declared pest or a person who is conducting an activity on the land must take such of the control measures specified in subregulation (1) as are reasonable and necessary to destroy, prevent or eradicate the declared pest.</p>
<p style="text-align: center;">C3 (Management)</p> <p>'(c) Category 3 (C3) — Management: if in the opinion of the Minister eradication of the declared pest from an area or part of an area for which it is declared is not feasible but that it is necessary to:</p> <p>(i) alleviate the harmful impact of the declared pest in the area; or</p> <p>(ii) reduce the number or distribution of the declared pest in the area; or</p> <p>(iii) prevent or contain the spread of the declared pest in the area.'</p> <p>Pests will be assigned to this category if they are established in Western Australia but it is feasible, or desirable, to manage them in order to limit their damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area which currently is free of that pest.</p>	<p>In relation to a category 3 declared pest, the owner or occupier of land in an area for which an organism is a declared pest or a person who is conducting an activity on the land must take such of the control measures specified in subregulation (1) as are reasonable and necessary to:</p> <p>(a) alleviate the harmful impact of the declared pest in the area for which it is declared; or</p> <p>(b) reduce the number or distribution of the declared pest in the area for which it is declared; or</p> <p>(c) prevent or contain the spread of the declared pest in the area for which it is declared.</p>

APPENDIX A4: OTHER DEFINITIONS

Environmentally sensitive areas

Environmentally sensitive areas are declared by the State Minister under section 51B of the *Environmental Protection Act 1986* (EP Act) and are listed in the *Environmental Protection (Environmentally Sensitive Areas) Notice 2005*, gazetted 8 April 2005. Specific environmentally sensitive areas relevant to this report include: a defined wetland and the area within 50 metres of the wetland; the area covered by vegetation within 50 metres of rare flora; the area covered by a threatened ecological community; a Bush Forever site – further areas and information are described in the *Environmental Protection (Environmentally Sensitive Areas) Notice 2005*.

Conservation significant flora

Under the *Environmental Factor Guideline: Flora and Vegetation* (Environmental Protection Authority 2016a), flora may be considered significant for a range of reasons, including, but not limited to the following:

- being identified as threatened or priority species;
- locally endemic or associated 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.

Conservation significant vegetation

Under the *Environmental Factor Guideline: Flora and Vegetation* (Environmental Protection Authority 2016a), vegetation may be considered significant for a range of reasons, including, but not limited to the following:

- being identified as threatened or priority ecological communities;
- 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.

APPENDIX A5: NVIS STRUCTURAL FORMATION TERMINOLOGY

Note: Adapted from Environmental Steering Committee for Australian Vegetation Information (2003).

COVER CHARACTERISTICS							
Foliage cover*	70-100	30-70	10-30	<10	≈0	0-5	unknown
Crown cover**	>80	50-80	20-50	0.25-20	<0.25	0-5	unknown
% cover***	>80	50-80	20-50	0.25-20	<0.25	0-5	unknown
Cover code	d	c	i	r	bi	bc	unknown

GROWTH FORM	HEIGHT RANGES (m)	STRUCTURAL FORMATION CLASSES						
		closed forest	open forest	woodland	open woodland	isolated trees	isolated clumps of trees	trees
tree, palm	<10, 10-30, >30	closed forest	open forest	woodland	open woodland	isolated trees	isolated clumps of trees	trees
tree mallee	<3, <10, 10-30	closed mallee forest	open mallee forest	mallee woodland	open mallee woodland	isolated mallee trees	isolated clumps of mallee trees	mallee trees
shrub, cycad, grass-tree, tree-fern	<1, 1-2, >2	closed shrubland	shrubland	open shrubland	sparse shrubland	isolated shrubs	isolated clumps of shrubs	shrubs
mallee shrub	<3, <10, 10-30	closed mallee shrubland	mallee shrubland	open mallee shrubland	sparse mallee shrubland	isolated mallee shrubs	isolated clumps of mallee shrubs	mallee shrubs
heath shrub	<1, 1-2, >2	closed heathland	heathland	open heathland	sparse heathland	isolated heath shrubs	isolated clumps of heath shrubs	heath shrubs
chenopod shrub	<1, 1-2, >2	closed chenopod shrubland	chenopod shrubland	open chenopod shrubland	sparse chenopod shrubland	isolated chenopod shrubs	isolated clumps of chenopod shrubs	chenopod shrubs
samphire shrub	<0.5, >0.5	closed samphire shrubland	samphire shrubland	open samphire shrubland	sparse samphire shrubland	isolated samphire shrubs	isolated clumps of samphire shrubs	samphire shrubs
hummock grass	<2, >2	closed hummock grassland	hummock grassland	open hummock grassland	sparse hummock grassland	isolated hummock grasses	isolated clumps of hummock grasses	hummock grasses
tussock grass	<0.5, >0.5	closed tussock grassland	tussock grassland	open tussock grassland	sparse tussock grassland	isolated tussock grassland	isolated clumps of tussock grasses	tussock grasses
other grass	<0.5, >0.5	closed grassland	grassland	open grassland	sparse grassland	isolated grasses	isolated clumps of grasses	other grasses
sedge	<0.5, >0.5	closed sedgeland	sedgeland	open sedgeland	sparse sedgeland	isolated sedges	isolated clumps of sedges	sedges
rush	<0.5, >0.5	closed rushland	rushland	open rushland	sparse rushland	isolated rushes	isolated clumps of rushes	rushes
forb	<0.5, >0.5	closed forbland	forbland	open forbland	sparse forbland	isolated forbs	isolated clumps of forbs	forbs
fern	<1, 1-2, >2	closed fernland	fernland	open fernland	sparse fernland	isolated ferns	isolated clumps of ferns	ferns
bryophyte	<0.5	closed bryophyteland	bryophyteland	open bryophyteland	sparse bryophyteland	isolated bryophytes	isolated clumps of bryophytes	bryophytes
lichen	<0.5	closed lichenland	lichenland	open lichenland	sparse lichenland	isolated lichens	isolated clumps of lichens	lichens
vine	<10, 10-30, >30	closed vineland	vineland	open vineland	sparse vineland	isolated vines	isolated clumps of vines	vines
aquatic	0-0.5, <1	closed aquatic bed	aquatic bed	open aquatic bed	sparse aquatics	isolated aquatics	isolated clumps of aquatics	aquatics
seagrass	0-0.5, <1	closed seagrass bed	seagrass bed	open seagrass bed	sparse seagrasses	isolated seagrasses	isolated clumps of seagrasses	seagrasses

APPENDIX A6: DEFINITION OF VEGETATION CONDITION SCALE FOR THE SOUTH WEST AND INTERZONE BOTANICAL PROVINCES

Vegetation condition ratings relate to vegetation structure, level of disturbance at each structural layer and the ability of the vegetation unit to regenerate (Table A6.1). Vegetation condition provides complementary information for assessing the significance of potential impacts.

Table A6.1 Definition of Vegetation Condition Categories

Note: Adapted from Keighery (1994).

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

**APPENDIX B: SITE LOCATIONS FOR THE CENTRAL NORSEMAN GOLD PROJECT SURVEY AREAS,
SEPTEMBER-OCTOBER 2020**

Note: Site prefix CA indicates the Camp survey area, CO is Cobbler, GL is Gladstone extensions, MA is Maybell, NR is North Royal extension, OK is OK, SC is Scotia extensions, SL is Slippers and TS is the TSF area. Datum is GDA94 and UTM zone is 51H.

SITE	EASTING	NORTHING
CA01	385984	6437785
CO01	381409	6441990
CO02	381617	6441718
CO03	381285	6441572
CO04	381715	6441276
CO05	381375	6441168
CO06	380968	6441245
CO07	380954	6440808
CO08	380403	6440458
CO09	380546	6440006
CO10	380053	6440335
CO11	380929	6440652
GL21	393571	6443066
GL22	393609	6442678
GL23	393656	6442484
GL24	393555	6442279
GL25	390616	6440207
GL26	390486	6440096
GL27	390816	6439848

SITE	EASTING	NORTHING
MA01	383150	6419599
MA02	383714	6419621
MA03	385012	6419818
MA04	385898	6419961
MA05	386656	6420043
MA06	386631	6419102
MA07	386887	6418598
MA08	387048	6418418
MA09	387151	6418355
MA10	387446	6418489
MA11	387596	6418311
MA12	387417	6417778
MA13	386670	6417398
MA14	386318	6416743
MA15	385859	6416835
MA16	386659	6417699
MA17	386386	6417837
MA18	386300	6418188
MA19	386452	6418375
MA21	386791	6418644
MA22	383362	6419703
NR23	387672	6446366
OK01	385213	6435048
OK02	385747	6434840
OK03	385431	6434315
OK04	386314	6435384
OK05	386436	6435846
OK06	386620	6436510
OK07	386731	6436451
OK08	384547	6434513
OK09	384672	6434574

SITE	EASTING	NORTHING
SC41	385451	6407999
SC42	385230	6406863
SC43	385232	6405581
SC44	387031	6408791
SC45	387610	6408407
SC46	387784	6408013
SC47	388059	6408013
SC48	387744	6407606
SC49	387996	6407519
SC50	387875	6407202
SC51	387340	6407159
SC52	387222	6404576
SC53	386997	6404665
SC54	386685	6404689
SC55	386369	6404851
SC56	386061	6404979
SL01	388078	6444367
SL02	388052	6444250
SL03	387835	6443715
TS01	386989	6436874
TS02	387425	6436794
TS03	387816	6436945
TS04	388549	6436563
TS05	388561	6436278
TS06	388919	6436260
TS07	389046	6435469
TS08	388247	6435582
TS09	387740	6435862
TS10	387738	6436561

APPENDIX C: VASCULAR PLANT SPECIES RECORDED AT EACH SITE IN THE NORSEMAN GOLD PROJECT SURVEY AREAS, SEPTEMBER-OCTOBER 2020

Note: * denotes introduced species; SCC denotes State Conservation Code (see Appendix A for definitions); OPPO are species recorded outside quadrats only (F=Flats survey area, H=Hills survey area).

FAMILY	SPECIES	SCC	AM	COBBLER											GLADSTONE											
			CA01	CO01	CO02	CO03	CO04	CO05	CO06	CO07	CO08	CO09	CO10	CO11	GL21	GL22	GL23	GL24	GL25	GL26	GL27					
FABACEAE (continued)	<i>Acacia merrallii</i>				X						X	X						X	X							
	<i>Acacia neurophylla</i> subsp. <i>neurophylla</i>						X																			
	<i>Acacia nyssophylla</i>										X															
	<i>Acacia pachypoda</i>										X															
	<i>Acacia resinistipulea</i>																									
	<i>Acacia</i> sp.																									
	<i>Daviesia ?benthamii</i>											X														
	<i>Mirbelia granitica</i>							X																		
	<i>Senna artemisioides</i> subsp. <i>filifolia</i>			X		X			X		X	X							X			X	X			
	<i>Senna</i> sp.					X																				
FRANKENIACEAE	<i>Frankenia interioris</i> var. <i>interioris</i>			X																		X				
GOODENIACEAE	<i>Dampiera latealata</i>						X							X												
	<i>Goodenia laevis</i> subsp. <i>laevis</i>	P3																								
	<i>Scaevola spinescens</i>			X	X		X	X	X	X	X	X	X	X	X			X	X	X	X		X	X		
HEMEROCALLIDACEAE	<i>Dianella revoluta</i>					X			X																	
LAMIACEAE	* <i>Salvia verbenaca</i>																							X		
	<i>Westringia rigida</i>		X	X	X		X	X	X	X	X	X	X					X	X	X						
LAURACEAE	<i>Cassytha</i> sp.					X																				
LOGANIACEAE	<i>Logania perryana</i>						X																			
MALVACEAE	<i>Lawrenzia squamata</i>																					X	X	X	X	X
	<i>Sida calyxhymentia</i>																									
MONTIACEAE	<i>Calandrinia eremaea</i>																									
	<i>Calandrinia</i> sp.																									
MYRTACEAE	<i>Calothamnus gilesii</i>					X	X																			
	<i>Calytrix tetragona</i>																									
	<i>Calytrix</i> sp.																						X		X	
	<i>Eucalyptus brockwayi</i>	P3									X															
	<i>Eucalyptus concinna</i>			X	X		X				X															
	<i>Eucalyptus delicata</i>																									
	<i>Eucalyptus dundasii</i>										X		X									X				

APPENDIX C: VASCULAR PLANT SPECIES RECORDED AT EACH SITE IN THE NORSEMAN GOLD PROJECT SURVEY AREAS, SEPTEMBER-OCTOBER 2020

Note: * denotes introduced species; SCC denotes State Conservation Code (see Appendix A for definitions); OPPO are species recorded outside quadrats only (F=Flats survey area, H=Hills survey area).

FAMILY	SPECIES	SCC	AM	COBBLER											GLADSTONE										
			CA01	CO01	CO02	CO03	CO04	CO05	CO06	CO07	CO08	CO09	CO10	CO11	GL21	GL22	GL23	GL24	GL25	GL26	GL27				
POLYGALACEAE	<i>Comesperma calymega</i>						X																		
PROTEACEAE	<i>Grevillea acuaria</i>			X	X	X	X		X				X						X						
	<i>Grevillea ?nematophylla</i> subsp. <i>nematophylla</i>																								
PTERIDACEAE	<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>																								
RHAMNACEAE	<i>Cryptandra wilsonii</i>							X							X										
	<i>Pomaderris forrestiana</i>																								
	<i>Trymalium myrtillus</i> subsp. <i>myrtillus</i>		X		X		X	X				X	X												
RUTACEAE	<i>Geijera linearifolia</i>			X									X					X	X	X	X				
	<i>Philothea apiculata</i>	P1												X											
	<i>Philothea fitzgeraldii</i>														X										
SANTALACEAE	<i>Exocarpos aphyllus</i>		X	X				X	X	X	X	X	X					X	X	X				X	
	<i>Santalum acuminatum</i>			X	X	X	X	X		X	X	X						X	X				X		
	<i>Santalum spicatum</i>																								
	<i>Santalum</i> sp.																								
SAPINDACEAE	<i>?Dodonaea bursariifolia</i>																								
	<i>Dodonaea microzyga</i> var. <i>acrolobata</i>				X	X		X					X	X											
	<i>Dodonaea stenozyga</i>		X																				X		
	<i>Dodonaea viscosa</i> subsp. <i>angustissima</i>																								
SCROPHULARIACEAE	<i>Eremophila alternifolia</i>																								X
	<i>Eremophila decipiens</i> subsp. <i>decipiens</i>			X																					X
	<i>Eremophila ?dempsteri</i>																							X	X
	<i>Eremophila ?gibbosa</i>					X																			
	<i>Eremophila glabra</i> subsp. <i>glabra</i>				X			X				X	X					X	X	X	X				X
	<i>Eremophila ionantha</i>																						X		
	<i>Eremophila parvifolia</i> ?subsp. <i>auricampi</i>																	X	X	X	X				
	<i>Eremophila psilocalyx</i>		X		X			X				X	X												
	<i>Eremophila purpurascens</i>	P3					X							X											
	<i>Eremophila purpurascens</i> x <i>E. alternifolia</i>							X			X														
	<i>Eremophila rugosa</i>																								
	<i>Eremophila scoparia</i>										X	X	X					X	X				X	X	
	<i>Eremophila</i> sp.																	X		X					
	<i>Myoporum platycarpum</i> subsp. <i>platycarpum</i>																	X		X					

APPENDIX C: VASCULAR PLANT SPECIES RECORDED AT EACH SITE IN THE NORSEMAN GOLD PROJECT SURVEY AREAS, SEPTEMBER-OCTOBER 2020

Note: * denotes introduced species; SCC denotes State Conservation Code (see Appendix A for definitions); OPPO are species recorded outside quadrats only (F=Flats survey area, H=Hills survey area).

FAMILY	SPECIES	SCC	MAYBELL																				NORTH ROYAL		
			MA01	MA02	MA03	MA04	MA05	MA06	MA07	MA08	MA09	MA10	MA11	MA12	MA13	MA14	MA15	MA16	MA17	MA18	MA19	MA21	MA22	NR23	
MYRTACEAE (continued)	<i>Eucalyptus gracilis</i>		X	X																			X		
	<i>Eucalyptus lesouefii</i>		X	X	X		X																X	X	
	<i>Eucalyptus ?oleosa</i>								X			X													
	<i>Eucalyptus ?oleosa</i> subsp. <i>oleosa</i>				X	X																			
	<i>Eucalyptus oleosa</i> ?subsp. <i>oleosa</i>																								
	<i>Eucalyptus prolixa</i>																								
	<i>Eucalyptus salmonophloia</i>																								
	<i>Eucalyptus salubris</i>																	X							
	<i>Eucalyptus spreta</i>									X		X													
	<i>Eucalyptus stricklandii</i>																								
	<i>Eucalyptus torquata</i>										X	X	X		X		X	X		X	X				
	<i>Eucalyptus urna</i>				X	X											X						X		
	<i>Eucalyptus websteriana</i> subsp. <i>norsemanica</i>	P1																							
	<i>Eucalyptus</i> sp.																								
	<i>Melaleuca acuminata</i> subsp. <i>acuminata</i>																								
	<i>Melaleuca coccinea</i>	P3																							
	<i>Melaleuca hamata</i>									X									X						
	<i>Melaleuca lanceolata</i>																				X				
	<i>Melaleuca lateriflora</i>																					X			
	<i>Melaleuca sheathiana</i>					X	X			X				X		X	X					X	X		
<i>Melaleuca</i> sp.						X																			
<i>Micromyrtus papillosa</i>	P1																								
<i>Thryptomene australis</i> subsp. <i>brachyandra</i>																									
Myrtaceae sp.																									
ORCHIDACEAE	<i>Pterostylis</i> sp.								X																
OXALIDACEAE	<i>Oxalis</i> sp.																								
POACEAE	<i>Aristida</i> sp.															X									
	<i>Austrostipa nitida</i>																								
	<i>Austrostipa ?nullarborensis</i>																								
	<i>Austrostipa platychaeta</i>			X	X		X	X				X												X	
	<i>Austrostipa</i> sp.		X	X																					
	<i>Eragrostis australasica</i>																								
	<i>Rytidosperma caespitosum</i>		X																						
	<i>Triodia scariosa</i>																								
Poaceae sp.						X		X		X	X						X				X				

APPENDIX C: VASCULAR PLANT SPECIES RECORDED AT EACH SITE IN THE NORSEMAN GOLD PROJECT SURVEY AREAS, SEPTEMBER-OCTOBER 2020

Note: * denotes introduced species; SCC denotes State Conservation Code (see Appendix A for definitions); OPPO are species recorded outside quadrats only (F=Flats survey area, H=Hills survey area).


FAMILY	SPECIES	SCC	MAYBELL																				NORTH ROYAL	
			MA01	MA02	MA03	MA04	MA05	MA06	MA07	MA08	MA09	MA10	MA11	MA12	MA13	MA14	MA15	MA16	MA17	MA18	MA19	MA21	MA22	NR23
POLYGALACEAE	<i>Comesperma calymega</i>																							
PROTEACEAE	<i>Grevillea acuaria</i>			X							X				X	X	X	X					X	
	<i>Grevillea ?nematophylla</i> subsp. <i>nematophylla</i>											X												
PTERIDACEAE	<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>										X	X							X					
RHAMNACEAE	<i>Cryptandra wilsonii</i>										X	X							X					
	<i>Pomaderris forrestiana</i>										X	X	X		X		X	X						
	<i>Trymalium myrtillus</i> subsp. <i>myrtillus</i>															X			X	X	X			
RUTACEAE	<i>Geijera linearifolia</i>						X	X						X								X		X
	<i>Philothea apiculata</i>	P1																	X	X				
	<i>Philothea fitzgeraldii</i>																							
SANTALACEAE	<i>Exocarpos aphyllus</i>					X	X	X		X	X	X	X	X	X		X		X		X	X		X
	<i>Santalum acuminatum</i>		X	X	X		X															X	X	X
	<i>Santalum spicatum</i>																		X	X				
	<i>Santalum</i> sp.													X		X								
SAPINDACEAE	<i>?Dodonaea bursariifolia</i>																							
	<i>Dodonaea microzyga</i> var. <i>acrolobata</i>								X	X	X	X			X	X	X	X	X	X	X			
	<i>Dodonaea stenozyga</i>															X					X	X		
	<i>Dodonaea viscosa</i> subsp. <i>angustissima</i>												X											
SCROPHULARIACEAE	<i>Eremophila alternifolia</i>																							
	<i>Eremophila decipiens</i> subsp. <i>decipiens</i>																							X
	<i>Eremophila ?dempsteri</i>																							
	<i>Eremophila ?gibbosa</i>																							
	<i>Eremophila glabra</i> subsp. <i>glabra</i>							X		X	X	X	X	X	X			X				X		X
	<i>Eremophila ionantha</i>																							
	<i>Eremophila parvifolia</i> ?subsp. <i>auricampi</i>																							X
	<i>Eremophila psilocalyx</i>							X			X			X	X	X		X	X					
	<i>Eremophila purpurascens</i>	P3													X									
	<i>Eremophila purpurascens</i> x <i>E. alternifolia</i>																							
	<i>Eremophila rugosa</i>																							
	<i>Eremophila scoparia</i>		X	X		X	X			X	X			X			X					X	X	X
	<i>Eremophila</i> sp.																							X
	<i>Myoporum platycarpum</i> subsp. <i>platycarpum</i>		X														X				X			

APPENDIX C: VASCULAR PLANT SPECIES RECORDED AT EACH SITE IN THE NORSEMAN GOLD PROJECT SURVEY AREAS, SEPTEMBER-OCTOBER 2020

Note: * denotes introduced species; SCC denotes State Conservation Code (see Appendix A for definitions); OPPO are species recorded outside quadrats only (F=Flats survey area, H=Hills survey area).

FAMILY	SPECIES	SCC	OK01							SCOTIA																	
			OK01	OK02	OK03	OK04	OK05	OK06	OK07	OK08	OK09	SC41	SC42	SC43	SC44	SC45	SC46	SC47	SC48	SC49	SC50	SC51	SC52	SC53	SC54	SC55	SC56
AIZOACEAE	<i>Disphyma crassifolium</i> subsp. <i>clavellatum</i> <i>Sarcozona praecox</i> Aizoaceae sp.												x						x								
AMARANTHACEAE	<i>Ptilotus ?eremita</i> <i>Ptilotus obovatus</i> <i>Ptilotus</i> sp.														x	x	x						x	x	x		
APOCYNACEAE	<i>Alyxia buxifolia</i> <i>Vincetoxicum lineare</i>					x		x	x	x	x	x			x	x	x	x	x	x	x	x	x	x	x		
ASPARAGACEAE	<i>Thysanotus manglesianus</i>																										
ASPHODELACEAE	* <i>Asphodelus fistulosus</i>								x																		
ASTERACEAE	<i>Chrysocephalum puteale</i> <i>Cratystylis conocephala</i> <i>Erymophyllum ramosum</i> subsp. <i>ramosum</i> * <i>Gazania linearis</i> <i>Minuria cunninghamii</i> <i>Olearia muelleri</i> <i>Olearia</i> sp. <i>Podolepis capillaris</i> <i>Sonchus oleraceus</i> <i>Vittadinia dissecta</i> var. <i>hirta</i> <i>Waitzia acuminata</i> Asteraceae sp.								x				x	x				x					x			x	
BORAGINACEAE	<i>Halgania andromedifolia</i>					x				x	x				x										x	x	
BRASSICACEAE	* <i>Carrichtera annua</i> <i>Lepidium platypetalum</i>																										
CASUARINACEAE	<i>Allocasuarina acutivalvis</i> subsp. <i>acutivalvis</i> <i>Allocasuarina campestris</i> <i>Allocasuarina eriochlamys</i> subsp. <i>grossa</i> <i>Allocasuarina helmsii</i> <i>Casuarina obesa</i>	P3																			x					x	

APPENDIX D: A SUMMARY OF VEGETATION COMMUNITIES RECORDED WITHIN THE HILLS SURVEY AREA, SPRING 2020

Vegetation Community Description	
Vegetation map code: NS3	
Structural	
Low open chenopod shrubland of <i>Maireana amoena</i> , <i>Atriplex</i> spp. and <i>Tecticornia</i> spp.	
Associated species	
<i>Acacia erinacea</i> , Aizoaceae spp., <i>Olearia muelleri</i> .	
Soils and Landforms: Cream to red sandy clay on flats on the edge of salt lakes and salty drainages.	
Outcropping: Absent.	
Total Area: 21.7 ha	Proportion of Hills survey area: 1.7 %
Number of Quadrats: 2	Species richness: 10.0 ± 4.0 (s.e.)
Representative Photograph	
	
Quadrat CO11	

APPENDIX D: A SUMMARY OF VEGETATION COMMUNITIES RECORDED WITHIN THE HILLS SURVEY AREA, SPRING 2020

Vegetation Community Description

Vegetation map code: S1

Structural

Shrubland of *Allocasuarina* spp., *Acacia neurophylla* subsp. *neurophylla*, *Melaleuca hamata*, *Dodonaea microzyga* var. *acrolobata* and *Cryptandra* spp. over mixed Asteraceae sp. and *Lepidosperma* sp.

Associated species

Lepidosperma spp., *Prostanthera* spp., *Scaevola spinescens*.

Soils and Landforms: Red-brown clayey loam and ironstone outcropping on upper slopes and ridges and rocky headlands at the edges of salt lakes.

Outcropping: Either absent or moderate granite/ banded ironstone

Total Area: 46.7 ha

Proportion of Hills survey area: 3.7 %

Number of Quadrats: 8

Species richness: 15.0 ± 1.1 (s.e.)

Representative Photograph



Quadrat SC54

APPENDIX D: A SUMMARY OF VEGETATION COMMUNITIES RECORDED WITHIN THE HILLS SURVEY AREA, SPRING 2020

Vegetation Community Description

Vegetation map code: W2

Structural

Woodland to open woodland of *Eucalyptus flocktoniae*, *E. urna*, *E. lesouefii* and *E. dundasii* over sparse shrubland of *Melaleuca sheathiana*, *Eremophila scoparia*, *Scaevola spinescens*, *Beyeria sulcata* and *Exocarpos aphyllus* over isolated shrubs of *Olearia muelleri*.

Associated species

Eremophila scoparia, *Senna artemisioides* subsp. *fillifolia*, *Alyxia buxifolia*.

Soils and Landforms: Orange-red to brown clayey loam on flats and slopes.

Outcropping: Either absent of moderate ironstone.

Total Area: 580.1 ha

Proportion of Hills survey area: 45.9 %

Number of Quadrats: 22

Species richness: 14.0 ± 0.9 (s.e.)

Representative Photograph



Quadrat SC42

APPENDIX D: A SUMMARY OF VEGETATION COMMUNITIES RECORDED WITHIN THE HILLS SURVEY AREA, SPRING 2020

Vegetation Community Description

Vegetation map code: W3

Structural

Open woodland of *Eucalyptus longicornis* or *E. delicata* over open shrubland of *Melaleuca sheathiana* and *Cratystylis conocephala* over mixed sparse chenopod shrubland.

Associated species

Eremophila interstans subsp. *virgata*, *Sclerolaena diacantha*, *Rhagodia ?eremaea*

Soils and Landforms: Pale brown clayey loam flats.

Outcropping: Absent.

Total Area: 51.6 ha

Proportion of Hills survey area: 4.1 %

Number of Quadrats: 1

Species richness: 10.0 ± 0.0 (s.e.)

Representative Photograph



Quadrat SC44

APPENDIX D: A SUMMARY OF VEGETATION COMMUNITIES RECORDED WITHIN THE HILLS SURVEY AREA, SPRING 2020

Vegetation Community Description

Vegetation map code: W4

Structural

Open woodland of *Eucalyptus torquata* over *Melaleuca sheathiana*, *Dodonaea microzyga*, *Alyxia buxifolia*, *Beyeria* spp. and *Eremophila* spp. over *Scaevola spinescens* and *Ptilotus obovatus*.

Associated species

Exocarpos aphyllus, *Myoporum platycarpum*, *Ptilotus obovatus*, *Senna artemisioides* subsp. *filifolia*, *Trymalium myrtillus* subsp. *myrtillus*.

Soils and Landforms: Red-brown clayey loam with surface rocks on slopes and ridges.

Outcropping: Moderate ironstone or possible quartz.

Total Area: 145.3 ha

Proportion of Hills survey area: 11.5 %

Number of Quadrats: 10

Species richness: 17.0 ± 1.0 (s.e.)

Representative Photograph



Quadrat MA10

APPENDIX D: A SUMMARY OF VEGETATION COMMUNITIES RECORDED WITHIN THE HILLS SURVEY AREA, SPRING 2020

Vegetation Community Description

Vegetation map code: W5

Structural

Open woodland of *Eucalyptus gracilis*, *E. flocktoniae* and *E. urna* over sparse shrubland of *Olearia* spp.

Associated species

Scaevola spinescens, *Sclerolaena diacantha*, *Eucalyptus lesouefii*.

Soils and Landforms: Red-orange clayey loam and sandy clay flats.

Outcropping: Absent.

Total Area: 8.1 ha

Proportion of Hills survey area: 0.6 %

Number of Quadrats: 1

Species richness: 14.0 ± 0.0 (s.e.)

Representative Photograph



Quadrat MA01

APPENDIX D: A SUMMARY OF VEGETATION COMMUNITIES RECORDED WITHIN THE HILLS SURVEY AREA, SPRING 2020

Vegetation Community Description

Vegetation map code: W6

Structural

Low open woodland of *Eucalyptus concinna* over isolated clumps of *Melaleuca* spp. and *Santalum acuminatum* mid-tall shrubs over isolated clumps of *Scaevola spinescens* low shrubs.

Associated species

Scaevola spinescens, *Sclerolaena diacantha*.

Soils and Landforms: Sandy clay with some outcropping on low ridges near salt lakes.

Outcropping: Absent.

Total Area: 6.2 ha

Proportion of Hills survey area: 0.5 %

Number of Quadrats: 3


Species richness: 23.7 ± 1.8 (s.e.)

Representative Photograph




Quadrat CO02


APPENDIX E: A SUMMARY OF VEGETATION COMMUNITIES RECORDED WITHIN THE FLATS SURVEY AREAS, SPRING 2020

Vegetation Community Description	
Vegetation map code: NS4	
Structural	
Sparse mid shrubland of <i>Dodonaea viscosa</i> subsp. <i>angustissima</i> over open low shrubland of <i>Eremophila</i> ? <i>decipiens</i> , <i>Scaevola spinescens</i> , <i>Atriplex</i> ? <i>vesicaria</i> , <i>Rhagodia</i> ? <i>drummondii</i> , mixed <i>Chenopodiaceae</i> spp. and <i>Frankenia</i> sp.	
Associated species	
<i>Eremophila scoparia</i> , <i>Exocarpos aphyllus</i> , ? <i>Geijera linearifolia</i> , <i>Maireana amoena</i> , <i>Tecticornia</i> sp. 3.	
Soils and Landforms: Red-brown sandy clay on low rises at the edge of salt lakes and salty drainages.	
Outcropping: Absent.	
Total area: 1.0 ha	Proportion of Flats survey area: 0.2 %
Number of Quadrats: 1	Species richness: 28 ± 0.0 (s.e.)
Representative Photograph	
	
Quadrat GL27	

APPENDIX E: A SUMMARY OF VEGETATION COMMUNITIES RECORDED WITHIN THE FLATS SURVEY AREAS, SPRING 2020

Vegetation Community Description	
Vegetation map code: S4	
Structural	
Open shrubland of <i>Grevillea nematophylla</i> subsp. <i>nematophylla</i> over <i>Hibbertia pungens</i> , <i>Allocasuarina acutivalvis</i> subsp. <i>acutivalvis</i> and <i>Dampiera latealata</i> .	
Associated species	
<i>Dodonaea microzyga</i> , <i>Alyxia buxifolia</i> .	
Soils and Landforms: Orange clay loam and ironstone outcropping.	
Outcropping: Moderate banded ironstone	
Total area: 20.4 ha	Proportion of Flats survey area: 4.7 %
Number of Quadrats: 1	Species richness: 15.0 ± 0.0 (s.e.)
Representative Photograph	
	
Quadrat TS08	

APPENDIX E: A SUMMARY OF VEGETATION COMMUNITIES RECORDED WITHIN THE FLATS SURVEY AREAS, SPRING 2020

Vegetation Community Description	
Vegetation map code: NW5	
Structural	
Mid woodland of <i>Eucalyptus lesouefii</i> and <i>Eucalyptus salubris</i> over mid isolated shrubs of <i>Eremophila scoparia</i> and occasional low <i>E. parvifolia</i> subsp. <i>?parvifolia</i> (P4) shrubs over open low chenopod shrubland of <i>Tecticornia</i> sp. 3 and <i>Atriplex ?vesicaria</i> .	
Associated species	
<i>Maireana</i> spp., <i>Atriplex</i> spp.	
Soils and Landforms: Orange to brown sandy clay with some surface gravel on flats and gentle slopes.	
Outcropping: Absent.	
Total Area: 12.1 ha	Proportion of Flats survey area: 2.8 %
Number of Quadrats: 3	Species richness: 15 ± 2.3 (s.e.)
Representative Photograph	
	
Quadrat GL25	

APPENDIX E: A SUMMARY OF VEGETATION COMMUNITIES RECORDED WITHIN THE FLATS SURVEY AREAS, SPRING 2020

Vegetation Community Description

Vegetation map code: NW8

Structural

Open low woodland of *Eucalyptus torquata* over mid sparse shrubland of *Beyeria sulcata* var. *brevipes* and *Eremophila* spp. over low isolated clumps of shrubs of *Scaevola spinescens*, *Atriplex?vesicaria*, *Olearia muelleri*.

Associated species

Soils and Landforms: Red to brown clayey loam on lower slopes.

Outcropping: Absent.

Total area: 5.7 ha

Proportion of Flats survey area: 1.3 %

Number of Quadrats: 1

Species richness: 15.0 ± 0.0 (s.e.)

Representative Photograph



Quadrat CA01

APPENDIX E: A SUMMARY OF VEGETATION COMMUNITIES RECORDED WITHIN THE FLATS SURVEY AREAS, SPRING 2020

Vegetation Community Description

Vegetation map code: NW9

Structural

Low woodland of *Eucalyptus spreata* over isolated samphire shrubs of *Tecticornia* sp. 3 and isolated tussock grassland of *Poaceae* sp. 3.

Associated species

Scaevola spinescens, *Atriplex* spp. *Cratystylis conocephala*, *Eremophila parvifolia* subsp. *auricampa*, *Eremophila glabra* subsp. *glabra*, *Exocarpos aphyllus*, *Geijera linearifolia*, *Lawrencia squamata*, *Maireana trichoptera*.

Soils and Landforms: Dry, powdery cream clayey loam on low dunes ridges near salt lakes.

Outcropping: Absent.

Total area: 11.3 ha

Proportion of Flats survey area: 2.6 %

Number of Quadrats: 3

Species richness: 17.7 ± 0.9 (s.e.)

Representative Photograph



Quadrat GL22

APPENDIX E: A SUMMARY OF VEGETATION COMMUNITIES RECORDED WITHIN THE FLATS SURVEY AREAS, SPRING 2020

Vegetation Community Description

Vegetation map code: NW10

Structural

Mid woodland of mixed *Eucalyptus* spp. over tall sparse shrubland of *Melaleuca ?sheathiana* over open mid-low shrubland of *Atriplex ?nummularia* and *A. ?vesicaria*.

Associated species

Eucalyptus distuberosa subsp. *distuberosa*, *E. dundasii*, *E. ?urna*, *?Geijera linearifolia*, *Alyxia buxifolia*, *Scaevola spinescens*.

Soils and Landforms: Brown clayey loam with some surface rocks on gentle mid slopes.

Outcropping: Absent.

Total area: 169.7 ha

Proportion of Flats survey area: 39.5 %

Number of Quadrats: 16


Species richness: 10.7 ± 1.2 (s.e.)

Representative Photograph




Quadrat OK06

APPENDIX E: A SUMMARY OF VEGETATION COMMUNITIES RECORDED WITHIN THE FLATS SURVEY AREAS, SPRING 2020

Vegetation Community Description	
Vegetation map code: NW11	
Structural	
Open low woodland of <i>Casuarina obesa</i> over low isolated clumps of <i>Rhagodia? drummondii</i> , <i>Atriplex? vesicaria</i> and <i>Tecticornia</i> sp. 3 chenopod shrubs and isolated tussock grassland of Poaceae sp. 3.	
Associated species	
<i>Maireana appressa</i> .	
Soils and Landforms: Dry, powdery cream clay on low dune ridges at the edge of salt lakes.	
Outcropping: Absent.	
Total area: 3.3 ha	Proportion of Flats survey area: 0.8 %
Number of Quadrats: 1	Species richness: 13.0 ± 0.0 (s.e.)
Representative Photograph	
	
Quadrat GL24	

APPENDIX E: A SUMMARY OF VEGETATION COMMUNITIES RECORDED WITHIN THE FLATS SURVEY AREAS, SPRING 2020

Vegetation Community Description	
Vegetation map code: NW13	
Structural	
Low open forest of mixed <i>Eucalyptus</i> spp. over mid sparse shrubland of <i>Eremophila scoparia</i> and other mixed mid shrubs.	
Associated species	
<i>Maireana amoena</i> , <i>Acacia merrallii</i> .	
Soils and Landforms: Pale brown clay on gentle lower slopes and flats in areas disturbed in the past.	
Outcropping: Absent.	
Total area: 33.7 ha	Proportion of Flats survey area: 7.8 %
Number of Quadrats: 2	Species richness: 9.0 ± 1.0 (s.e.)
Representative Photograph	
	
Quadrat OK09	

APPENDIX E: A SUMMARY OF VEGETATION COMMUNITIES RECORDED WITHIN THE FLATS SURVEY AREAS, SPRING 2020

Vegetation Community Description

Vegetation map code: NW14

Structural

Low-mid woodland of *Eucalyptus urna* over mid-tall shrubland of *Eremophila ?ionantha*, *Ricinocarpos stylosus* and *Santalum acuminatum* over mixed low shrubs

Associated species

Exocarpos aphyllus, *Maireana suaedifolia*, *Pimelea microcephala* subsp. *microcephala*.

Soils and Landforms: Red clayey soils with some surface gravel in drainage lines.

Outcropping: Absent.

Total area: 7.4 ha

Proportion of Flats survey area: 1.7 %

Number of Quadrats: 2

Species richness: 17.0 ± 0.0 (s.e.)

Representative Photograph



Quadrat TS06

APPENDIX E: A SUMMARY OF VEGETATION COMMUNITIES RECORDED WITHIN THE FLATS SURVEY AREAS, SPRING 2020

Vegetation Community Description

Vegetation map code: NW15

Structural

Mid woodland of *Eucalyptus lesouefii* and *E. dundasii* over open mid shrubland of *Trymalium myrtillus* subsp. *myrtillus* and *Halgania ?andromedifolia*

Associated species

Beyeria sulcata var. *brevipes*, *Myoporum platycarpum* subsp. *platycarpum*

Soils and Landforms: Red-brown clay-gravel on mid slopes with some outcropping granite in areas disturbed in the past.

Outcropping: Moderate granite

Total area: 4.2 ha

Proportion of Flats survey area: 1.0 %

Number of Quadrats: 1

Species richness: 8.0 ± 0.0 (s.e.)

Representative Photograph

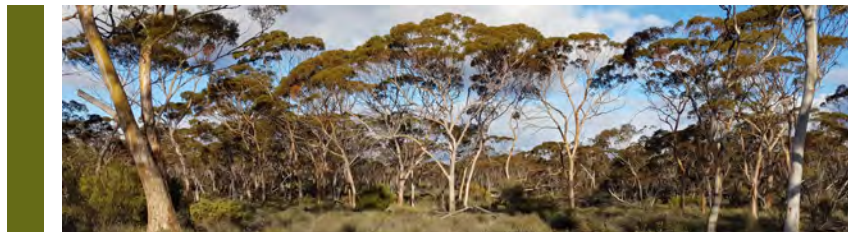


Quadrat TS05

**APPENDIX 4: SCOTIA RECONNAISSANCE FLORA
AND VEGETATION SURVEY (BIOTA 2020)**



Norseman Gold (Scotia) Reconnaissance Flora and Vegetation Survey



Prepared for Pantoro South

October 2020



© Biota Environmental Sciences Pty Ltd 2020
ABN 49 092 687 119
Level 1, 228 Carr Place
Leederville Western Australia 6007
Ph: (08) 9328 1900 Fax: (08) 9328 6138

Project No.: 1536

Prepared by: A. Braxton-Smith
C. Flaherty

Document Quality Checking History

Version: Rev A Peer review: R. Mason
Director review: M. Maier
Format review: R. Warner

Approved for issue: M. Maier

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 Biota Environmental Sciences Pty Ltd.

This report has been designed for double-sided printing. Hard copies supplied by Biota are printed on recycled paper.

Scotia – Reconnaissance Flora and Vegetation Survey

Contents

1.0	Summary	9
1.1	Project	9
1.2	Vegetation and Flora	9
2.0	Introduction	11
2.1	Project Purpose, Background and Location	11
2.2	Scope and Objectives	11
3.0	Methodology	15
3.1	Definitions of Significant Communities and Species	15
3.2	Desktop Assessment	16
3.3	Assessment of Likelihood of Occurrence for Conservation Significant Flora	17
3.4	Field Survey	17
3.5	Specimen Identification, Nomenclature, and Data Management	20
3.6	Limitations of the Study	21
4.0	Desktop Assessment	23
4.1	IBRA Bioregion and Subregion	23
4.2	Conservation Reserves in the Locality	23
4.3	Great Western Woodlands	23
4.4	Surface Geology and Soils	25
4.5	Regional Vegetation Mapping	28
4.6	Previous Botanical Surveys in the Locality	30
4.7	Vegetation of Conservation Significance from the Locality	30
4.8	Significant Flora Species Known from the Locality	31
5.0	Vegetation	33
5.1	Previous Vegetation Mapping of the Study Area	33
5.2	Vegetation Types of the Study Area	35
5.3	Condition of the Vegetation Types	42
5.4	Vegetation of Conservation Significance	42
6.0	Flora	45
6.1	Overview	45
6.2	Unresolved Taxa	45
6.3	Flora of Conservation Significance	45
6.4	Introduced Flora	47
7.0	Key Biological Constraints	49
7.1	Matters of National Environmental Significance	49
7.2	Other Features of Significance	49
8.0	References	51

Appendix 1

Framework for Conservation Significance Ranking of Communities and Species in WA

Appendix 2

Database Searches

Appendix 3

Potential Flora of Conservation Significance Compiled from Database and Literature Searches

Appendix 4

Vegetation Structural Classification and Condition Scale

Appendix 5

Raw Quadrat Data

Appendix 6

Survey Effort

Appendix 7

Combined Vascular Flora List from the Study area

Tables

Table 3.1:	Explanation of codes used to identify categories of conservation significance for flora species.	15
Table 3.2:	Ranking system used to assign the likelihood of occurrence of flora of conservation significance.	17
Table 3.3:	Summary of personnel involved in the survey.	17
Table 3.4:	Potential constraints and limitations of the current study.	21
Table 4.1:	Extent of surface geology units as described in Geoscience Australia (2008).	25
Table 4.2:	Extent of vegetation associations in the study area as described and mapped by Beard (1979).	28
Table 4.3:	Conservation significant communities identified for the locality during the desktop review.	31
Table 5.1:	Vegetation types previously mapped in the study area by Matiske (2020).	33
Table 5.2:	Extent of the mapping units within the study area.	35
Table 5.3:	Extent of vegetation condition categories within the study area.	42
Table 6.1:	Native families and genera with the highest species richness in the study area (based on 2020 data only).	45
Table 6.2	Priority flora locations within the study area.	46

Figures

Figure 2.1:	Location of the Scotia study area.	13
Figure 3.1:	Total monthly rainfall for the 12 months preceding the survey, compared to the long-term monthly median (2000-2019) for Norseman Aero recording station.	18
Figure 4.1:	Conservation and Heritage areas in the locality.	24
Figure 4.2:	Geological units intersected by the study area.	26
Figure 4.3:	Soil units intersected by the study area.	27

Figure 4.4: Beard’s vegetation associations intersected by the study area.	29
Figure 5.1: Previously mapped vegetation within the study area (Mattiske 2020).	34
Figure 5.2: Vegetation units of the study area, with locations of Priority flora.	41
Figure 5.3: Vegetation condition of the study area, with locations of introduced flora.	43

Plates

Plate 5.1: Representative photographs of the E1 vegetation type.	36
Plate 5.2: Representative photographs of the E2 vegetation type.	36
Plate 5.3: Representative photographs of the E3 vegetation type.	37
Plate 5.4: Representative photographs of the E4 vegetation type.	38
Plate 5.5: Representative photographs of the E5 vegetation type.	38
Plate 5.6: Representative photographs of the MS vegetation type.	39
Plate 5.7: Representative photographs of the SS vegetation type.	39
Plate 5.8: Representative photograph of the SL vegetation type.	40
Plate 6.1: <i>Eremophila purpurascens</i> – specimen collected in the study area placed against WA Herbarium specimen (WA Herbarium 2020b).	46
Plate 6.2: <i>Lepidosperma ? lyonsii</i> – specimen collected in the study area placed against the specimen at the WA Herbarium (WA Herbarium 2020b) and close up comparison of the rhizomatous base.	47

This page is intentionally left blank.

1.0 Summary

1.1 Project

Pantoro South Pty Ltd (Pantoro), the operator of the Norseman Gold Project, is planning to undertake development associated with its Scotia Gold Mine. The proposed development of the Scotia project involves dewatering to facilitate gold mining. The discharged water is proposed to be piped, using an existing pipeline, to a small ephemeral playa lake located adjoining the western edge of Lake Dundas, approximately 30 km south of Norseman, in the Goldfields region of Western Australia. Hydrological modelling has been undertaken to identify the predicted dewatering discharge volume footprint and the potential impact areas for vegetation.

Pantoro commissioned Biota Environmental Sciences Pty Ltd (Biota) to undertake a baseline 'Reconnaissance' level flora and vegetation survey of the littoral areas that may be impacted by the activities and development (primarily dewatering and discharge) associated with the Scotia Gold Mine. We understand that impact modelling has been undertaken, and the potential impact area (hereafter referred to as the study area) has subsequently been identified. The study area comprised a 248 ha area, consisting of salt flats and littoral vegetation. The overall objective of the survey was to provide baseline flora and vegetation data to support the environmental approval process, and later inform a monitoring program.

1.2 Vegetation and Flora

A desktop review and a four-day survey were conducted by two botanists in mid-August 2020. The baseline survey included quadrat sampling (10 standard 20 x 20 m flora quadrats), mapping of vegetation types and vegetation condition, and targeted searches for significant flora (native and introduced) while traversing the site on foot.

Seven vegetation types were identified within the study area. A mosaic of five different *Eucalyptus* open forest vegetation types (E1 to E5) was recorded on plains surrounding the lake; these encompassed differing dominant *Eucalypt* species in the tree canopy and slight changes in dominant mid and lower level stratum. The MS (*Melaleuca* shrubland) vegetation type occurred along the salt lake margins, with three small depressions of SS (*samphire* shrubland) scattered through the site. Two other units not assessed as vegetation types were also identified and mapped; these were SL (the non-vegetation bed of the salt lake) and RT (cleared gravel roads and tracks).

The majority of the study area (150.67 ha, or 60.73%) was comprised of 'Pristine' vegetation condition with no signs of human disturbance or presence of introduced flora. Less than 5% of the study area was rated as 'Excellent' (the E5 vegetation type) due to the presence of the weed species *Pentameris airoides*, while less than 1% was rated as 'Completely Degraded' and comprised the cleared roads and tracks. The non-vegetated salt lake bed, covering just over a third of the study area, was not assigned a condition rating due to it being naturally devoid of vegetation.

Based on database searches, the study area does not intersect any mapped occurrences of Threatened or Priority Ecological Communities (TECs or PECs). The August 2020 survey confirmed the absence of TECs or PECs within the study area. The nearest known PEC is located approximately 12 km north, namely the Priority 1 *Allocasuarina globosa* assemblages on greenstone rock; this sheoak species was not recorded in the study area.

A total of 136 native vascular flora taxa from 68 genera and 41 families were recorded from the study area. In addition, one introduced flora species (**Pentameris airoides*) was recorded.

No Commonwealth listed Threatened flora were found within the study area, however one State-listed Priority species was recorded, *Eremophila purpurascens* (Priority 3). Two plants were

recorded at two separate locations in the E5 vegetation type. These records are over 70 m from the salt lake margin on a raised hill crest and are highly unlikely to be impacted by the proposed dewatering activities. One potential State-listed Priority species, *Lepidosperma ? lyonsii* (Priority 1), was not able to be confirmed through the formal identification process as the taxonomic revision for the genus is not yet complete. A small population of this species was found within the MS vegetation type along the central western edge of the study area.

2.0 Introduction

2.1 Project Purpose, Background and Location

Pantoro, the operator of the Norseman Gold Project, is planning to undertake development associated with its Scotia Gold Mine. The Scotia deposit is situated on the western side of Lake Dundas, approximately 30 km south of Norseman in the Goldfields region of Western Australia, and is contained within the Great Western Woodlands¹.

The Scotia deposit has been mined both open cut and underground periodically since the 1890s, with two main pits and several waste rock dumps still present on the site. The proposed development of the Scotia project involves dewatering to facilitate gold mining. The discharged water is proposed to be piped, using an existing pipeline, to a small ephemeral playa lake adjoining the western edge of Lake Dundas. Hydrological modelling has been undertaken to identify the predicted dewatering discharge volume footprint and the potential areas of impact on vegetation.

The proposed dewatering discharge for the Scotia project will require approval by the Department of Water and Environmental Regulation (DWER), via a licence issued under the *Environmental Protection Act 1986* (EP Act). The dewatering impact area is located within the Shire of Dundas in the Eastern Goldfields Interim Biogeographic Regionalisation of Australia (IBRA) subregion of Western Australia (Figure 2.1).

2.2 Scope and Objectives

Pantoro commissioned Biota to undertake a baseline flora and vegetation assessment of the littoral areas that may be impacted by the activities and development (primarily dewatering and discharge) associated with the Scotia Gold Mine. Impact modelling has been undertaken, and the potential impact area (henceforth referred to as the study area) has subsequently been identified. The study area comprised a 248 ha area, consisting of salt flats and littoral vegetation (Figure 2.1). The primary objective of the survey was to provide baseline flora and vegetation data to support the environmental approval process, and later to inform the design of a monitoring program.

The approach and methodology of the ‘Reconnaissance’ level flora and vegetation survey was undertaken in accordance with all relevant legislation and Commonwealth and State documentation, including the following:

- *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016a); and
- *Environmental Factor Guideline: Flora and Vegetation* (EPA 2016b).

This report documents the methods, results and key findings of the flora and vegetation survey conducted in 2020 in the study area. The specific objectives of this study were as follows:

1. Undertake a desktop assessment, including database and literature searches, to consolidate all available existing data relevant to the study area.
2. Undertake a field survey to:
 - describe, photograph and map the dominant vegetation units in the study area;
 - assess and map vegetation condition through the study area;
 - identify any vegetation units of significance in the study area, including assessment of potential TECs against the relevant Commonwealth conservation advice documents, and

¹ The Great Western Woodlands is the largest intact temperate woodland on the planet; see <http://greatwesternwoodlands.com>

assessment of potential PECs against information available from the Department of Biodiversity, Conservation and Attractions (DBCA);

- compile a list of vascular flora species for the study area;
 - record and photograph flora of particular significance, including Threatened and Priority species and any other species of interest; and
 - record any significant introduced flora species (weeds) occurring in the study area.
3. Prepare a flora and vegetation report to collate, present and discuss all data from the 2020 survey and desktop review, with a particular focus on identifying communities or species of particular significance.
 4. Supply all relevant data to Pantoro in the relevant data standards, submit flora specimens as required to the WA Herbarium, and submit Report forms for all Threatened and Priority flora and any TECs or PECs to the DBCA.

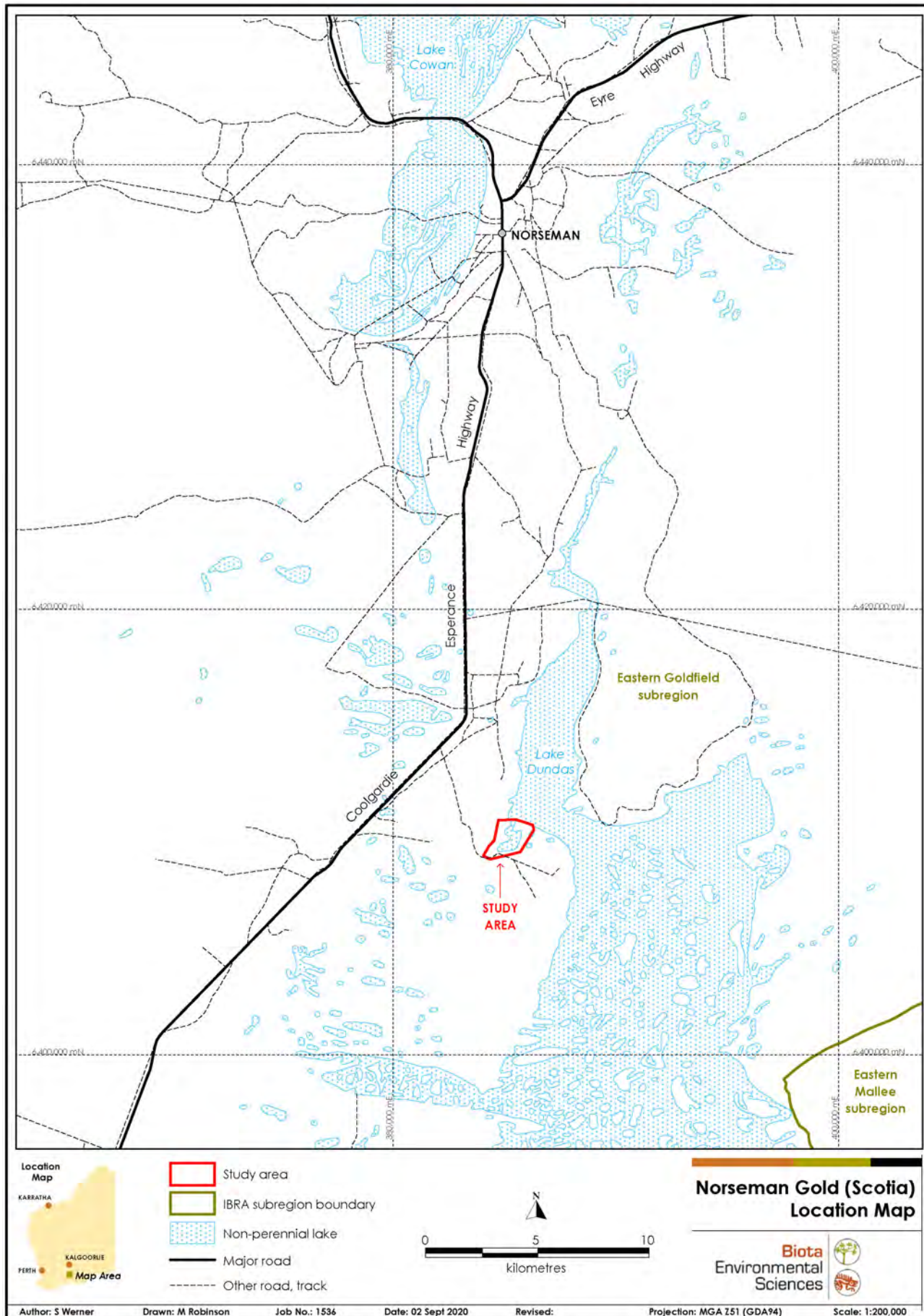


Figure 2.1: Location of the Scotia study area.

This page is intentionally left blank.

3.0 Methodology

3.1 Definitions of Significant Communities and Species

3.1.1 Communities

In Western Australia, an ecological community that is presumed to be totally destroyed or at risk of becoming totally destroyed may be listed as a TEC by the Minister for the Environment under the *Biodiversity Conservation Act 2016* (BC Act). Communities may also be listed as TECs at the Federal level under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Communities with insufficient information available to be considered a TEC, or which are rare but not currently threatened, are placed on the Priority list and referred to as PECs. Further information regarding the framework for conservation significance ranking of communities in WA is presented in Appendix 1.

3.1.2 Species

Native flora species that are rare, threatened with extinction, or have high conservation value, are specially protected by law under either or both of the WA BC Act and the Commonwealth EPBC Act. The WA DBCA also maintains a list of Priority species that are considered to be of conservation significance, but which have not been assigned statutory protection under the BC Act.

Appendix 1 details the categories of conservation significance recognised under the above frameworks and Table 3.1 outlines the codes used throughout this report for each category.

Table 3.1: Explanation of codes used to identify categories of conservation significance for flora species.

Category	Listing		
	EPBC Act	BC Act	DBCA
Critically Endangered	CR	CR	-
Endangered	EN	EN	-
Vulnerable	VU	VU	-
Extinct	-	EX	-
Extinct in the Wild	-	EW	-
Conservation Dependent	CD	-	-
Near Threatened	NT	-	-
Priority 1	-	-	P1
Priority 2	-	-	P2
Priority 3	-	-	P3
Priority 4	-	-	P4

3.1.3 Environmentally Sensitive Areas

Environmentally sensitive areas (ESAs) are declared by the WA Minister for the Environment under section 51B of the *Environmental Protection Act 1986* (EP Act). ESAs that could potentially be of relevance to the current study would comprise:

- a defined wetland and the area within 50 metres of the wetland;
- the area covered by vegetation within 50 metres of Threatened flora; or
- the area covered by a TEC.

3.2 Desktop Assessment

A desktop review was undertaken to compile and review information relevant to the study area, in particular to identify known features of conservation significance (see Appendix 1), and as a preliminary assessment of potential key issues relating to the vegetation present. This review considered regional information and previous biological surveys in the locality (Section 3.2.1), as well as the results of database searches (Section 3.2.2).

3.2.1 Literature Review

Published and unpublished reports relevant to the study area were reviewed, including regional scale reports:

- Flora and Vegetation Assessment: Norseman Gold Project (Mattiske 2020);
- Coolgardie 3 (COO3-Eastern Goldfields subregion) (Cowan 2001);
- The Great Western Woodlands – A Global Treasure (The Wilderness Society 2020); and
- A Biodiversity and Cultural Strategy for the Great Western Woodlands (DEC 2010).

Results of several biological surveys either overlapping the study area or completed in the locality were reviewed and incorporated into the desktop assessment (see Section 4.6).

Regional and bioregional mapping and datasets relevant to the study area were also reviewed, including soils and geology, and vegetation mapping (Beard 1979).

3.2.2 Database Searches

The following databases were searched to assist in the determination of flora and vegetation of conservation significance occurring in the study area:

1. NatureMap² is a joint project of the DBCA and the WA Museum, and represents the most comprehensive source of information on the distribution of WA's flora. It includes records from the DBCA Threatened and Priority Flora Database and the WA Herbarium Specimen Database.
2. A specific search of the DBCA Threatened and Priority Flora Database was also commissioned to confirm the Threatened and Priority flora species known from the area.
3. The DBCA database of TECs, PECs and ESAs was searched to identify significant communities known to occur in the locality.
4. The EPBC Act Protected Matters Search Tool (PMST) was used to identify flora species and other matters of national environmental significance (MNES) that may occur in the locality.

The searches of NatureMap and the DBCA Threatened and Priority Flora Database were conducted for a 30 km radius around the study area, as was the DBCA TEC, PEC and ESA Communities database search. The EPBC Act PMST was conducted for a 30 km radius around a central point of the study area. The conservation significant flora species returned from NatureMap, the DBCA database and the EPBC Act Protected Matters Search Tool are compiled and provided in Appendix 2.

² <http://naturemap.dbca.wa.gov.au>

3.3 Assessment of Likelihood of Occurrence for Conservation Significant Flora

In order to determine which flora of conservation significance species have the potential to occur in the study area, consideration was given to:

- the results of the database and literature searches;
- the known habitat preferences for each species compared to those available within the study area; and
- distributions and last known records for the species.

For each conservation significant flora species, defined rankings and criteria were subsequently applied as per Table 3.2 (see Appendix 3).

Table 3.2: Ranking system used to assign the likelihood of occurrence of flora of conservation significance.

Rank	Criteria
Recorded	1. The species has been previously recorded in the study area.
Likely to occur	1. There are existing records of the species within 20 km of the study area; and <ul style="list-style-type: none"> • the species is strongly linked to a specific habitat, which is present in the study area; or • the species has more general habitat preferences, and suitable habitat is present.
May potentially occur	1. There are existing records of the species within 20 km of the study area, however <ul style="list-style-type: none"> • the species is strongly linked to a specific habitat, of which only a small amount is present in the study area; or • the species has more general habitat preferences, but only some suitable habitat is present. 2. There is suitable habitat in the study area, but the species is recorded infrequently in the region.
Unlikely to occur	1. The species is linked to a specific habitat, which is absent in the study area; or 2. Suitable habitat is present, however there are no existing records of the species from within 20 km of the study area despite reasonable previous search effort in suitable habitat; or 3. There is some suitable habitat in the study area, however the species is very infrequently recorded in the region.
Would not occur	1. The species is strongly linked to a specific habitat, which is absent from the study area; and/or 2. The species' range is very restricted and would not include the study area.

3.4 Field Survey

3.4.1 Study Team and Survey Timing

The field survey was conducted between the 11th and 14th of August 2020 by Scott Werner (Senior Biologist) and Aster Braxton-Smith (Graduate Botanist). A total of five person-days were spent on the field component of this study (excludes travel time - 2.5 days of survey effort for two botanists). A summary of the field personnel and their respective roles in the survey is provided in Table 3.3.

Table 3.3: Summary of personnel involved in the survey.

Name	Position	Qualification	Years of Experience	Survey Role	DBCFA Flora Licence No.
Scott Werner	Senior Biologist	BSc (Conservation Biology & Management) (Hons)	10	Project Manager Vegetation mapping Quadrat sampling Rare flora searches	FB62000038
Aster Braxton-Smith	Graduate Botanist	BSc (Conservation & Wildlife Biology)	2	Vegetation mapping Quadrat sampling Rare flora searches	FB62000269

3.4.2 Survey Conditions

The weather conditions (particularly rainfall) leading up to a biological survey are important factors that influence both the number and type of species recorded from an area, especially for flora. One of the more notable effects is the increased presence of annual species following high rainfall, in addition to a higher likelihood of plants bearing reproductive material (flowers and/or fruit). This typically results in a more complete list of species from the area, along with greater confidence in identifications.

The survey was undertaken in the last month of winter, which is outside of the recommended season for botanical surveys in the Eremaean Botanical Province (EPA 2016a). Total monthly rainfall data relevant to the study area were sourced from the Norseman Aero weather station (Bureau of Meteorology station #12009), located approximately 26 km north of the study area. Data for the 12 months preceding the field survey were compared to the monthly median rainfall for the years 2000-2019 from the same station (Figure 3.1).

Rainfall recorded during the month prior to the survey (20.2 mm) was slightly higher than the long-term median (15.8 mm). A total of 36.2 mm of rainfall was received in the three months prior to the field survey (May – July 2020), which is slightly lower than the long-term median for the same period (42.4 mm; 2000-2019). Long-term climate data indicate that the rainfall recorded preceding the survey was slightly lower than the average for the time of year. However, the vegetation was in healthy condition overall and several annual species (e.g. *Erodium cygnorum* and *Hyalochlamys globifera*) were present at the time of the survey. Based on the rainfall data and the on-ground conditions, conditions were considered adequate for the collection of most ephemeral and cryptic perennial flora, however some material was in poor condition and not able to be fully identified (see Section 6.0).

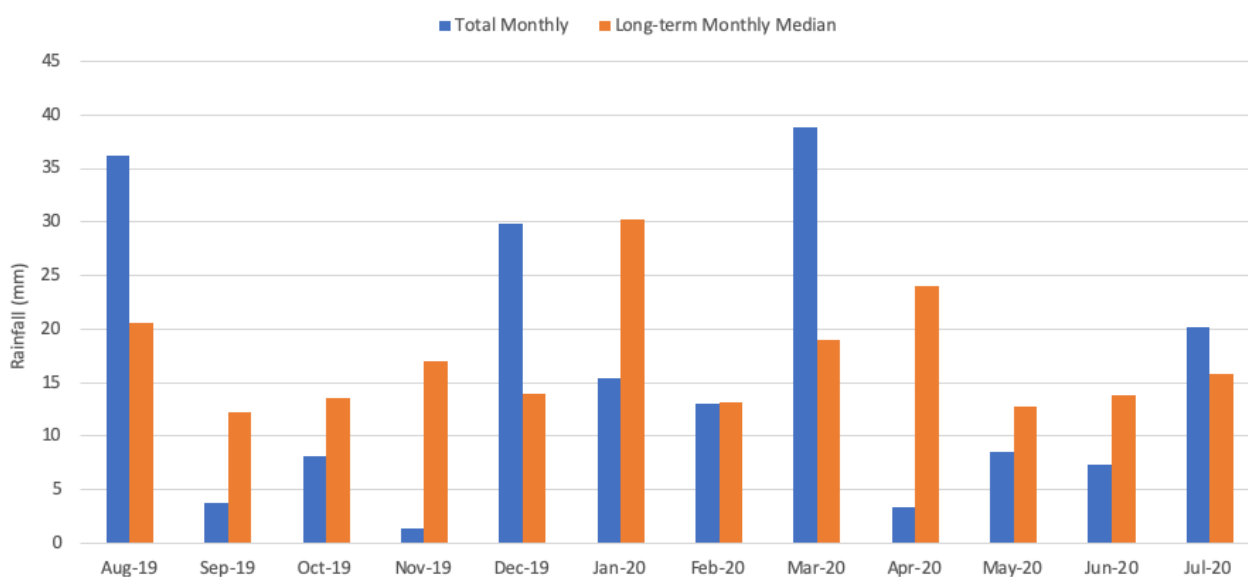


Figure 3.1: Total monthly rainfall for the 12 months preceding the survey, compared to the long-term monthly median (2000-2019) for Norseman Aero recording station.

3.4.3 Site Selection

Initial site selection was based on the vegetation types apparent from viewing aerial photography, and avoided areas that appeared to be in 'Degraded' or 'Completely Degraded' condition. Ground-truthing revealed several indicative site locations to be less representative of the surrounding vegetation, therefore new locations were selected in the field.

The intention was to establish three replicate quadrats within each of the vegetation types required to be sampled, as per the current recognised standard for sampling replication (EPA 2016a). This was achieved for the MS vegetation type (*Melaleuca* tall open shrubland over samphire low shrubland), but was not possible for the five *Eucalyptus* open forest vegetation types due to their mosaic nature, continual changes in dominant canopy *Eucalypt* species, and variability in dominant mid and lower level stratum.

A total of 10 quadrats were established for the current study, and data were also available from four quadrats sampled previously by Mattiske (2020).

3.4.4 Floristic Data Collection: Assessment of Quadrats

Ten quadrats (20 x 20 m) were assessed during the field survey within native vegetation in the study area. Each site was marked with pegs and delineated with tapes.

The following information was recorded for each quadrat:

1. location using MGA coordinates (GDA94, zone 50K); recorded with a Tablet unit for the four corners;
2. digital photographs of each site;
3. habitat description;
4. broad description of soil type;
5. fire history (approximate time since last fire, where applicable);
6. all species present and their estimated height and percent foliar cover;
7. vegetation description, based on the height and estimated cover of dominant species using the vegetation structural classes scheme developed by Keighery (1994) and summarised in Bush Forever (WA Planning Commission 2000) (see Appendix 4); and
8. vegetation condition ranking according to Keighery (1994) as presented in Bush Forever (WA Planning Commission 2000) (Appendix 4).

Raw quadrat data are provided in Appendix 5, along with coordinates of each corner point, and colour photographs of the overstorey and understorey.

3.4.5 Vegetation Description and Mapping

Vegetation in the study area was described at the sub-association level (Level VI as per the National Vegetation Information System³). The sub-association level includes information about the dominant growth form, height and cover for up to five species in all layers/sub-strata observed.

The vegetation maps were created and consolidated using Geographical Information System (GIS) software (QGIS and MapInfo Professional). All maps in this report were produced by Melissa Robinson (Senior GIS Cartographer) and Brandon King (Data Administrator), both of Biota, using MapInfo Professional GIS v12.

Full descriptions of all vegetation types are presented in Section 5.2.

³ See the NVIS Information Hierarchy: <http://www.environment.gov.au/land/publications/australian-vegetation-attribute-manual-v6/section-2#hierarchy>.

3.4.6 Vegetation Condition Mapping

In addition to spatially mapping the extent of vegetation throughout the study area, an assessment of the condition of the vegetation was also carried out. Vegetation condition is determined in relation to the (perceived) ability of the vegetation to maintain itself (Keighery 1994). This is commonly interpreted from the visible amount of introduced species compared to native species. However, numerous other factors are also considered in the assessment of condition, including disturbance (e.g. grazing, erosion), degree of alteration to community and habitat structure, and overall site ecology. The categories of vegetation condition used (see Appendix 4) were consistent with the descriptive and qualitative method developed by Keighery (1994).

3.4.7 Searches for Conservation Significant Flora and Weeds

The desktop review identified a subset of significant flora (i.e. Threatened and Priority listed species) that had been previously recorded from the locality and were considered to have some potential to occur in the study area (see Appendix 3). Targeted systematic searches for these species were then conducted on foot throughout the entire study area. Tracklogs of foot traverses were captured using handheld GPS units and are shown in Appendix 6.

Locations of species of conservation significance or unknown taxa were recorded using a handheld GPS unit with accuracy equivalent to a differential GPS (<1.5 m). The number of individuals and extent of the population were also recorded for each location.

Locations of any declared pests (weeds listed under the WA Biosecurity and Agriculture Management Act 2007; the BAM Act) or Weeds of National Significance (WoNS) were also recorded during the foot traverses, along with an estimate of their population size. Opportunistic records were also made of other introduced flora species, however no attempt was made to document all such species throughout the entire study area.

3.5 Specimen Identification, Nomenclature, and Data Management

Flora species were identified either in the field, or in the office following the field survey. If a species was common and well known to the survey botanists, the identification was confirmed and noted in the field. If the species was of conservation significance, difficult to determine without microscopic examination, belonged to a recognised species complex, or was poorly collected or otherwise unusual, a voucher specimen was collected. Specimens were pressed in the field, and then dried for further study and confirmation.

Voucher specimens were identified using flora keys, reference to appropriate publications, use of voucher reference collections and comparisons to the collections held at the WA Herbarium. Biota botanists Aster Braxton-Smith and Scott Werner identified the majority of the specimens. A subset of specimens were submitted to the WA Herbarium for paid identifications as per Section 6.2.

All data were entered into a Microsoft Access Vegetation Database structure held internally at Biota. The database model employed by Biota was developed by Ted Griffin (private consultant) at the request of Malcolm Trudgen (M.E. Trudgen and Associates).

A full list of vascular flora species recorded from the study area is presented in Appendix 7; this includes all species recorded by Biota, as well as those recorded by Mattiske (2020) in quadrats within the current study area. Nomenclature and conservation significance rankings used in this report are in accordance with the current listing of WA flora recognised by the WA Herbarium, as listed on FloraBase⁴ at the time of reporting.

⁴ <http://florabase.dbca.wa.gov.au>

3.6 Limitations of the Study

The results of the field survey provide a good representation of the vegetation and flora of the study area. However, there are limitations to this study that must be considered when reviewing and applying the results detailed in this report. As per the relevant EPA Technical Guidance Statement (EPA 2016a), potential constraints and consequent limitations of this study are summarised in Table 3.4.

Table 3.4: Potential constraints and limitations of the current study.

Potential Constraint	Statement of Limitations
1. Availability of contextual information at a regional and local scale	<ul style="list-style-type: none"> A small number of previous biological surveys have been completed in the locality of the study area, and regional studies were considered as part of the desktop review. Publicly available databases of information relating to rare species and communities were also searched. The current biological survey added considerable new data specific to the study area, and was supplemented with data from a previous survey that overlapped the area (Mattiske 2020). <p>Contextual information is therefore not considered to be a limiting factor for this study.</p>
2. Competency / experience of the team carrying out the survey, including experience in the bioregion surveyed	<ul style="list-style-type: none"> The field personnel were suitably qualified to identify flora and the team leader has over nine years of experience in conducting biological surveys. <p>There were therefore no limitations due to experience of personnel.</p>
3. Proportion of flora recorded and/or collected, any identification issues	<ul style="list-style-type: none"> All vascular flora encountered during the field survey were recorded, comprising 136 native taxa and one introduced flora species. The majority of the flora specimens collected (92%) were of sufficient quality to be fully determined to the lowest relevant taxonomic level. Fungi and non-vascular flora (algae, mosses and liverworts) were not systematically surveyed, which is consistent with the accepted level of effort for a survey of this type and scale. <p>The proportion of flora recorded was considered to be a limitation for this study. Additional taxa would be recorded with further survey work under more optimal conditions, and this may include some species of conservation significance (e.g. the Priority 3 annual species <i>Phlegmatospermum eremaeum</i> and <i>Notisia intonsa</i>).</p>
4. Appropriate area fully surveyed (effort and extent)	<ul style="list-style-type: none"> The scope of works required a Reconnaissance level survey for vegetation and flora, together with a Targeted survey for significant flora (terms as described in EPA 2016a). A total of five person days were spent surveying the flora and vegetation of the study area. The entire study area was searched on foot for significant flora, and mapping of vegetation types and vegetation condition was prepared. A total of 10 quadrats were completed in the study area. Due to the small size of the study area and the mosaic nature of the vegetation, the number of quadrats per vegetation type was fewer than recommended by EPA (2016a), however the units are considered to have been adequately surveyed.
5. Access restrictions within the study area	<ul style="list-style-type: none"> The entire study area was accessible and there were no access restrictions.
6. Survey timing, rainfall, season of survey	<ul style="list-style-type: none"> The flora and vegetation survey was completed in mid-August 2020 and was considered adequate for the recording of most annual and cryptic perennial species, however not all specimens were able to be identified on the basis of the material collected (see Section 3.4.2). Timing of the flora and vegetation survey was considered a limitation for the assessment of the study area values.

<p>7. Disturbance that may have affected the results of survey such as fire, flood or clearing</p>	<ul style="list-style-type: none">• Disturbance within the study area was minimal. Two minor vehicle access tracks were present in the southern part of the study area. These are not considered to have substantially affected the vegetation, and are not considered to be a limitation for the study.
--	--

4.0 Desktop Assessment

4.1 IBRA Bioregion and Subregion

The study area lies within the Eastern Goldfields subregion (COO3) of the Coolgardie (COO) bioregion, as defined by the IBRA (DSEWPaC 2012). The Eastern Goldfields subregion is 5,102,425 ha in size, and described by Cowan (2001) as:

“Gently undulating plains interrupted in the west with low hills and ridges of Archaean greenstones and in the east by a horst of Proterozoic basic granulite. The underlying geology is of gneisses and granites eroded into a flat plane covered with tertiary soils and with scattered exposure of bedrock. Calcareous earths are the dominant soil group and cover much of the plains and greenstone areas. A series of large playa lakes in the western half are the remnants of an ancient major drainage line.

The vegetation is of mallees, Acacia thickets and shrub heaths on sandplains. Diverse Eucalyptus woodlands occur around salt lakes, on ranges, and in valleys. Salt lakes support dwarf shrublands of samphire. Woodlands and Dodonaea shrubland occur on basic granulites of the Fraser Range. The area is rich in endemic Acacias. The climate is Arid to Semi-arid with 200-300 mm of rainfall, sometimes in summer but usually in winter.”

4.2 Conservation Reserves in the Locality

No conservation reserves overlap the study area or are located in close proximity.

There are a number of conservation reserves in the surrounding area, the closest of which is the Dundas Nature Reserve, located approximately 10 km east of the study area (Figure 4.1). The other DBCA-managed lands in the vicinity of the study area include:

- four un-named nature reserves (R 6043, R 42943, R 33501 and R 33113);
- the Dowak Nature Reserve; and
- an un-named Timber Reserve (see Figure 4.1).

4.3 Great Western Woodlands

The study area occurs within the southern extent of the ‘Great Western Woodlands’, which represents the largest remaining area of intact Mediterranean-climate woodland in the world (DEC 2010, The Wilderness Society 2020). The Great Western Woodlands span an area from the edge of the Wheatbelt to Kalgoorlie-Boulder in the north, to the inland deserts of the northeast and the Nullabor Plain to the east, and cover 16 million hectares (DEC 2010). They consist mostly of Eucalypt woodlands and are recognised for being botanically rich, supporting over 30% of all Australia’s Eucalypt species and over 20% of all of Australia’s native plants (The Wilderness Society 2020). Although largely intact, the Great Western Woodlands are under increasing pressure from competing land uses, with more than 60% of the woodlands covered by operating mines, granted mineral tenements and tenement applications (DEC 2010).

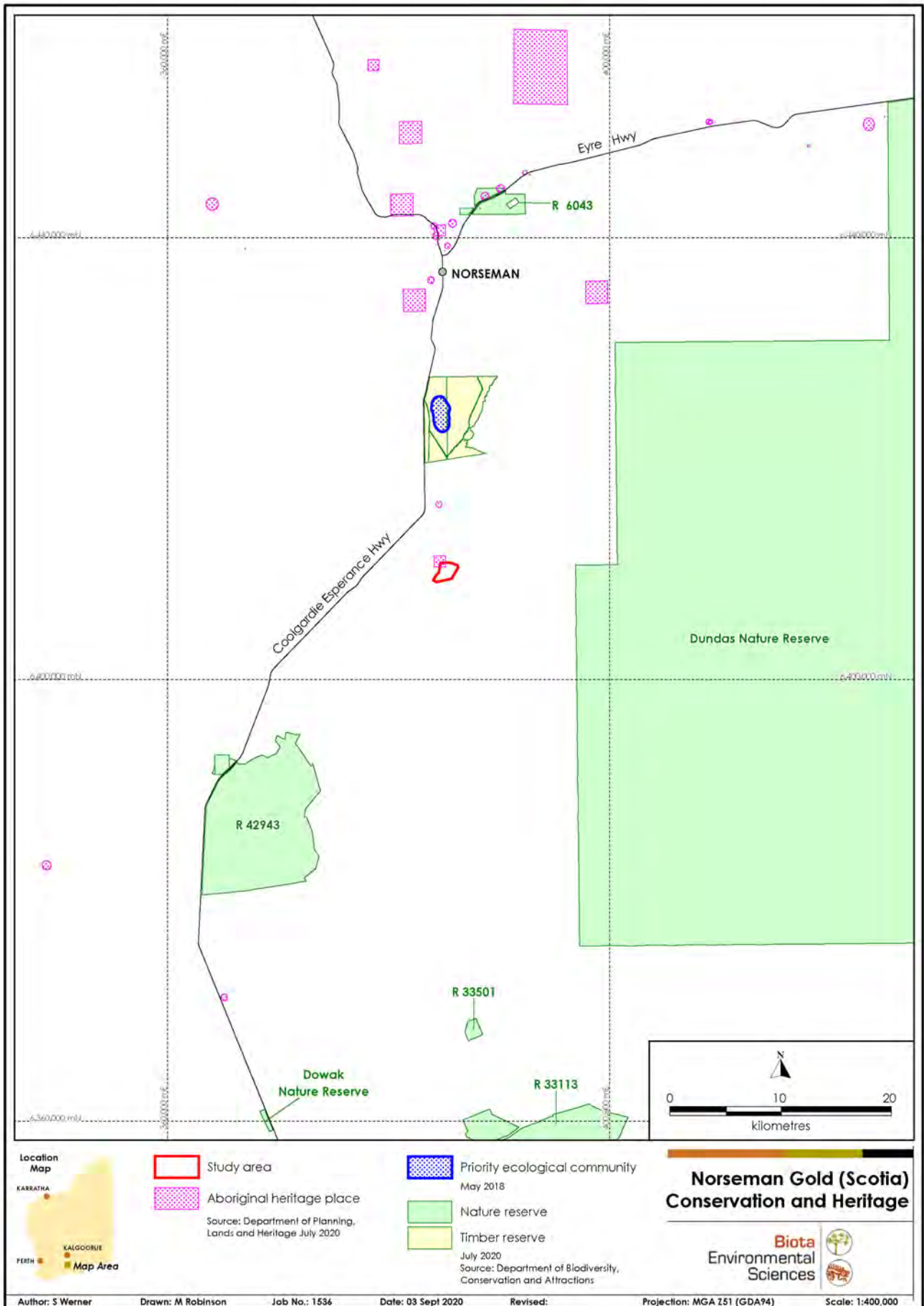


Figure 4.1: Conservation and Heritage areas in the locality.

4.4 Surface Geology and Soils

The study area contains six geological units (Figure 4.2 and Table 4.1), mapped at a scale of 1:100,000 by the Geological Survey of WA and collated in Geoscience Australia (2008). The geologic ages of the units within the study area are Archaean and Phanerozoic, with Cztd identified as the dominant geological unit, covering almost half of the study area.

Table 4.1: Extent of surface geology units as described in Geoscience Australia (2008).

Unit	Description	Geological Age	Proportion in Study Area (ha; %)	
Aci	Banded iron-formation: layered quartz-hematite-magnetite rock; massive and layered gossanous ironstone.	Archaean	6.4 ha	2.6%
Agmd	Lake Dundas monzogranite: sub-equigranular, medium- to coarse-grained biotite monzogranite.	Archaean	20.8 ha	8.3%
Asn	Clastic and sedimentary rocks: includes polymictic conglomerate (locally important felsic volcanoclastic component and associated massive iron sulphide body), pelite.	Archaean	2.5 ha	1.0%
Czc	Colluvium: gravel, sand, and soil; may include laterite debris.	Phanerozoic	15.3 ha	6.2%
Cztd	Quartz sand and gypsum dune deposits adjacent to playas.	Phanerozoic	112.9 ha	45.6%
Czts	Saline and gypsiferous evaporite deposits interbedded with sand and clays in playas.	Phanerozoic	90.1 ha	36.3%

According to the Atlas of Australian Soils (Northcote et al. 1960) two soil types occur within the study area, namely DD14 and SV2 (Figure 4.2). The dominant soil type is DD14, which covers an area of 196.2 ha (79.1%) and is characterised as “flat to undulating land with small valleys occasionally broken by low narrow rocky hills and ridges, or tors and bosses” (Northcote et al. 1960). The SV2 soil type is located along the eastern edge and covers an area of 51.8 ha (20.9%). It is described as “saline valleys with some dunes including barchan forms, salt lake channels, mostly devoid of true soils, and their fringing areas” (Northcote et al. 1960).

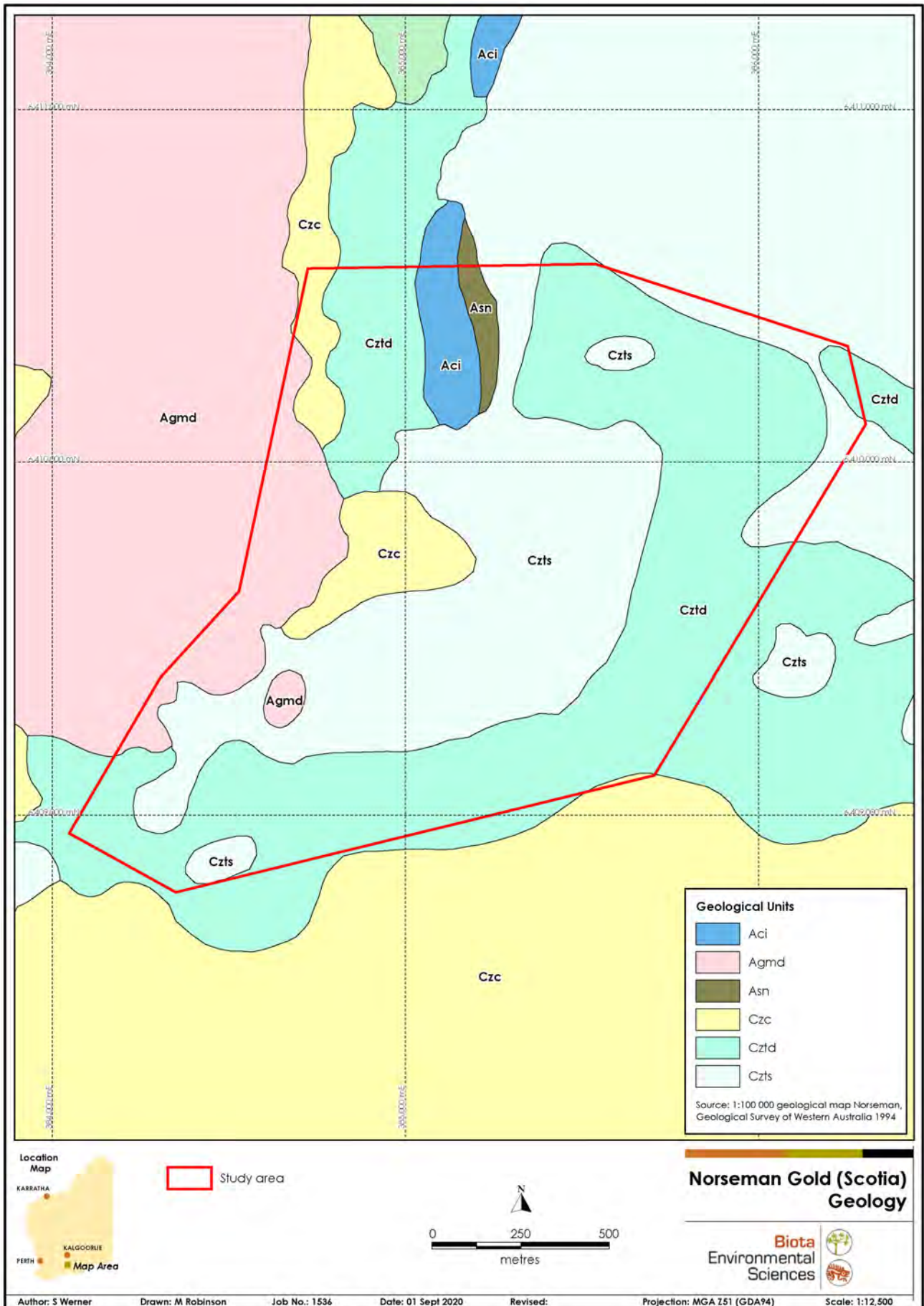


Figure 4.2: Geological units intersected by the study area.

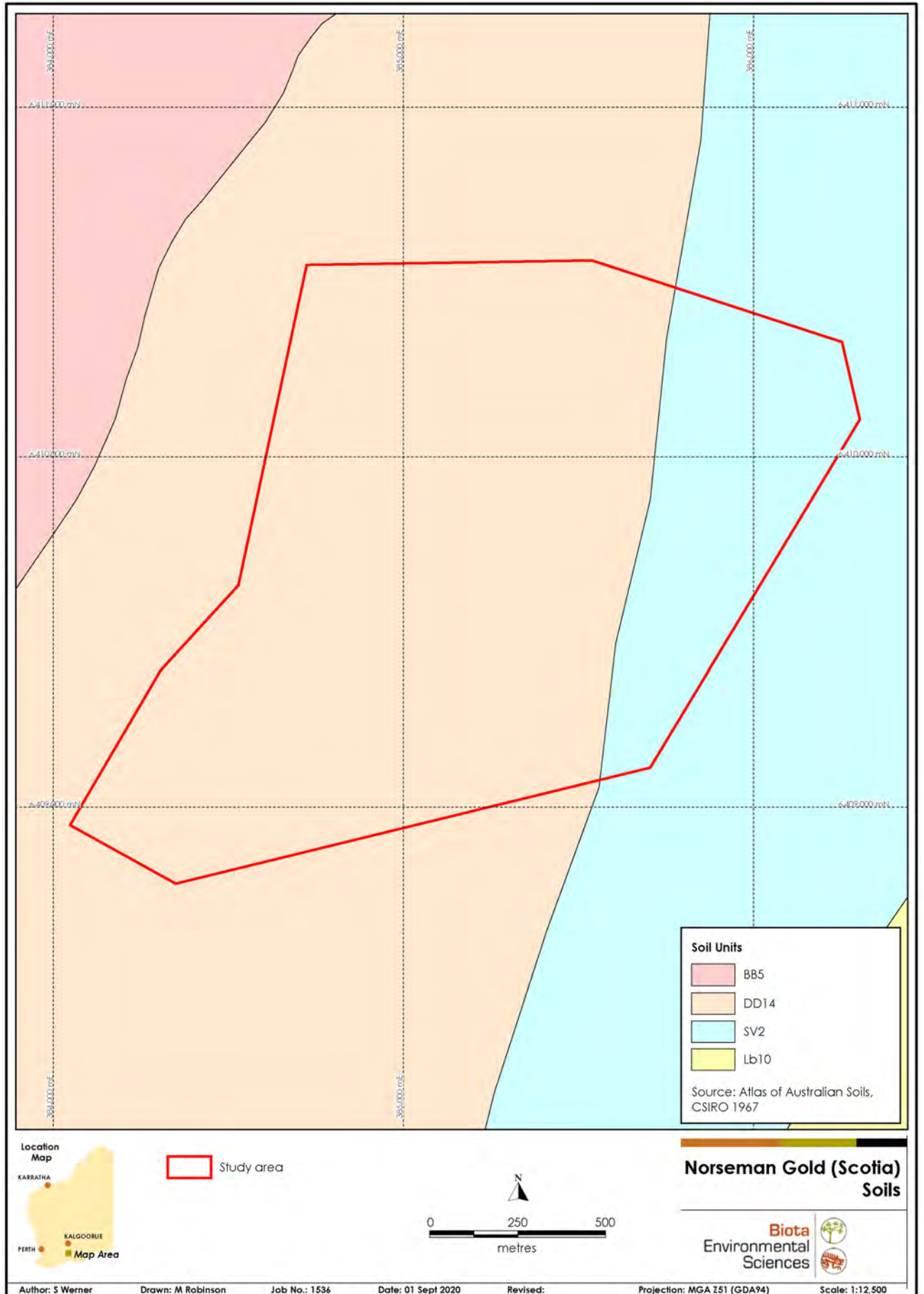


Figure 4.3: Soil units intersected by the study area.

4.5 Regional Vegetation Mapping

4.5.1 Pre-European Vegetation Mapping by Beard (1979)

John Beard mapped broad “vegetation associations” for the locality at 1:250,000 scale (Beard 1979), with each vegetation association divided into finer scale “system associations” (see Table 4.2, Figure 4.4). The majority (62.0%) of the study area was mapped as Dundas 125, encompassing the non-vegetated salt lake bed. The remainder of the study area was mapped as Dundas 3106 (31.1%), which is comprised of *Eucalyptus* woodlands; and Dundas 221 (3.9%), which is comprised of saltbush (*Atriplex* spp.) shrubland with other *Chenopodiaceae* species.

Table 4.2: Extent of vegetation associations in the study area as described and mapped by Beard (1979).

Beard's Vegetation System Association	Description	Proportion in Study Area	
		ha	%
Dundas 221	<i>Atriplex</i> spp., <i>Maireana</i> spp. communities on alkaline soils.	9.6	3.9
Dundas 125	Salt lake, lagoon, clay pan.	153.8	62.0
Dundas 3106	For the Goldfields region; Eucalypt woodlands of Gimlet, Redwood etc. <i>Eucalyptus salubris</i> , <i>Eucalyptus oleosa</i>	84.6	34.1

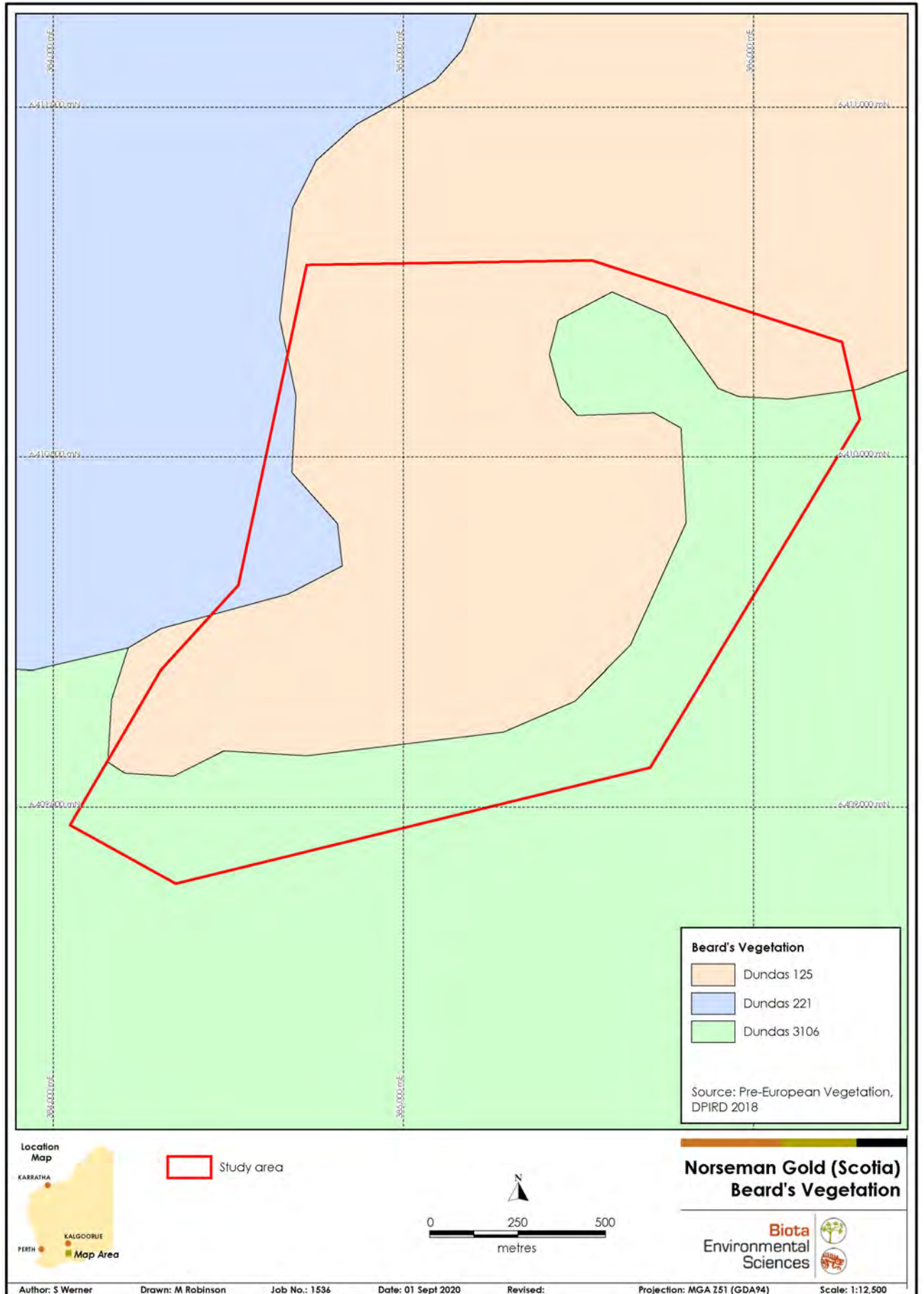


Figure 4.4: Beard's vegetation associations intersected by the study area.

4.6 Previous Botanical Surveys in the Locality

A number of biological surveys have been conducted in close proximity to the study area, with the most relevant being the following:

- Flora and Vegetation Assessment: Norseman Gold Project, Norseman, WA (Mattiske 2020).

The majority of the Mattiske (2020) survey was conducted approximately 500 m south of the study area, however a small section overlaps the current study area, where two minor tracks are currently situated. The main results and methodologies of Mattiske (2020) were reviewed prior to the field survey and the conservation significant flora recorded were included in the likelihood assessment (see Appendix 3).

In addition, the conservation significant species recorded from the following four recent biological surveys conducted on the Scotia tenement (results of which are summarised in Mattiske (2020)) were also included in the likelihood assessment⁵:

- Rare flora and vegetation survey of North Scotia prospect, conducted August 2004 (Paul Armstrong & Associates 2004)
- Report for proposed small scale mining operation – targeted flora survey (GHD 2009);
- Addendum to 'Report prepared for proposed small scale mining operation – targeted flora survey' (GHD 2010); and
- Flora and vegetation survey of the Mt Henry study area (Mattiske 2013).

4.7 Vegetation of Conservation Significance from the Locality

4.7.1 Threatened and Priority Ecological Communities

Based on database search results and a review of regional vegetation mapping and associated literature, the study area does not intersect any mapped occurrences of TECs or PECs.

Two conservation significant communities were identified from the desktop review as occurring in the vicinity of the study area (Table 4.3).

The EPBC Act PMST search results returned the 'Proteaceae Dominated Kwongkan Shrublands of the Southeast Coastal Floristic Province of Western Australia' TEC. This community is federally protected as an endangered TEC as well as being protected at a state-level as a Priority 3 PEC (DBCA 2020). It is described as consisting of "predominantly obligate seeding proteaceous shrubland and heath (kwongkan) and mallee heath on sandplain, duplex sand/clay and gravels overlying Eocene sediments, quartzite, schist, Yilgarn and Albany Fraser granite and greenstone ranges." It is confined to coastal areas on the south coast of WA and would not occur in the study area.

The DBCA communities database search returned the '*Allocasuarina globosa* assemblages on Greenstone rock (Esperance District)' PEC, which has been recorded approximately 12 km north of the study area (Figure 4.1). This PEC is listed as Priority 1 at a State level by the DBCA (DBCA 2020) (Table 4.3). It is described as "*Allocasuarina* thickets on greenstone ridges of lateritic breakaways; *Acacia duriuscula*, *Allocasuarina globosa*, *Eucalyptus georgei* subsp. *georgei* and *Eucalyptus oleosa* thickets on greenstone ridges with skeletal soils" (DBCA 2020). Based on an assessment of the aerial photography, greenstone ridges (key habitat for this PEC) appear to be absent from the study area, therefore this PEC is considered unlikely to occur.

⁵ These reports were available for review; only the summarised results presented in Mattiske (2020) were incorporated into the likelihood assessment.

Table 4.3: Conservation significant communities identified for the locality during the desktop review.

Community Name	Status		Likelihood of Occurrence in the Study Area
	Commonwealth	State	
Threatened Ecological Community (TEC)			
Proteaceae Dominated Kwongkan Shrublands of the Southeast Coastal Floristic Province of Western Australia	Endangered	Priority 3	Would not occur: community occurs in the south coast region of WA.
Priority Ecological Community (PEC)			
<i>Allocasuarina globosa</i> assemblages on Greenstone rock (Esperance District)	-	Priority 1	Unlikely to occur: community strongly linked to greenstone ridges, which are absent from the study area.

4.8 Significant Flora Species Known from the Locality

A large number of Threatened and Priority flora species were identified through the desktop review as having been recorded from the locality, including some that were considerably distant from the study area. An assessment of the likelihood of occurrence of each of these species within the study area was completed during the desktop review, based on the habitats and vegetation types known to be present, as well as the number and currency of records in close proximity (within 20 km; see Appendix 3).

This likelihood assessment found that 27 of these species had some potential to occur in the study area:

- six species were considered “likely to occur”:
 - *Bossiaea arcuata* (P1);
 - *Bossiaea aurantiaca* (P1);
 - *Aotus* sp. Dundas (M.A. Burgman 2835) (P2);
 - *Drosera salina* (P2);
 - *Acacia ancistrophylla* var. *perarcuata* (P3);
 - *Acacia truculenta* (P3).
- 21 species “may potentially occur”:
 - *Allocasuarina globosa* (T);
 - *Acacia dorsenna* (P1);
 - *Calandrinia lefroyensis* (P1);
 - *Cryptandra exserta* (P1);
 - *Eucalyptus jimberlanica* (P1);
 - *Lepidosperma lyonsii* (P1);
 - *Micromyrtus papillosa* (P1);
 - *Philothea apiculate* (P1);
 - *Scaevola tortuosa* (P1);
 - *Acacia kerryana* (P2);
 - *Beyeria sulcata* var. *truncata* (P3);
 - *Chrysocephalum apiculatum* subsp. *norsemanense* (P3);
 - *Eremophila purpurascens* (P3);
 - *Goodenia laevis* subsp. *laevis* (P3);
 - *Melaleuca macronychia* subsp. *trygonoides* (P3);

- *Notisia intonsa* (P3);
- *Phlegmatospermum eremaeum* (P3);
- *Pityrodia chrysocalyx* (P3);
- *Stylidium pulviniforme* (P3);
- *Eremophila parvifolia* subsp. *parvifolia* (P4); and
- *Frankenia glomerata* (P4).

These species collectively comprised the target species for the current field survey.

5.0 Vegetation

5.1 Previous Vegetation Mapping of the Study Area

Overall, the vegetation types mapped during the current survey were similar to those mapped by Mattiske (2020), in terms of the dominant species and general composition (Table 5.1).

Previous vegetation mapping by Mattiske (2020) intersecting the current study area is shown in Figure 5.1.

Table 5.1: Vegetation types previously mapped in the study area by Mattiske (2020).

Vegetation Type Code: Description
W2: Woodland to open woodland of <i>Eucalyptus flocktoniae</i> complex, <i>Eucalyptus lesouefii</i> and <i>Eucalyptus dundasii</i> over sparse shrubland of <i>Melaleuca sheathiana</i> , <i>Scaevola spinescens</i> , <i>Beyeria sulcata</i> and <i>Exocarpos aphyllus</i> over isolated shrubs of <i>Olearia muelleri</i> on orange-red to brown clayey loam on flats and slopes.
W5: Open woodland of <i>Eucalyptus gracilis</i> and <i>Eucalyptus flocktoniae</i> over sparse shrubland of <i>Olearia</i> sp. <i>Eremicola</i> (Diels & Pritzel s.n. PERTH 00449628) and <i>Olearia muelleri</i> on red-orange clayey loam flats.
S3: Open woodland of <i>Eucalyptus ?salicola</i> over open shrubland of <i>Bossiaea barbarae</i> , <i>Acacia assimilis</i> subsp. <i>assimilis</i> and <i>Melaleuca lanceolata</i> over <i>Lepidosperma</i> sp. on pale orange sand flats on salt lake margins.
SL: Salt lake or non-vegetated lake bed.

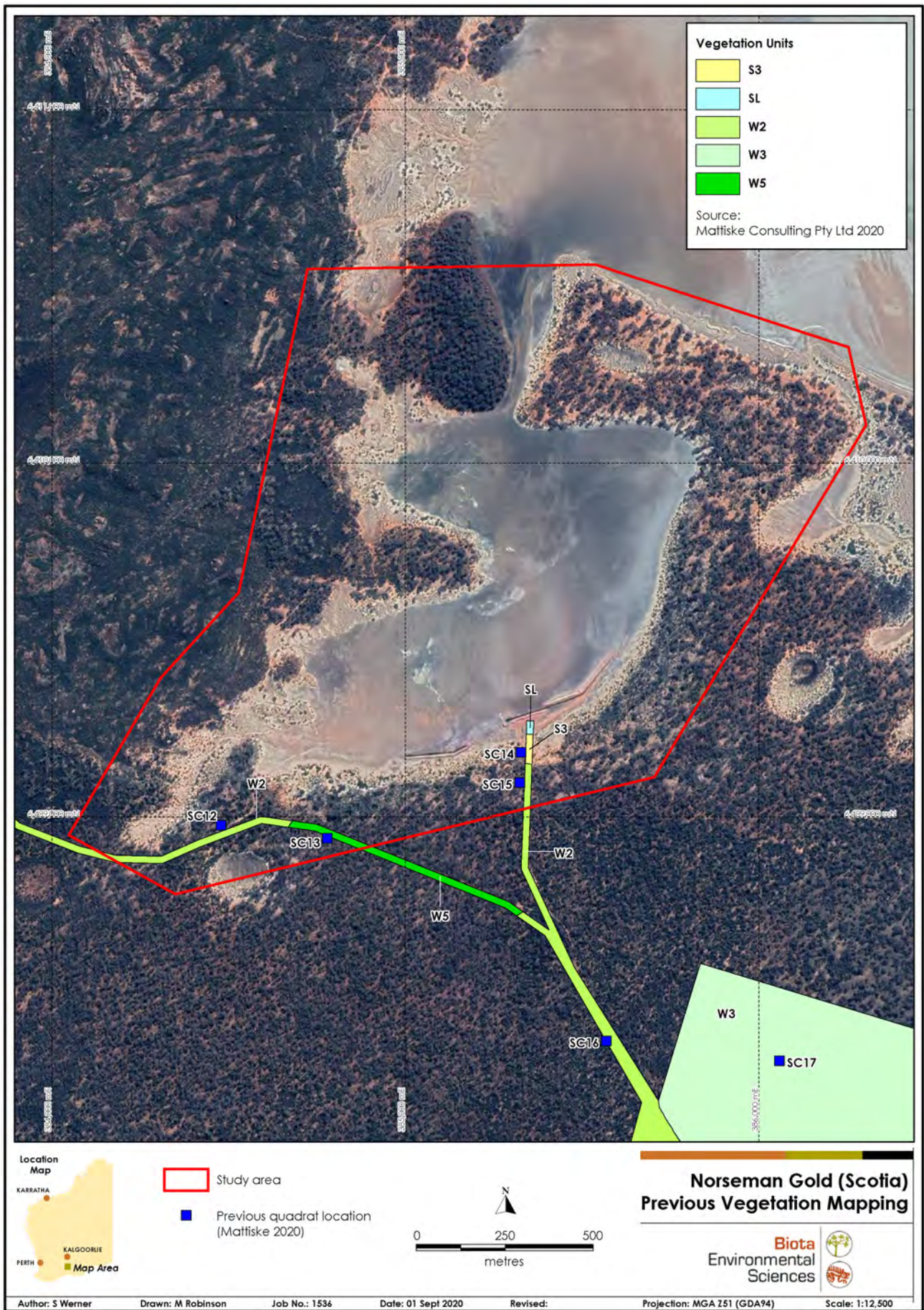


Figure 5.1: Previously mapped vegetation within the study area (Mattiske 2020).

5.2 Vegetation Types of the Study Area

Vegetation types were mapped for the study area utilising data from the sampling sites and foot traverses. Seven vegetation types were identified within the study area and are described and discussed in Sections 5.2.1 to 5.2.7 below. Two other units not assessed as vegetation types in the field were also identified and mapped; these were SL (the non-vegetation salt lake bed) and RT (cleared gravel roads and tracks) (see Section 5.2.8).

Five ‘mosaic’ *Eucalyptus* open forest vegetation types (E1 to E5) were identified and described, comprising differing dominant canopy *Eucalypt* species and slight changes in dominant mid and lower level stratum. The MS (*Melaleuca* shrubland) vegetation type occurred along the salt lake margins, with three small stands of SS (*samphire* shrubland) scattered in depressions through the site. The most widespread vegetation types in the study area were MS, which covered a third of the study area; followed by E2 and E1, which together covered over a quarter of the area.

Maps showing the distribution of the seven vegetation types and the two other mapping units in the study area are presented in Figure 5.2, with the extent of each described in Table 5.2.

Table 5.2: Extent of the mapping units within the study area.

Mapping unit code: Description	Area (ha)	Proportion of Study Area (%)
Vegetation Types		
E1: <i>Eucalyptus</i> open forest over <i>Alyxia</i> , <i>Olearia</i> open shrubland over <i>Lepidosperma</i> open sedgeland	33.0	13.3
E2: <i>Eucalyptus</i> open forest over <i>Exocarpos</i> , <i>Cratystylis</i> low open shrubland over scattered herbs, grasses and sedges	35.1	14.2
E3: <i>Eucalyptus</i> (mallee) low open woodland over <i>Melaleuca</i> , <i>Acacia</i> , <i>Eremophila</i> and <i>Grevillea acuaria</i> low shrubland	16.1	6.5
E4: <i>Eucalyptus</i> open forest over <i>Melaleuca</i> tall open shrubland over <i>Senna</i> , <i>Acacia</i> open shrubland	16.1	6.5
E5: <i>Eucalyptus</i> open forest over <i>Cratystylis</i> , <i>Eremophila</i> open shrubland and scattered low <i>Chenopodiaceae</i> shrubs	11.9	4.8
MS: <i>Melaleuca</i> tall open shrubland over <i>samphire</i> low shrubland	45.3	18.2
SS: <i>Samphire</i> low shrubland	5.0	2.0
Other Units		
SL: Non-vegetated salt lake bed	84.1	33.9
RT: Roads and tracks	1.4	0.6
Total	284.0	100.0

5.2.1 E1: *Eucalyptus* open forest over *Alyxia*, *Olearia* open shrubland over *Lepidosperma* open sedgeland

Vegetation Code	E1
Vegetation Type Description	<i>Eucalyptus gracilis</i> , <i>Eucalyptus salicola</i> , <i>Eucalyptus transcontinentalis</i> open forest over <i>Alyxia buxifolia</i> , <i>Olearia muelleri</i> , <i>Westringia cephalantha</i> var. <i>cephalantha</i> , <i>Acacia</i> spp. open shrubland over <i>Lepidosperma</i> sp., <i>Chamaexeros fimbriata</i> open sedgeland with scattered herbs and grasses.
Distribution	This vegetation type (Plate 5.1) occurred in the southeastern portion of the study area.
Sampling Sites	LSC01, LSC04.
Vegetation Condition	Pristine.



Plate 5.1: Representative photographs of the E1 vegetation type.

5.2.2 E2: *Eucalyptus* open forest over *Exocarpos*, *Cratystylis* low open shrubland over scattered herbs, grasses and sedges

Vegetation Code	E2
Vegetation Type Description	<i>Eucalyptus gracilis</i> , <i>Eucalyptus salicola</i> (<i>Eucalyptus dundasii</i>) open forest over <i>Exocarpos aphyllus</i> , <i>Cratystylis conocephala</i> , <i>Bossiaea walkeri</i> , <i>Alyxia buxifolia</i> , <i>Olearia</i> spp., <i>Acacia</i> spp. low open shrubland over scattered herbs, grasses and sedges.
Distribution	This vegetation type (Plate 5.2) occurred within lower-lying areas in the northern half of the study area.
Sampling Sites	LSC03, LSC07.
Vegetation Condition	Pristine.



Plate 5.2: Representative photographs of the E2 vegetation type.

5.2.3 **E3: *Eucalyptus* low open mallee woodland over *Melaleuca*, *Acacia*, *Eremophila* and *Grevillea acuaría* low shrubland**

Vegetation Code	E3
Vegetation Type Description	<i>Eucalyptus spreata</i> , <i>Eucalyptus</i> spp. low open mallee woodland over <i>Melaleuca hamata</i> , <i>Acacia</i> spp. scattered tall shrubs over <i>Acacia</i> spp., <i>Eremophila</i> spp., <i>Grevillea acuaría</i> low shrubland over scattered grasses, sedges and herbs (including <i>Orchidaceae</i> spp. and <i>Drosera</i> sp.).
Distribution	This vegetation type (Plate 5.3) occurred within higher elevated areas along the western portion of the study area. Depressions in between the outcropping granite had a high density of <i>Lepidosperma</i> sedges and small herbs (including <i>Drosera andrewsiana</i> and <i>Orchidaceae</i> spp.).
Sampling Sites	LSC09.
Vegetation Condition	Pristine.



Plate 5.3: Representative photographs of the E3 vegetation type.

5.2.4 **E4: *Eucalyptus* open forest over *Melaleuca* tall open shrubland over *Senna*, *Acacia* open shrubland**

Vegetation Code	E4
Vegetation Type Description	<i>Eucalyptus dundasii</i> , <i>Eucalyptus salicola</i> (<i>Eucalyptus urna</i>) open forest over <i>Melaleuca subalaris</i> tall open shrubland over <i>Senna artemisioides</i> , <i>Acacia</i> spp., <i>Eremophila</i> spp., <i>Dodonaea</i> spp. open shrubland.
Distribution	This vegetation type (Plate 5.4) occurred within the western portion of the study area adjacent to the E3 vegetation type; it included large patches of juvenile <i>Eucalyptus</i> species under 2 m tall.
Sampling Sites	LSC06
Vegetation Condition	Pristine



Plate 5.4: Representative photographs of the E4 vegetation type.

5.2.5 E5: *Eucalyptus* open forest over *Cratystylis*, *Eremophila* open shrubland and scattered low *Chenopodiaceae* shrubs

Vegetation Code	E5
Vegetation Type Description	<i>Eucalyptus dundasii</i> , <i>Eucalyptus lesouefii</i> (<i>Eucalyptus torquata</i> and <i>Allocasuarina acutivalvis</i> scattered in the higher elevated areas) open forest over <i>Cratystylis conocephala</i> , <i>Eremophila</i> spp. open shrubland over <i>Atriplex nummularia</i> and <i>Rhagodia ulicina</i> scattered low shrubs.
Distribution	This vegetation type (Plate 5.5) occurred in the northwestern corner of the study area.
Sampling Sites	LSC05.
Vegetation Condition	Excellent.



Plate 5.5: Representative photographs of the E5 vegetation type.

5.2.6 MS: *Melaleuca* tall open shrubland over samphire low shrubland

Vegetation Code	MS
Vegetation Type Description	<i>Melaleuca subalaris</i> , (<i>Melaleuca thyoides</i> and <i>Melaleuca lateriflora</i>) tall open shrubland over <i>Tecticornia</i> spp., <i>Maireana</i> spp. and <i>Frankenia</i> spp. low shrubland.
Distribution	This vegetation type (Plate 5.6) occurred around almost the entirety of the salt lake margins.
Sampling Sites	LSC02, LSC08, LSC10.
Vegetation Condition	Pristine.



Plate 5.6: Representative photographs of the MS vegetation type.

5.2.7 SS: Samphire low shrubland

Vegetation Code	SS
Vegetation Type Description	<i>Melaleuca thyoides</i> , <i>Melaleuca subalaris</i> scattered tall shrubs (on margins) over <i>Tecticornia halocnemoides</i> subsp. <i>caudata</i> , <i>Maireana amoena</i> low shrubland.
Distribution	This vegetation type (Plate 5.7) occurred in low depressions within the <i>Eucalyptus</i> open forests. It was devoid of larger shrubs, other than scattered <i>Melaleuca</i> species along the margins.
Sampling Sites	Detailed mapping notes.
Vegetation Condition	Pristine.



Plate 5.7: Representative photographs of the SS vegetation type.

5.2.8 Other Mapping Units

SL: The salt lake bed was naturally devoid of any vegetation (Plate 5.8) and made up 33.9% (84.1 ha) of the area mapped.

RT: Cleared gravel roads and tracks were similarly devoid of native vegetation and made up 0.6% (1.4 ha) of the area mapped.



Plate 5.8: Representative photograph of the SL vegetation type.

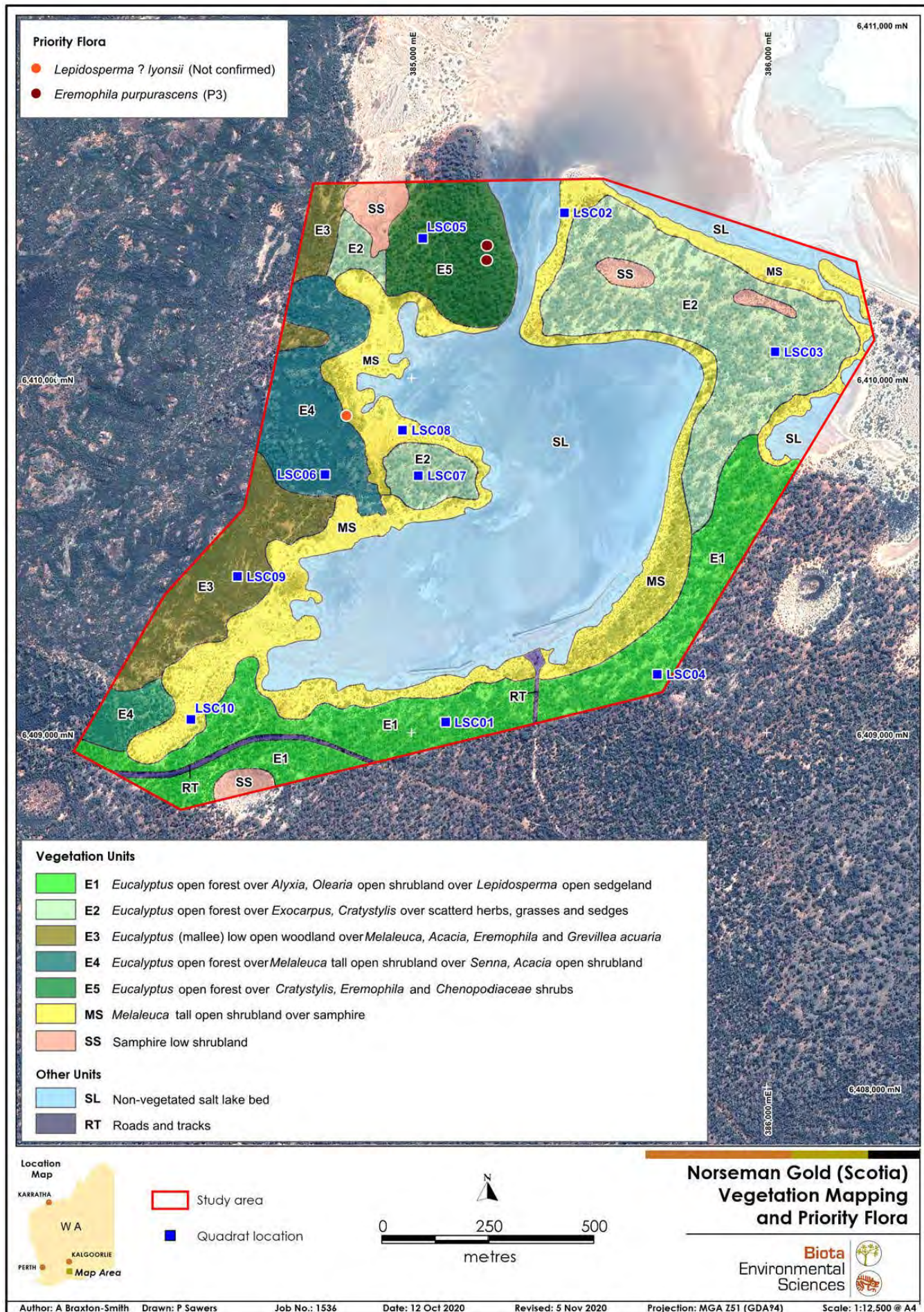


Figure 5.2: Vegetation units of the study area, with locations of Priority flora.

5.3 Condition of the Vegetation Types

The condition of the vegetation in the study area is mapped in Figure 5.3. The vegetation condition assessments were based on the ranking scale of Keighery (1994). The rankings considered the degree of invasion by introduced flora (weeds), impact from historical and ongoing human activity, and the structural integrity of the vegetation (see Appendix 4). The cleared areas (vegetation type RT), which was devoid of native vegetation, was assigned 'Completely Degraded'. Vegetation type SL (non-vegetated salt lake bed) was naturally devoid of native vegetation and was not assigned a condition rating.

A large portion of the vegetated study area had a condition rating of 'Pristine', with no signs of human disturbance or presence of introduced flora (weeds) (Figure 5.3). Vegetation type E5 was assigned a condition rating of 'Excellent' due to the presence of the weed species **Pentameris airoides* (location shown in Figure 5.3; see also Section 6.4). The extent of the vegetation condition categories are provided in Table 5.3.

Table 5.3: Extent of vegetation condition categories within the study area.

Condition Ranking	Area (ha)	Proportion of Study Area (%)
Pristine	150.7	60.7
Excellent	11.8	4.8
Very Good	-	-
Good	-	-
Degraded	-	-
Completely Degraded	1.4	0.6
N/A (Non-vegetated)	84.1	33.9
Total	248.0	100.0

5.4 Vegetation of Conservation Significance

5.4.1 Threatened and Priority Ecological Communities

Database search results showed that the study area does not intersect any mapped occurrences of Threatened or Priority Ecological Communities. The current study confirmed the absence of TECs or PECs within the study area, with the nearest known PEC located approximately 12 km north, namely the Priority 1 '*Allocasuarina globosa* assemblages on greenstone rock (Esperance District)'. Confirmation of the absence of this PEC is further reinforced by the absence of the species *Allocasuarina globosa* from the study area.

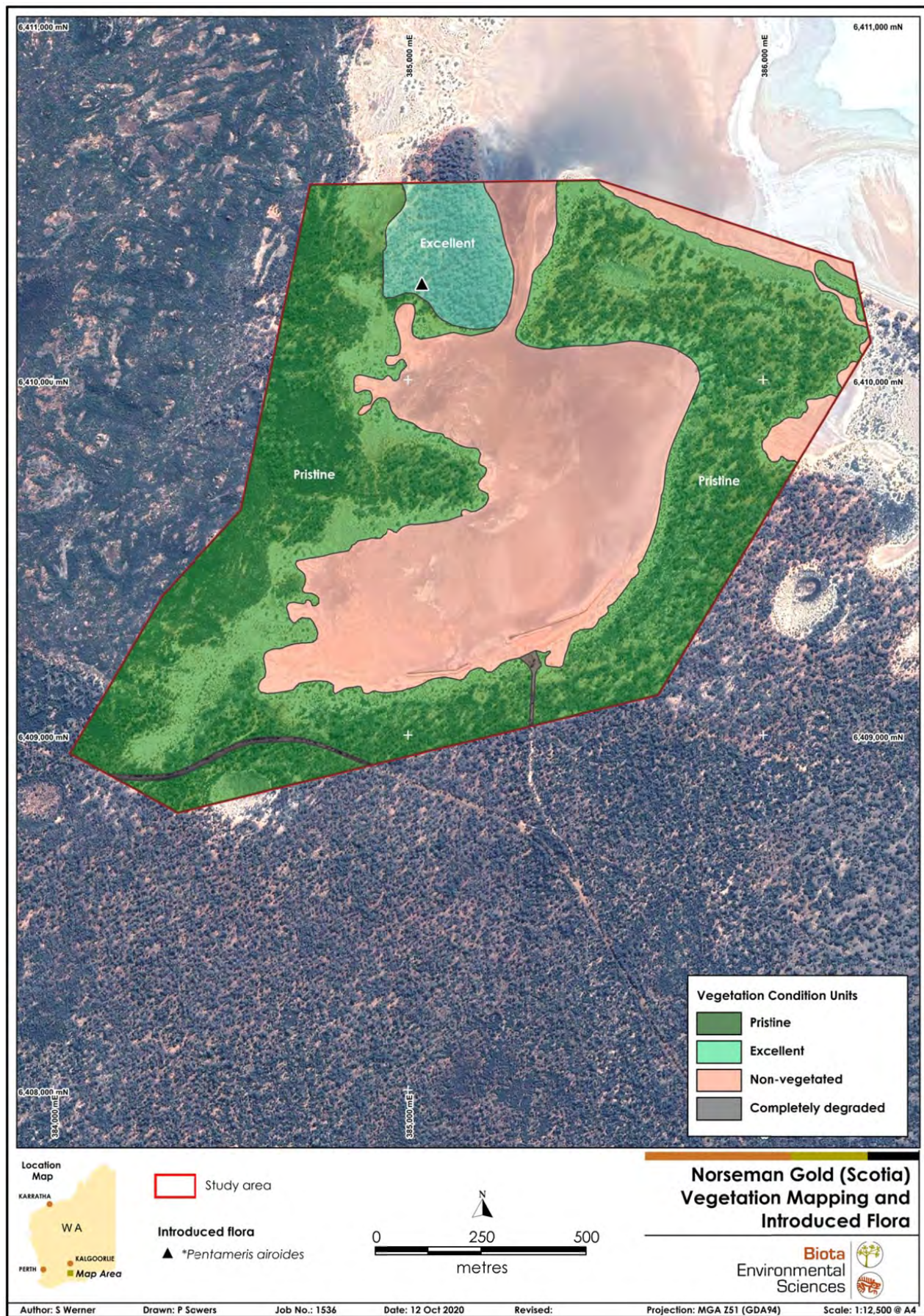


Figure 5.3: Vegetation condition of the study area, with locations of introduced flora.

This page is left intentionally blank

6.0 Flora

6.1 Overview

A total of 136 native vascular flora taxa from 68 genera and 41 families were recorded from the study area in 2020, and some additional taxa were previously recorded in the area by Mattiske (2020) (see Appendix 7). One introduced flora species (**Pentameris airoides*) was recorded in 2020, and is discussed further in Section 6.4.

Native plant families and genera with the highest species richness are shown in Table 6.1. The dominant families and genera recorded from the study area are typically well represented in species lists from the Eastern Goldfields region (see Table 6.1).

Table 6.1: Native families and genera with the highest species richness in the study area (based on 2020 data only).

Family	No. of Native Taxa	Genus	No. of Native Taxa
Myrtaceae	26	<i>Eucalyptus</i>	14
Chenopodiaceae	13	<i>Acacia</i>	10
Fabaceae	13	<i>Melaleuca</i>	10
Scrophulariaceae	9	<i>Eremophila</i>	9
Asteraceae	7	<i>Pterostylis</i>	4
Orchidaceae	6		

A full list of flora species identified during this study is presented in Appendix 7. It is not possible to accurately determine the total number of species recorded, as approximately 11 of the taxa listed were insufficiently resolved to determine if they may include more than one taxon (e.g. “Poaceae sp.” and “Lepidosperma sp.”), or may represent taxa that are already listed.

6.2 Unresolved Taxa

The majority (92%) of taxa were able to be determined with confidence to the lowest level possible within the current available taxonomic framework. The remaining species generally lacked sufficient material and were lodged with the WA Herbarium for formal identification. The following taxa warrant particular comment:

- Four *Lepidosperma* specimens were submitted to the WA Herbarium for identification, as this genus is currently undergoing revision by Dr Russell Barrett. Unfortunately, due this revision process, the WAH were unable to provide authoritative identifications. It’s possible that one or more of the specimens submitted represent conservation significant species.
- Single specimens of the orchids *Diuris* sp. and *Pterostylis* sp. were not collected in the field; these had sufficient material to confirm to genus, but inadequate for further determination to species.

6.3 Flora of Conservation Significance

6.3.1 Threatened Flora

No species listed as Threatened under the EPBC Act or BC Act were recorded in the study area, and none of the species that have been recorded from the locality are considered likely to occur (see Appendix 3).

6.3.2 Priority Flora

One confirmed Priority species, *Eremophila purpurascens* (Priority 3), was identified within the study area; one of the unidentified *Lepidosperma* specimens may represent a Priority species, however this is unable to be determined until the taxonomic revision is complete (see Section 6.2). Detailed location information for these taxa is presented in Table 6.2 and shown in Figure 5.2, with a brief summary of each taxon provided below.

Table 6.2 Priority flora locations within the study area.

Species	Cons. Status	Easting (mE)	Northing (mN)
Confirmed			
<i>Eremophila purpurascens</i>	Priority 3	385212	6410377
<i>Eremophila purpurascens</i>	Priority 3	385211	6410336
Pending Confirmation			
<i>Lepidosperma ? lyonsii</i>	Priority 1	384817	6409896

Eremophila purpurascens (confirmed) (Priority 3)

This species is an erect bushy shrub to 1.5 m tall, with pink, purple and/or red flowers (Plate 6.1). It has been recorded on sandy clay, stony loam over greenstone on granite hills and rocks (WA Herbarium 2020). The distribution of this species is limited to the Dundas Local Government Area (LGA) with the closest recorded location only 3.6 km north of the study area (WA Herbarium 2020). Two plants were recorded within the study area (Figure 5.2).



Plate 6.1: *Eremophila purpurascens* – specimen collected in the study area placed against WA Herbarium specimen (WA Herbarium 2020b).

Lepidosperma ? lyonsii (pending confirmation) (Priority 1)

This species is a tufted rhizomatous perennial sedge, reaching 0.5 m in height, with distichous culms and leaves (Plate 6.3). It has been recorded in skeletal sandy loam with banded ironstone gravel along gentle hill slopes and upper slopes of large hills (WA Herbarium 2020a). The distribution of this species extends from the LGAs of Yilgarn across Kalgoorlie-Boulder. The closest confirmed voucher specimen is from about 200 km northwest of the study area, however specimens of "*Lepidosperma* aff. *lyonsii*" have been vouchered from 7 km north of the study area. A small population of this species was recorded (Figure 5.2, Table 6.2). This genus is currently undergoing revision by Dr Russell Barrett as discussed in Section 6.2.



Plate 6.2 *Lepidosperma ? lyonsii* – specimen collected in the study area placed against the specimen at the WA Herbarium (WA Herbarium 2020b) and close up comparison of the rhizomatous base.

6.4 Introduced Flora

Introduced flora (weeds) were uncommon within the study area, with only one species found, namely **Pentameris airoides* (False Hairgrass). This species was found opportunistically (385039 mE, 6410270 mN; location shown in Figure 5.3). Under the then Department of Parks and Wildlife's Weed Prioritisation Process for the Goldfields region (Department of Parks and Wildlife 2014), this species was given an Ecological Impact rating of Unknown and an Invasiveness rating of Rapid. In the previous survey conducted in Autumn 2020 (Mattiske 2020), no introduced taxa were recorded in the quadrats that were located within the current study area.

This page is left intentionally blank

7.0 Key Biological Constraints

7.1 Matters of National Environmental Significance

7.1.1 Vegetation

Based on database search results, the field survey data, and a review of regional vegetation mapping and associated literature, the study area does not intersect any mapped occurrences of TECs.

The EPBC Act PMST search results from the desktop review returned the Endangered Priority 3 'Proteaceae Dominated Kwongan Shrublands of the Southeast Coastal Floristic Province of Western Australia' TEC as potentially occurring within the area, however as this community is located within the south coast region of Western Australia, it would not occur within the study area.

7.1.2 Flora

No flora species listed as Threatened under the EPBC Act were recorded during the field survey. One Threatened species (*Allocasuarina globosa*) was considered to have some potential to occur within the study area based on the desktop review (see Section 4.8), but was not encountered during the field survey and is now considered unlikely to occur (see Section 6.3.1).

7.2 Other Features of Significance

7.2.1 Vegetation

Based on database search results, the field survey data, and review of regional vegetation mapping and associated literature, the study area does not intersect any mapped occurrences of PECs.

The DBCA Threatened and Priority Ecological Communities database search returned the Priority 1 'Allocasuarina globosa assemblages on Greenstone rock (Esperance District)' PEC as potentially occurring within the area. This was considered "unlikely to occur" as the community is strongly linked to greenstone ridges, which are absent from the study area. The nearest known location of this PEC is located 12 km north of the study area.

7.2.2 Flora

One confirmed State-listed Priority species was recorded within the study area, *Eremophila purpurascens* (Priority 3); single individuals of the shrub were recorded from two locations within the study area.

One potential State-listed Priority species, *Lepidosperma ? lyonsii* (Priority 1), was not able to be confirmed through the formal identification process as the taxonomic revision for the genus is not yet complete. A small population of this species was found within the MS vegetation type along the central western edge of the study area.

This page is left intentionally blank

8.0 References

- Beard, J. S. (1979). *Vegetation Survey of Western Australia: Perth, Kellerberrin, Corrigin: Map and Explanatory Memoir 1:1,000,000 series*. University of Western Australia Press, Perth.
- Cowan, M. (2001). Coolgardie 3 (COO3 - Eastern Goldfields subregion). Pages 156–169 A *Biodiversity Audit of Western Australia's 53 Biogeographical Subregions*. Western Australia.
- DBCA (2020). *Priority Ecological Communities for Western Australia, Version 30*. Species and Communities Branch, Department of Biodiversity, Conservation and Attractions, 28 July 2020.
- DEC (2010). *A Biodiversity and Cultural Conservation Strategy for the Great Western Woodlands*. Retrieved from <http://www.dec.wa.gov.au/content/view/6115/2183/>.
- Department of Parks and Wildlife (2014). *Goldfields Region Species Prioritisation Process - Ecological Impact and Invasiveness Ratings*. Retrieved from <https://www.dpaw.wa.gov.au/plants-and-animals/plants/weeds/156-how-does-dpaw-manage-weeds>.
- DSEWPac (2012). *Interim Biogeographic Regionalisation for Australia (IBRA), Version 7 (Subregions) - States and Territories*. Department of Sustainability, Environment, Water, Population and Communities, Canberra. Retrieved from <http://www.environment.gov.au/topics/land/national-reserve-system/science-maps-and-data/australias-bioregions-ibra>.
- EPA (2016a). *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment*. Environmental Protection Authority, Western Australia.
- EPA (2016b). *Environmental Factor Guideline: Flora and Vegetation*. Environmental Protection Authority, Western Australia.
- Geoscience Australia (2008). *Surface geology of Australia 1:1,000,000 scale, Western Australia [Digital Dataset]*. Retrieved from <http://www.ga.gov.au>.
- GHD (2009). *Report for proposed small scale mining operation - targeted flora survey*. Unpublished report prepared for Matsa Resources Pty Ltd, Western Australia.
- GHD (2010). *Addendum to 'Report for proposed small scale mining operation – targeted flora survey' (GHD, 2009)*. Unpublished memorandum prepared Matsa Resources Ltd, Western Australia.
- Keighery, B. J. (1994). *Bushland Plant Survey - A Guide to Plant Community Survey for the Community*. Wildflower Society of Western Australia (Inc), Nedlands, Western Australia.
- Mattiske (2013). *Flora and vegetation survey of the Mt Henry survey area*. Unpublished report prepared for Panoramic Resources Ltd, Mattiske Consulting Pty Ltd, Western Australia.
- Mattiske (2020). *Flora and Vegetation Assessment: Norseman Gold Project, Norseman, WA*. Unpublished report prepared for Pantoro Ltd, Mattiske Consulting Pty Ltd, WA.
- Northcote, K. H., G. G. Beckmann, E. Bettenay, H. M. Churchward, D. C. Van Dijk, G. M. Dimmock, G. D. Hubble, R. F. Isbell, W. M. McArthur, G. G. Murtha, K. D. Nicolls, T. R. Paton, C. H. Thompson, A. A. Webb, and M. J. Wright (1960). *Atlas of Australian Soils: Sheets 1 to 10 with explanatory data*. CSIRO Australia and Melbourne University Press, Melbourne, Victoria.
- Paul Armstrong & Associates (2004). *Rare flora and vegetation survey of North Scotia prospect, conducted August 2004*. Unpublished report prepared for Kinross Gold Australia Pty Ltd, Western Australia.
- The Wilderness Society (2020). *Great Western Woodlands - A Global Treasure [WWW Document]*. Retrieved June 8, 2020, from <http://greatwesternwoodlands.com>.

WA Herbarium (2020a). FloraBase - the Western Australian Flora [WWW Document]. Department of Biodiversity, Conservation and Attractions, . Retrieved from <http://florabase.dpaw.wa.gov.au/>.

WA Herbarium (2020b). Photographs of Reference Specimens. Used with the permission of the Department of Biodiversity, Conservation and Attractions. Personal communication; October 2020.

WA Planning Commission (2000). Bush Forever Volume 2: Directory of Bush Forever Sites. Government of Western Australia, Department of Environmental Protection, Perth.

Appendix 1

Framework for Conservation Significance Ranking of Communities and Species in WA



A. Definitions, Categories and Criteria for Threatened and Priority Ecological Communities

Species and Communities Branch, Department of Environment and Conservation, December 2010.

1. General Definitions

Ecological Community

A naturally occurring biological assemblage that occurs in a particular type of habitat.

Note: The scale at which biological communities are defined will often depend on the level of detail in the information source, therefore no particular scale is specified.

A threatened ecological community (TEC) is one which is found to fit into one of the following categories; “presumed totally destroyed”, “critically endangered”, “endangered” or “vulnerable”.

Possible threatened ecological communities that do not meet survey criteria are added to the Department of Parks and Wildlife’s Priority Ecological Community Lists under Priorities 1, 2 and 3. Ecological Communities that are adequately known, are rare but not threatened, or meet criteria for Near Threatened, or that have been recently removed from the threatened list, are placed in Priority 4. These ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5.

An assemblage is a defined group of biological entities.

Habitat is defined as the areas in which an organism and/or assemblage of organisms lives. It includes the abiotic factors (e.g. substrate and topography), and the biotic factors.

Occurrence: a discrete example of an ecological community, separated from other examples of the same community by more than 20 metres of a different ecological community, an artificial surface or a totally destroyed community.

By ensuring that every discrete occurrence is recognised and recorded future changes in status can be readily monitored.

Adequately Surveyed is defined as follows:

“An ecological community that has been searched for thoroughly in most likely habitats, by relevant experts.”

Community structure is defined as follows:

“The spatial organisation, construction and arrangement of the biological elements comprising a biological assemblage” (e.g. *Eucalyptus salmonophloia* woodland over scattered small shrubs over dense herbs; structure in a faunal assemblage could refer to trophic structure, e.g. dominance by feeders on detritus as distinct from feeders on live plants).

Definitions of Modification and Destruction of an ecological community:

Modification: “changes to some or all of ecological processes (including abiotic processes such as hydrology), species composition and community structure as a direct or indirect result of human activities. The level of damage involved could be ameliorated naturally or by human intervention.”

Destruction: “modification such that reestablishment of ecological processes, species composition and community structure within the range of variability exhibited by the original community is unlikely within the foreseeable future even with positive human intervention.”

Note: Modification and destruction are difficult concepts to quantify, and their application will be determined by scientific judgement. Examples of modification and total destruction are cited below:

Modification of ecological processes: The hydrology of Toolibin Lake has been altered by clearing of the catchment such that death of some of the original flora has occurred due to dependence on fresh water. The system may be brought back to a semblance of the original state by redirecting saline runoff and pumping waters of the rising underground watertable away to restore the hydrological balance. Total destruction of downstream lakes has occurred due to hydrology being altered to the point that few of the original flora or fauna species are able to tolerate the level of salinity and/or water logging.

Modification of structure: The understorey of a plant community may be altered by weed invasion due to nutrient enrichment by addition of fertiliser. Should the additional nutrients be removed from the system the balance may be restored, and the original plant species better able to compete. Total destruction may

occur if additional nutrients continue to be added to the system causing the understorey to be completely replaced by weed species, and death of overstorey species due to inability to tolerate high nutrient levels. Modification of species composition: Pollution may cause alteration of the invertebrate species present in a freshwater lake. Removal of pollutants may allow the return of the original inhabitant species. Addition of residual highly toxic substances may cause permanent changes to water quality, and total destruction of the community.

Threatening processes are defined as follows:

“Any process or activity that threatens to destroy or significantly modify the ecological community and/or affect the continuing evolutionary processes within any ecological community.”

Examples of some of the continuing threatening processes in Western Australia include: general pollution; competition, predation and change induced in ecological communities as a result of introduced animals; competition and displacement of native plants by introduced species; hydrological changes; inappropriate fire regimes; diseases resulting from introduced micro-organisms; direct human exploitation and disturbance of ecological communities.

Restoration is defined as returning an ecological community to its pre-disturbance or natural state in terms of abiotic conditions, community structure and species composition.

Rehabilitation is defined as the re-establishment of ecological attributes in a damaged ecological community although the community will remain modified.

2. Definitions and Criteria for Presumed Totally Destroyed, Critically Endangered, Endangered and Vulnerable Ecological Communities

ECOLOGICAL COMMUNITIES

Presumed Totally Destroyed (PD)

An ecological community that has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future.

An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant and either of the following applies (A or B):

- A) Records within the last 50 years have not been confirmed despite thorough searches of known or likely habitats or
- B) All occurrences recorded within the last 50 years have since been destroyed

Critically Endangered (CR)

An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated.

An ecological community will be listed as Critically Endangered when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This will be determined on the basis of the best available information, by it meeting any one or more of the following criteria (A, B or C):

- A) The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% and either or both of the following apply (i or ii):
 - i) geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 10 years);
 - ii) modification throughout its range is continuing such that in the immediate future (within approximately 10 years) the community is unlikely to be capable of being substantially rehabilitated.
- B) Current distribution is limited, and one or more of the following apply (i, ii or iii):
 - i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 10 years);

- ii) there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes;
 - iii) there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes.
- C) The ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 10 years).

Endangered (EN)

An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future.

An ecological community will be listed as Endangered when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B, or C):

- A) The geographic range, and/or total area occupied, and/or number of discrete occurrences have been reduced by at least 70% since European settlement and either or both of the following apply (i or ii):
 - i) the estimated geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short term future (within approximately 20 years);
 - ii) modification throughout its range is continuing such that in the short term future (within approximately 20 years) the community is unlikely to be capable of being substantially restored or rehabilitated.
- B) Current distribution is limited, and one or more of the following apply (i, ii or iii):
 - i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short term future (within approximately 20 years);
 - ii) there are few occurrences, each of which is small and/or isolated and all or most occurrences are very vulnerable to known threatening processes;
 - iii) there may be many occurrences but total area is small and all or most occurrences are small and/or isolated and very vulnerable to known threatening processes.
- C) The ecological community exists only as very modified occurrences that may be capable of being substantially restored or rehabilitated if such work begins in the short-term future (within approximately 20 years).

Vulnerable (VU)

An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range.

An ecological community will be listed as Vulnerable when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction or significant modification in the medium to long-term future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B or C):

- A) The ecological community exists largely as modified occurrences that are likely to be capable of being substantially restored or rehabilitated.
- B) The ecological community may already be modified and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations.
- C) The ecological community may be still widespread but is believed likely to move into a category of higher threat in the medium to long term future because of existing or impending threatening processes.

3. Definitions and Criteria for Priority Ecological Communities

PRIORITY ECOLOGICAL COMMUNITY LIST

Possible threatened ecological communities that do not meet survey criteria or that are not adequately defined are added to the Priority Ecological Community Lists under Priorities 1, 2 and 3. These three categories are ranked in order of priority for survey and/or definition of the community, and evaluation of conservation status, so that consideration can be given to their declaration as threatened ecological communities. Ecological Communities that are adequately known, and are rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list, are placed in Priority 4. These ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5.

Priority One: Poorly-known ecological communities

Ecological communities with apparently few, small occurrences, all or most not actively managed for conservation (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) and for which current threats exist. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.

Priority Two: Poorly-known ecological communities

Communities that are known from few small occurrences, all or most of which are actively managed for conservation (e.g. within national parks, conservation parks, nature reserves, State forest, unallocated Crown land, water reserves, etc.) and not under imminent threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.

Priority Three: Poorly known ecological communities

- (i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or:
- (ii) communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or;
- (iii) communities made up of large, and/or widespread occurrences, that may or not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes.

Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.

Priority Four: Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring.

- (a) Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands.
- (b) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.
- (c) Ecological communities that have been removed from the list of threatened communities during the past five years.

Priority Five: Conservation Dependent ecological communities

Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

B. Categories for Flora and Fauna Species

1. Western Australian *Biodiversity Conservation Act 2016*, and Priority Species Classification In Western Australia, 'Threatened', 'Extinct' and 'Specially Protected' fauna and flora species are protected under the *Biodiversity Conservation Act 2016* (the BC Act), making it an offence to take or disturb these species without Ministerial approval. The definition of 'take' is broad, and includes killing, injuring, harvesting or capturing fauna, and gathering, cutting, destroying, harvesting or damaging flora.

Such species are classified within a framework of several categories.

Species of the highest conservation significance are designated as Threatened species and are protected under sections 19(1)(a), 19(1)(b) and 19(1)(c) of the BC Act. Species are listed within one of three categories:

- Critically endangered (CR), Endangered (EN), or Vulnerable (V), representing those species listed in Schedules 1 to 3 respectively of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* or the *Wildlife Conservation (Rare Flora) Notice 2018*.

Presumed extinct species are protected under sections 24 and 25 of the BC Act and are listed in one of two categories:

- Extinct (EX), representing those species listed in Schedule 4 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* or the *Wildlife Conservation (Rare Flora) Notice 2018*; or
- Extinct in the wild (EW); there are currently no listed species under this category.

Specially protected species are protected under section 13(1) of the BC Act, and include species of special conservation interest, migratory species, cetaceans, species subject to international agreement, or species otherwise in need of special protection. Of these:

- Migratory species (MI) are those listed under schedule 5 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*;
- Species of special conservation interest (conservation dependent fauna) (CD) are those listed under schedule 6 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*; and
- Other specially protected fauna (OS) are those listed under schedule 7 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*;

In addition to the species formally designated as protected under the BC Act, the WA Department of Biodiversity, Conservation and Attractions (DBCA) also maintains a list of 'Priority species'.

Species that appear to be rare or threatened, but for which there is insufficient information to properly evaluate their conservation significance, are assigned to one of three Priority categories (Priority 1 to Priority 3), while species that are adequately known but require regular monitoring are assigned to Priority 4.

Note that of the above classifications, only 'Threatened', 'Extinct' and 'Specially Protected' species have statutory standing. The Priority flora and fauna classifications are employed by the WA DBCA to manage and classify their database of species considered potentially rare or at risk, but these categories have no legislative status.

Further explanations of the categories is provided in more detail in the following pages.



CONSERVATION CODES

For Western Australian Flora and Fauna

Threatened, Extinct and Specially Protected fauna or flora¹ are species² which have been adequately searched for and are deemed to be, in the wild, threatened, extinct or in need of special protection, and have been gazetted as such.

The *Wildlife Conservation (Specially Protected Fauna) Notice 2018* and the *Wildlife Conservation (Rare Flora) Notice 2018* have been transitioned under regulations 170, 171 and 172 of the *Biodiversity Conservation Regulations 2018* to be the lists of Threatened, Extinct and Specially Protected species under Part 2 of the *Biodiversity Conservation Act 2016*.

Categories of Threatened, Extinct and Specially Protected fauna and flora are:

T **Threatened species**

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).

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.

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.

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.

CR **Critically endangered species**

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*".

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.

EN **Endangered species**

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*".

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.

VU **Vulnerable species**

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*".

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.

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.

EX Extinct species

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).

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.

EW Extinct in the wild species

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).

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.

Specially protected species

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.

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.

MI Migratory species

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).

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.

Published as migratory birds protected under an international agreement under schedule 5 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*.

CD Species of special conservation interest (conservation dependent fauna)

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).

Published as conservation dependent fauna under schedule 6 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*.

OS Other specially protected species

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).

Published as other specially protected fauna under schedule 7 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*.

P **Priority species**

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

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

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

1 **Priority 1: Poorly-known species**

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.

2 **Priority 2: Poorly-known species**

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.

3 **Priority 3: Poorly-known species**

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.

4 **Priority 4: Rare, Near Threatened and other species in need of monitoring**

(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.

(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.

(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

¹ The definition of flora includes algae, fungi and lichens

² Species includes all taxa (plural of taxon - a classificatory group of any taxonomic rank, e.g. a family, genus, species or any infraspecific category i.e. subspecies or variety, or a distinct population).

2. Commonwealth Environment Protection and Biodiversity Conservation Act 1999

Many of the species that are specially protected at State level are also listed as Threatened species at the Federal level, as one of the Matters of National Environmental Significance (MNES) identified under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (the EPBC Act). These may be classified as 'critically endangered', 'endangered', 'vulnerable' or 'lower risk', consistent with IUCN categories:

1. Critically Endangered (CR): a taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future.
2. Endangered (EN): a taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future.
3. Vulnerable (VU): a taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future.
4. Lower Risk (LR): a taxon is Lower Risk when it has been evaluated, does not satisfy the criteria for any of the categories Critically Endangered, Endangered or Vulnerable. Taxa included in the Lower Risk category can be separated into three subcategories:
 - Conservation Dependent (CD). Taxa which are the focus of a continuing taxon-specific or habitat-specific conservation program targeted towards the taxon in question, the cessation of which would result in the taxon qualifying for one of the threatened categories above within a period of five years.
 - Near Threatened (NT). Taxa which do not qualify for Conservation Dependent, but which are close to qualifying for Vulnerable.
 - Least Concern (LC). Taxa which do not qualify for Conservation Dependent or Near Threatened.

In addition, numerous Migratory fauna species are listed as MNES under the EPBC Act (some of which are also listed as Threatened). Migratory species are those animals that migrate to Australia and its external territories, or pass through or over Australian waters during their annual migrations. The list of migratory species consists of those species listed under the following international conventions:

1. Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention);
2. China-Australia Migratory Bird Agreement (CAMBA);
3. Japan-Australia Migratory Bird Agreement (JAMBA); and,
4. Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA).

Marine species are also protected under the EPBC Act, and are listed to ensure the long-term conservation of the species. Marine species include all Australian sea snakes, seals, crocodiles, dugongs, marine turtles, seahorses and seabirds that naturally occur in the Commonwealth marine area.

Under the terms of the EPBC Act, an action (e.g. a project or development) is required to be referred to the Australian Government Environment Minister for approval if it has, will have, or is likely to have, a significant impact on an MNES. The term 'action' includes projects and developments subsequent to commencement of the Act, however there are a number of exemptions (e.g. projects in Commonwealth areas). According to Department of the Environment (2013), a 'significant impact' is an impact which is important, notable, or of consequence, having regard to its context or intensity. Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment which is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts.

References:

Department of the Environment (2013). Matters of National Environmental Significance - Significant Impact Guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999. Department of the Environment, Canberra, Australia.

Appendix 2

Database Searches



Scotia 30km radius

Created By Guest user on 15/10/2020

Kingdom Plantae
Conservation Status Conservation Taxon (T, X, IA, S, P1-P5)
Current Names Only Yes
Core Datasets Only Yes
Species Group All Plants
Method 'By Circle'
Centre 121° 46' 55" E, 32° 26' 31" S
Buffer 30km
Group By Conservation Status

Conservation Status	Species	Records
Priority 1	11	68
Priority 2	4	7
Priority 3	15	87
Priority 4	2	6
Rare or likely to become extinct	3	15
TOTAL	35	183

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
Rare or likely to become extinct				
1.	12656 <i>Allocasuarina globosa</i>		T	
2.	12327 <i>Daviesia microcarpa</i>		T	
3.	13645 <i>Eucalyptus platydisca</i>		T	
Priority 1				
4.	12256 <i>Acacia dorsenna</i>		P1	
5.	14617 <i>Acacia hystrix subsp. continua</i>		P1	
6.	30235 <i>Bossiaea arcuata</i>		P1	Y
7.	30237 <i>Bossiaea aurantiaca</i>		P1	
8.	31615 <i>Cryptandra exserta</i>		P1	
9.	12378 <i>Eucalyptus jimberlanica</i>		P1	
10.	2064 <i>Grevillea phillipsiana</i>		P1	
11.	16448 <i>Micromyrtus papillosa</i>		P1	
12.	18520 <i>Philothea apiculata</i>		P1	
13.	7649 <i>Scaevola tortuosa (Tortuous-stem Scaevola)</i>		P1	
14.	46035 <i>Verticordia sp. Dundas (C.A. Gardner 2848)</i>		P1	Y
Priority 2				
15.	14401 <i>Aotus sp. Dundas (M.A. Burgman 2835)</i>		P2	
16.	13206 <i>Drosera salina</i>		P2	
17.	23462 <i>Goodenia granitica</i>		P2	
18.	25876 <i>Triglochin sp. Condingup (R. Davis 10877)</i>		P2	
Priority 3				
19.	14048 <i>Acacia ancistrophylla var. perarcuata</i>		P3	
20.	14614 <i>Acacia truculenta</i>		P3	
21.	13897 <i>Allocasuarina eriochlamys subsp. grossa</i>		P3	
22.	17520 <i>Atriplex lindleyi subsp. conduplicata</i>		P3	
23.	34298 <i>Beyeria sulcata var. truncata</i>		P3	
24.	7258 <i>Eremophila purpurascens</i>		P3	
25.	15049 <i>Eremophila succinea</i>		P3	
26.	5569 <i>Eucalyptus brockwayi (Dundas Mahogany)</i>		P3	
27.	12888 <i>Eucalyptus histophylla</i>		P3	
28.	5754 <i>Eucalyptus pterocarpa</i>		P3	
29.	17655 <i>Goodenia laevis subsp. laevis</i>		P3	
30.	5891 <i>Melaleuca coccinea (Goldfields Bottlebrush)</i>		P3	
31.	14701 <i>Melaleuca macronychia subsp. trygonoides</i>		P3	
32.	6804 <i>Pityrodia chrysocalyx</i>		P3	
33.	13789 <i>Stylidium pulviniforme</i>		P3	

	Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
Priority 4					
	34.	31763	<i>Lepidosperma lyonsii</i>		P4
	35.	6197	<i>Myriophyllum petraeum</i> (<i>Granite Myriophyllum</i>)		P4

Conservation Codes

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

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



EPBC Act Protected Matters Report

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

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

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

Report created: 08/10/20 13:18:25

[Summary](#)

[Details](#)

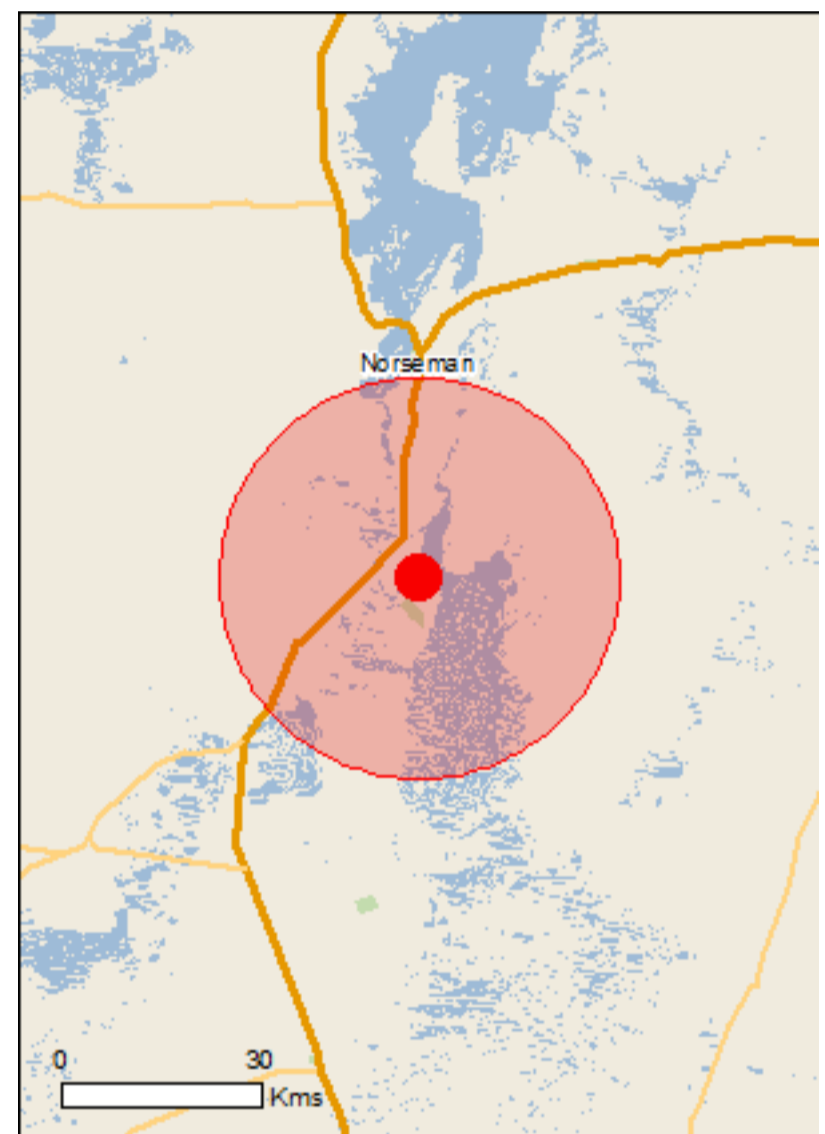
[Matters of NES](#)

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

[Extra Information](#)

[Caveat](#)

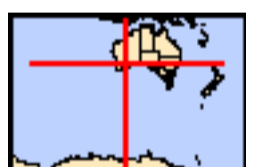
[Acknowledgements](#)



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2015

[Coordinates](#)

Buffer: 30.0Km



Summary

Matters of National Environmental Significance

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

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	1
Listed Threatened Species:	7
Listed Migratory Species:	7

Other Matters Protected by the EPBC Act

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

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

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

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	12
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

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

State and Territory Reserves:	2
Regional Forest Agreements:	None
Invasive Species:	13
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities

[\[Resource Information \]](#)

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

Name	Status	Type of Presence
Proteaceae Dominated Kwongan Shrublands of the Southeast Coastal Floristic Province of Western Australia	Endangered	Community may occur within area

Listed Threatened Species

[\[Resource Information \]](#)

Name	Status	Type of Presence
Birds		

Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
---	-----------------------	--

Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat may occur within area
---	------------	--

Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat known to occur within area
---	------------	---

Pezoporus occidentalis Night Parrot [59350]	Endangered	Species or species habitat may occur within area
--	------------	--

Mammals

Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat may occur within area
---	------------	--

Plants

Daviesia microcarpa Norseman Pea [56766]	Endangered	Species or species habitat likely to occur within area
---	------------	--

Eremophila lactea Milky Emu Bush [2416]	Endangered	Species or species habitat may occur within area
--	------------	--

Listed Migratory Species

[\[Resource Information \]](#)

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		

Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
---	--	--

Migratory Terrestrial Species

Name	Threatened	Type of Presence
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [\[Resource Information \]](#)

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -

Listed Marine Species [\[Resource Information \]](#)

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat known to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat may occur within area

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Dundas	WA
Unnamed WA42943	WA

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

Name	Status	Type of Presence
Birds		
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Mammals		
Camelus dromedarius Dromedary, Camel [7]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Carrichtera annua Ward's Weed [9511]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area

Caveat

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

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

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

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

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

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

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

- migratory and
- marine

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

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

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

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

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

Coordinates

-32.44315 121.7791

Acknowledgements

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

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

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

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

© Commonwealth of Australia

Department of Agriculture Water and the Environment

GPO Box 858

Canberra City ACT 2601 Australia

+61 2 6274 1111

Appendix 3

Potential Flora of Conservation Significance Compiled from Database and Literature Searches



Species	Habit	Habitat	Database Search				Previous Botanical Surveys	Likelihood of Occurrence Within the Study Area	
			Nature Map	TPFL Database	EPBC Act (PMST)	WA Herbarium		Initial Ranking Based on the Desktop Review (NR = nearest record)	Final Ranking including Results of 2020 Field Survey
Threatened									
<i>Allocasuarina globosa</i>	Shrub to 1.5 m tall.	Laterite, clay, loam; greenstone ridges.	☑	☑		☑		May potentially occur, if any suitable habitat present. (NR 13.3 km N).	Unlikely to occur; no particularly suitable habitat and not recorded during the field survey.
<i>Daviesia microcarpa</i> (Norseman Pea)	Shrub to 40 cm tall.	Weathered gravel on hills.	☑	☑	☑	☑		Unlikely to occur; no particularly suitable habitat and no records in close proximity (NR 26.2 km N).	Unlikely to occur.
<i>Eremophila lactea</i> (Milky Emu Bush)	Shrub to 3.5 m tall.	White sandy clay loam in <i>Eucalyptus</i> woodland and mixed shrubland.			☑			Unlikely to occur: known distribution is considerably further S (NR >80 km S).	Unlikely to occur.
<i>Eucalyptus platydisca</i>	Mallee to 4 m tall.	Granite soils on stony hills.	☑	☑		☑		Unlikely to occur; no suitable habitat and no records in close proximity (NR 26.3 km N).	Unlikely to occur.
Priority 1									
<i>Acacia dorsenna</i>	Shrub to 1.6 m tall.	Rocky sandy loam or clay loam. Low rocky hills.	☑	☑		☑		May potentially occur; some suitable habitat but no records in close proximity (NR 26.8 km N).	Unlikely to occur; not recorded during the field survey.
<i>Acacia hystrix</i> subsp. <i>continua</i>	Shrub to 1 m tall.	Flat plain, laterite.	☑	☑		☑		Unlikely to occur; no suitable habitat present; few known records, and none in close proximity (NR 25.1 km SW).	Unlikely to occur.
<i>Beyeria constellata</i>	Shrub to 1.5 m tall.	Gravelly sand.						N/A (NR 460 km NW)	Unlikely to occur.
<i>Bossiaea arcuata</i>	Shrub to 1.5 m tall.	Deep white sand. Perimeter of salt lakes.	☑	☑		☑		Likely to occur: suitable habitat present and records in close proximity (NR 14.6 km NW).	May potentially occur; not recorded during the field survey.
<i>Bossiaea aurantiaca</i>	Shrub to 1.5 m tall.	Red sand, red clay loam. Low-lying, winter-damp sites.	☑	☑		☑		Likely to occur: suitable habitat present and records in close proximity (NR 16.9 km NW).	May potentially occur; not recorded during the field survey.
<i>Calandrinia lefroyensis</i>	Slender perennial herb to 20 cm tall.	Sand dunes, saline flats, salt lake edges.					Mattiske (2020)	May potentially occur; suitable habitat present but no records in close proximity (nearest vouchered record 73 km N, but recorded by Mattiske (2020) from 31.6 km N).	May potentially occur; not recorded during the field survey but may not have been visible at the time.
<i>Cryptandra exserta</i>	Shrub to 50 cm tall.	Sandy soil with laterite gravel; mid-slopes and plains.	☑	☑		☑		May potentially occur; suitable habitat may be present (NR 16.3 km SW).	May potentially occur.
<i>Eucalyptus jimberlanica</i>	Tree (mallee) to 10 m tall.	Loam. Valley edges.	☑	☑		☑	Mattiske (2013)	May potentially occur; suitable habitat may be present and a	Unlikely to occur; not recorded during the field survey.

Species	Habit	Habitat	Database Search				Previous Botanical Surveys	Likelihood of Occurrence Within the Study Area	
			Nature Map	TPFL Database	EPBC Act (PMST)	WA Herbarium		Initial Ranking Based on the Desktop Review (NR = nearest record)	Final Ranking including Results of 2020 Field Survey
								record in close proximity (NR 8.2 km N).	
<i>Eucalyptus websteriana</i> subsp. <i>norsemanica</i>	Mallee to 3 m tall, minni ritchi bark.	Rocky rises.		☑		☑		Unlikely to occur; suitable habitat appears to be absent and no records in close proximity (NR 31.5 km NW)	Unlikely to occur.
<i>Grevillea phillipsiana</i>	Shrub to 1.5 m tall.	Red sand, stony loam. Granite hills.	☑	☑		☑		Unlikely to occur: only a small amount of suitable habitat appears to be present and no records in close proximity (NR 26.6 km N).	Unlikely to occur.
<i>Lepidosperma lyonsii</i>	Perennial sedge to 50 cm tall.	Skeletal sandy loam with banded ironstone gravel & rock, well-drained shallow stony loamy with quartz. Gentle hill slopes, upper slopes of large hill.	☑					May potentially occur: specimens identified as " <i>Lepidosperma</i> aff. <i>lyonsii</i> " vouchered from 7 km N.	Recorded (pending confirmation).
<i>Micromyrtus papillosa</i>	Shrub to 1.2 m tall.	Sandy or clay soils, ironstone, granite. Rocky sites, outcrops, on hills from base to summit.	☑	☑		☑		May potentially occur; a record in close proximity with minimal suitable habitat (NR 14.6 km N).	May potentially occur.
<i>Philotheca apiculata</i>	Shrub to 1.5 m tall.	Stony clay loam. Rocky outcrops, hillsides.	☑	☑		☑	Mattiske (2013); GHD (2009, 2010).	May potentially occur; records in close proximity with minimal suitable habitat present (NR 8.3 km N).	May potentially occur.
<i>Philotheca nutans</i>	Shrub to 90 cm tall.	Sandy soils. Low plains, undulating rises, edges of salt lakes.		☑				Unlikely to occur: suitable habitat present but only a single record from the locality, which was not vouchered; all other known records are over 400 km NW (32.5 km N).	Unlikely to occur.
<i>Scaevola tortuosa</i>	Perennial herb to 20 cm tall.	Margins of salt lakes.	☑	☑		☑		May potentially occur: suitable habitat present but no records in close proximity (NR 22.1 km SW).	Unlikely to occur; not recorded during field survey.
<i>Verticordia</i> sp. Dundas (C.A. Gardner 2848)	Shrub.	Red granitic soil.	☑			☑		Unlikely to occur; only records are from 1931, and location records are likely imprecise (NR apparently 15.9 km S).	Unlikely to occur.

Priority 2

Species	Habit	Habitat	Database Search				Previous Botanical Surveys	Likelihood of Occurrence Within the Study Area	
			Nature Map	TPFL Database	EPBC Act (PMST)	WA Herbarium		Initial Ranking Based on the Desktop Review (NR = nearest record)	Final Ranking including Results of 2020 Field Survey
<i>Acacia kerryana</i>	Spreading shrub to 1 m tall.	Granitic loamy sand, stony clayey loam or clayey sand. Low stony ridges, undulating plains.		☑		☑	Mattiske (2020)	May potentially occur: suitable habitat may be present but no records in close proximity (NR 26.6 km N).	Unlikely to occur; not recorded during field survey.
<i>Aotus</i> sp. Dundas (M.A. Burgman 2835)	Shrub to 1 m tall.	Edges of salt lakes, sandy soils.	☑			☑		Likely to occur; suitable habitat present and records to N and S (NR 8.3 km N).	May potentially occur; not recorded during field survey but would not have been flowering at the time and may have been overlooked.
<i>Drosera salina</i>	Perennial herb to 10 cm tall.	Salt-free white sand. Margins of salt lakes	☑	☑		☑	Paul Armstrong & Associates (2004)	Likely to occur; suitable habitat present and a record in very close proximity (NR 150 m N).	May potentially occur; not recorded during field survey but this small herb may be overlooked without intensive searches..
<i>Frankenia brachyphylla</i>	Halophytic shrub to 15 cm tall.	Salt lake margins.		☑		☑		Unlikely to occur; suitable habitat present but no records in close proximity (NR 44.6 km SW).	Unlikely to occur.
<i>Thysanotus brachyantherus</i>	Perennial herb to 40 cm tall.	Clay over limestone, loam, with samphire.	☑			☑		Unlikely to occur; suitable habitat may be present but no records in close proximity (NR 36 km N).	Unlikely to occur.
<i>Triglochin</i> sp. Condingup (R. Davis 10877)	Perennial herb.	Pools of water in granite outcrops, brown mud.	☑	☑		☑		Unlikely to occur; a record in close proximity but no suitable habitat (NR 8.7 km W).	Unlikely to occur.
Priority 3									
<i>Acacia ancistrophylla</i> var. <i>perarcuata</i>	Shrub to 1.6 m tall.	Red sand, clay loam, loam. Undulating plains.	☑			☑		Likely to occur; suitable habitat present and a record in close proximity (NR 5.6 km S).	Unlikely to occur: not recorded during field survey.
<i>Acacia truculenta</i>	Prickly shrub to 2.2 m tall.	Sand or loam.	☑			☑		Likely to occur: suitable habitat present and records to N and S (NR 16.6 km N).	May potentially occur; not recorded during field survey.
<i>Allocasuarina eriochlamys</i> subsp. <i>grossa</i>	Shrub to 3 m tall.	Stony loam, laterite clay. Granite outcrops and laterite hills.	☑			☑	Mattiske (2013)	Unlikely to occur: a record in close proximity but no particularly suitable habitat present (NR 16.5 km N).	Unlikely to occur.
<i>Atriplex lindleyi</i> subsp. <i>conduplicata</i>	Annual or perennial herb to 20 cm tall.	Clay plains	☑			☑		Would not occur; no suitable habitat and very rarely collected (NR 24 km N).	Would not occur.

Species	Habit	Habitat	Database Search				Previous Botanical Surveys	Likelihood of Occurrence Within the Study Area	
			Nature Map	TPFL Database	EPBC Act (PMST)	WA Herbarium		Initial Ranking Based on the Desktop Review (NR = nearest record)	Final Ranking including Results of 2020 Field Survey
<i>Beyeria sulcata</i> var. <i>truncata</i>	Shrub to 1.3 m tall.	Plains, orange-yellow sands.	☑			☑		May potentially occur; suitable habitat present but no records in close proximity (NR 26.2 km N).	Unlikely to occur; not recorded during field survey.
<i>Chrysocephalum apiculatum</i> subsp. <i>norsemanense</i>	Biannual (?) daisy to 40 cm tall.	Well-drained granitic loamy sandplains.				☑		May potentially occur; suitable habitat present but no records in close proximity (NR 29.9 km N).	Unlikely to occur; not recorded during field survey
<i>Cyathostemon</i> sp. Salmon Gums (B. Archer 769)	Shrub to 3 m tall.	Orange or white sand, sandy clay over granite, light brown clay with gypsum, saline soils. Flats, near river beds, claypans.				☑	Mattiske (2013)	Unlikely to occur; potentially some suitable habitat present (near salt lake) but no records in close proximity (NR 33.5 km SW).	Unlikely to occur.
<i>Eremophila purpurascens</i>	Shrub to 1.5 m tall.	Sandy clay, stony loam over greenstone. Granite hills and rocks.	☑			☑	Mattiske (2013); GHD (2009); Paul Armstrong & Associates (2004)	May potentially occur; some suitable habitat and a record in close proximity (NR 3.6 km N).	Recorded.
<i>Eremophila succinea</i>	Shrub to 3 m tall.	Sand over clay.	☑					Unlikely to occur; no particularly suitable habitat and nearest record location is uncertain (NR 23.1 km W).	Unlikely to occur.
<i>Eucalyptus brockwayi</i> (Dundas Mahogany)	Tree to 20 m tall.	Gravelly sandy loam. Low rocky hills and slopes.	☑			☑	Mattiske (2013); GHD (2009)	Unlikely to occur: a record in close proximity but no suitable habitat appears to be present (NR 6.2 km N).	Unlikely to occur.
<i>Eucalyptus histophylla</i> (Dundas Mallee)	Mallee to 6 m tall.	Sandy loam on granite or laterite; granite outcrops.	☑			☑		Unlikely to occur: a record in close proximity but minimal suitable habitat (NR 18.1 km SW).	Unlikely to occur.
<i>Eucalyptus pterocarpa</i>	Tree to 15 m tall.	Red-brown sandy loam, yellow-brown silty loam. Creek edges, rocky slopes.	☑			☑		Unlikely to occur: no particularly suitable habitat present and no records further SE from NR (30.9 km NW).	Unlikely to occur.
<i>Goodenia laevis</i> subsp. <i>laevis</i>	Subshrub to 25 cm tall.	Sandy loam or laterite.	☑			☑	Mattiske (2013)	May potentially occur : suitable habitat present; a record in close proximity but infrequently collected (16.5 km N).	May potentially occur.
<i>Melaleuca coccinea</i> (Goldfields Bottlebrush)	Shrub to 2.6 m tall.	Sandy loam over granite. Granite outcrops, sandplain, river valleys.	☑			☑	Mattiske (2013)	Unlikely to occur; a record in close proximity but no particularly suitable habitat present (NR 7.6 km N).	Unlikely to occur.
<i>Melaleuca macronychia</i> subsp. <i>trygonoides</i>	Shrub to 4 m tall.	Sandy soils. Granite outcrops.	☑			☑	Paul Armstrong & Associates (2004)	May potentially occur; small amount of granite appears to be present in W section of study area (NR 580 m NW).	Unlikely to occur; not recorded during field survey.

Species	Habit	Habitat	Database Search				Previous Botanical Surveys	Likelihood of Occurrence Within the Study Area	
			Nature Map	TPFL Database	EPBC Act (PMST)	WA Herbarium		Initial Ranking Based on the Desktop Review (NR = nearest record)	Final Ranking including Results of 2020 Field Survey
<i>Notisia intonsa</i>	Annual daisy to 10 cm tall.	Hillslopes and plains; red clay loams, granitic soils, edges of salt lakes.				☑		May potentially occur: suitable habitat present; records to N and S, but none in close proximity (NR 30.2 km N).	May potentially occur: not recorded during field survey but may not have been visible at the time of survey.
<i>Phlegmatospermum eremaeum</i>	Annual herb to 10 cm tall.	Stony loam.				☑		May potentially occur: suitable habitat present; records to N and S, but none in close proximity (NR 32.5 km N).	May potentially occur: not recorded during field survey but this very small herb may be overlooked without intensive searches..
<i>Pityrodia chrysocalyx</i>	Shrub to 75 cm tall.	Sandy soils.	☑			☑		May potentially occur: suitable habitat present; records to N and S, but none in close proximity (NR 26.2 km N).	Unlikely to occur; not recorded during field survey.
<i>Stylidium pulviniforme</i>	Perennial herb to 5 cm tall.	Saline flats.	☑	☑		☑		May potentially occur: suitable habitat present but no records E of the closest record (NR 26.5 km SW).	Unlikely to occur; not recorded during field survey.
Priority 4									
<i>Eremophila parvifolia</i> subsp. <i>parvifolia</i>	Shrub to 70 cm tall.	Loam, yellow sand, clay, limestone. Plains and claypans.					Mattiske (2020)	May potentially occur: suitable habitat present but no records in close proximity (closest vouchered record is 170 km E but unconfirmed records from 36.4 km N; see Mattiske (2020)).	Unlikely to occur: not recorded during field survey.
<i>Frankenia glomerata</i> (Cluster Head Frankenia)	Subshrub to 30 cm tall.	White sand.		☑		☑		May potentially occur: suitable habitat present; records to N and S, but none in close proximity (28.9 km N).	Unlikely to occur: not recorded during field survey.
<i>Myriophyllum petraeum</i> (Granite Myriophyllum)	Aquatic annual herb.	Strictly confined to ephemeral rock pools on granite outcrops.	☑	☑		☑		Unlikely to occur; a record in close proximity but no suitable habitat (NR 8.8 km W).	Unlikely to occur.

NB. Record of "*Goodenia granitica*" returned by NatureMap search is not included here as it refers to a WA Herbarium specimen identified as *G. aff. granitica*; all other specimens of this species are over 300 km NW.

Appendix 4

Vegetation Structural Classification and Condition Scale



Vegetation Structural Classes*

Stratum	Canopy Cover (%)				
	70-100%	30-70%	10-30%	2-10%	<2%
Trees over 30 m	Tall closed forest	Tall open forest	Tall woodland	Tall open woodland	Scattered tall trees
Trees 10-30 m	Closed forest	Open forest	Woodland	Open woodland	Scattered trees
Trees under 10 m	Low closed forest	Low open forest	Low woodland	Low open woodland	Scattered low trees
Tree Mallee	Closed tree mallee	Tree mallee	Open tree mallee	Very open tree mallee	Scattered tree mallee
Shrub Mallee	Closed shrub mallee	Shrub mallee	Open shrub mallee	Very open shrub mallee	Scattered shrub mallee
Shrubs over 2 m	Tall closed scrub	Tall open scrub	Tall shrubland	Tall open shrubland	Scattered tall shrubs
Shrubs 1-2 m	Closed heath	Open heath	Shrubland	Open shrubland	Scattered shrubs
Shrubs under 1 m	Low closed heath	Low open heath	Low shrubland	Low open shrubland	Scattered low shrubs
Hummock grasses	Closed hummock grassland	Hummock grassland	Open hummock grassland	Very open hummock grassland	Scattered hummock grasses
Grasses, Sedges, Herbs	Closed tussock grassland / bunch grassland / sedgeland / herbland	Tussock grassland / bunch grassland / sedgeland / herbland	Open tussock grassland / bunch grassland / sedgeland / herbland	Very open tussock grassland / bunch grassland / sedgeland / herbland	Scattered tussock grasses / bunch grasses / sedges / herbs

- Based on Keighery (1994), adapted from Muir (1977), and Aplin's (1979) modification of the vegetation classification system of Specht (1970):
 - Keighery B.J. (1994). *Bushland Plant Survey: A Guide for Community Surveys*. Wildflower Society of Western Australia, Perth WA;
 - Aplin T.E.H. (1979). The Flora. Chapter 3 In O'Brien, B.J. (ed.) (1979). *Environment and Science*. University of Western Australia Press;
 - Muir B.G. (1977). *Biological Survey of the Western Australian Wheatbelt. Part II: Vegetation and habitat of Bending Reserve*. Records of the Western Australian Museum, Suppl. No. 3;
 - Specht R.L. (1970). *Vegetation*. In *The Australian Environment*. 4th edn (Ed. G.W. Leeper). Melbourne.

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

Appendix 5

Raw Quadrat Data



Site	LSC01		
Described by	SW, ABS	Date 11-Aug-20	Type Quadrat 20 x 20 m
MGA Zone	384946mE 6408872mN		
Habitat	Undulating plain, 0-3% gradient slope to the northwest, 200 m from salt lake margin.		
Soil	5YR 4/6 yellowish red loamy sand.		
Vegetation	Eucalyptus gracilis, Eucalyptus eremophila open forest over Eucalyptus transcontinentalis low open woodland over Alyxia buxifolia (Acacia hemiteles, Exocarpos aphyllus) shrubland over Olearia muelleri, Westringia cephalantha var. cephalantha, Acacia merrallii, Acacia pachypoda low open shrubland over scattered sedges and herbs.		
Veg Condition	Pristine.		
Fire Age	Very long unburnt.		

Species	Cover (%)	Height (cm)	Specimen
<i>Acacia hemiteles</i>	1.5	130	LSC01-11
<i>Acacia merrallii</i>	1	50	LSC01-13
<i>Acacia pachypoda</i>	1	100	LSC01-15
<i>Alyxia buxifolia</i>	15	150	LSC01-10
Asteraceae sp.	0.1	15	LSC01-09
<i>Austrostipa</i> sp.	0.1	20	LSC01-16
<i>Eremophila psilocalyx</i>	0.5	100	LSC01-05
<i>Eucalyptus eremophila</i>	40	1000	LSC01-01
<i>Eucalyptus gracilis</i>	20	1500	LSC01-02
<i>Eucalyptus transcontinentalis</i>	10	300	LSC01-03
<i>Exocarpos aphyllus</i>	0.5	150	LSC01-06
<i>Olearia muelleri</i>	5	50	LSC01-04
<i>Olearia</i> sp. <i>Eremicola</i> (Diels & Pritzel s.n. PERTH 00449628)	0.5	50	LSC01-14
<i>Scaevola spinescens</i>	0.5	50	LSC01-08
<i>Thysanotus manglesianus</i>	0.1	150	LSC01-07
<i>Westringia cephalantha</i> var. <i>cephalantha</i>	1.5	40	LSC01-12



LSC01 – Overstorey



LSC01 – Understorey

Site LSC02
 Described by SW, ABS Date 12-Aug-20 Type Quadrat 20 x 20 m
 MGA Zone 385305mE 6410324mN
 Habitat Salt lake margin, flat 0% gradient.
 Soil 7.5YR 4/4 brown loamy sand.
 Vegetation *Melaleuca thyoides* tall shrubland over *Melaleuca subalaris*, *Tecticornia halocnemoides* subsp. *caudata*, *Scaevola spinescens*, *Maireana amoena*, *Frankenia irregularis* low open shrubland over scattered sedges and herbs.
 Veg Condition Pristine.
 Fire Age Very long unburnt.

Species	Cover (%)	Height (cm)	Specimen
<i>Acacia prairi</i>	0.25	100	LSC02-04
<i>Atriplex nana</i>	0.5	50	LSC02-10
<i>Austrostipa</i> sp.	0.1	50	LSC02-16
<i>Billardiera lehmanniana</i>	0.1	50	LSC02-08
<i>Chenopodium desertorum</i> subsp. <i>microphyllum</i>	0.1	100	LSC02-13
<i>Chenopodium desertorum</i> subsp. <i>microphyllum</i>	0.1	10	LSC02-12
<i>Disphyma crassifolium</i>	0.1	10	
<i>Eragrostis dielsii</i>	0.1	5	LSC02-17
<i>Frankenia irregularis</i>	1	10	LSC02-02
<i>Gunniopsis quadrifida</i>	0.1	20	LSC02-09
<i>Leucopogon</i> sp. Kau Rock (M.A. Burgman 1126)	0.5	100	LSC02-01
<i>Maireana amoena</i>	1	20	LSC02-11
<i>Maireana oppositifolia</i>	0.1	10	LSC02-15
<i>Melaleuca subalaris</i>	8	60	LSC02-05
<i>Melaleuca thyoides</i>	12	300	LSC02-14
<i>Rhagodia ulicina</i>	0.1	25	LSC02-06
<i>Scaevola spinescens</i>	1	50	LSC02-03
<i>Tecticornia halocnemoides</i> subsp. <i>caudata</i>	4	30	LSC02-07



LSC02 – Overstorey



LSC02 – Understorey

Site LSC03
 Described by SW, ABS Date 12-Aug-20 Type Quadrat 20 x 20 m
 MGA Zone 385896 mE 6409929 mN
 Habitat Undulating plain, crest of a slope between Scotia Salt Lake and Lake Dundas tributary.
 Soil 5YR 4/6 yellowish red sandy loam.
 Vegetation *Eucalyptus gracilis*, *Eucalyptus spreta*, *Eucalyptus salicola* open forest over *Santalum acuminatum* scattered low trees over *Olearia muelleri*, *Acacia prainii* low open shrubland over *Chamaexeros fimbriata* very open sedgeland over scattered perennial herbs and grasses.
 Veg Condition Pristine
 Fire Age No sign of recent fire.

Species	Cover (%)	Height (cm)	Specimen
<i>Acacia erinacea</i>	2	50	LSC03-12
<i>Acacia prainii</i>	0.1	60	LSC02-04=
<i>Alyxia buxifolia</i>	0.5	100	
<i>Aristida contorta</i>	0.1	10	LSC03-06
Asteraceae sp.	0.1	0.1	LSC01-09=
<i>Austrostipa</i> sp.	0.1	25	LSC03-14
<i>Austrostipa</i> sp.	0.1	20	LSC01-16=
<i>Austrostipa trichophylla</i>	0.25	25	LSC03-10
<i>Chamaexeros fimbriata</i>	2	40	LSC03-05
<i>Dianella revoluta</i> var. <i>divaricata</i>	0.5	80	
<i>Enchylaena tomentosa</i>	0.1	50	
<i>Erodium cygnorum</i>	0.1	0.1	LSC03-09
<i>Eucalyptus gracilis</i>	16	2000	LSC03-01
<i>Eucalyptus gracilis</i>	1	500	LSC03-03
<i>Eucalyptus salicola</i>	9	2000	LSC03-04
<i>Eucalyptus spreta</i>	14	1300	LSC03-02
<i>Exocarpos aphyllus</i>	0.5	80	
<i>Olearia muelleri</i>	3	50	LSC01-04=
<i>Santalum acuminatum</i>	1.5	300	
<i>Sclerolaena diacantha</i>	0.1	5	LSC03-08
<i>Senna artemisioides</i>	0.25	60	LSC03-07
<i>Solanum nummularium</i>	0.1	30	LSC03-11
<i>Thysanotus manglesianus</i>	0.1	30	LSC01-07=
<i>Westringia rigida</i>	0.1	20	LSC03-13



LSC03 – Overstorey



LSC03 – Understorey

Site LSC04
 Described by SW, ABS Date 12-Aug-20 Type Quadrat 20 x 20 m
 MGA Zone 385560 mE 6409023 mN
 Habitat Undulating plain, flat with 0% gradient.
 Soil 5YR 5/4 orange loamy sand.
 Rock Type Gravel 1-25%.
 Vegetation *Eucalyptus salicola* open forest over *Alyxia buxifolia*, *Leucopogon* sp. outer wheatbelt (M. Hislop 30) tall open shrubland over *Beyeria sulcata* var. *sulcata*, *Acacia camptoclada*, *Olearia* sp. *Eremicola* (Diels & Pritzel s.n. PERTH 00449628) low open shrubland over *Lepidosperma* sp., sedgeland.
 Veg Condition Pristine.
 Fire Age No sign of recent fire.

Species	Cover (%)	Height (cm)	Specimen	Notes
<i>Acacia camptoclada</i>	1	120	LSC04-05	
<i>Alyxia buxifolia</i>	2	220	LSC01-10=	
<i>Austrostipa</i> sp.	0.1	10	LSC03-14=	
<i>Austrostipa</i> sp.	1	30	LSC01-16=	
<i>Beyeria sulcata</i> var. <i>sulcata</i>	4	110	LSC04-03	
<i>Eucalyptus salicola</i>	55	1200	LSC04-02	
<i>Exocarpos sparteus</i>	0.5	200	LSC04-07	
<i>Lepidosperma</i> sp.	31	45	LSC04-01	? <i>diurnum</i>
<i>Leucopogon</i> sp. outer wheatbelt (M. Hislop 30)	1	200	OPPABS-13=	
<i>Melaleuca hamata</i>	0.5	210	OPPABS-11=	
<i>Olearia muelleri</i>	0.1	30	LSC01-04=	
<i>Olearia</i> sp. <i>Eremicola</i> (Diels & Pritzel s.n. PERTH 00449628)	1	100	LSC04-04	
<i>Scaevola spinescens</i>	0.1	45	LSC02-03=	
<i>Westringia cephalantha</i> var. <i>cephalantha</i>	0.1	15	LSC04-06	



LSC04 – Overstorey



LSC04 – Understorey

Site LSC05
 Described by SW, ABS Date 13-Aug-20 Type Quadrat 20 x 20 m
 MGA Zone 384889 mE 6410253 mN
 Habitat Undulating plain sloping to WNW, 0-3% gradient, lower slope.
 Soil 5YR 3/4 dark reddish brown sandy clay loam.
 Rock Type Dolerite, quartz, limestone, dark red conglomerates.
 Vegetation *Eucalyptus dundasii*, *Eucalyptus lesouefii* open forest over *Eremophila scoparia*,
Cratystylis conocephala, *Exocarpos aphyllus* open shrubland over *Atriplex*
nummularia, *Rhagodia ulicina* low open shrubland.
 Veg Condition Pristine.
 Fire Age Very long unburnt.
 Notes Bare ground 5%. Leaf litter 95%

Species	Cover (%)	Height (cm)	Specimen
<i>Alyxia buxifolia</i>	0.1	50	LSC01-10=
<i>Atriplex nummularia</i>	3.5	80	LSC05-04
<i>Chenopodium nitrariaceum</i>	0.1	30	LSC05-09
<i>Cratystylis conocephala</i>	1.5	100	LSC05-03
<i>Eremophila deserti</i>	0.25	50	LSC05-10
<i>Eremophila scoparia</i>	1.75	180	LSC05-06
<i>Eucalyptus dundasii</i>	28	1500	LSC05-02
<i>Eucalyptus lesouefii</i>	17	1500	LSC05-01
<i>Exocarpos aphyllus</i>	1	100	LSC05-08
<i>Rhagodia ulicina</i>	1	50	LSC05-07
<i>Scaevola spinescens</i>	0.1	30	LSC02-03=
<i>Tecticornia halocnemoides</i> subsp. <i>caudata</i>	0.1	80	LSC05-05



LSC05 – Overstorey



LSC05 – Understorey

Site LSC06
 Described by SW, ABS Date 13-Aug-20 Type Quadrat 20 x 20 m
 MGA Zone 384609 mE 6409584 mN
 Habitat Sandplain, slopes towards lake in east in SE direction at 5% gradient. elevated rocky outcrop to the west (fair distance).
 Soil 7.5YR 4/3 and 3/3 brown clayey loam (small percentage of sand; 70% loam, 20% clay, 10% sand).
 Rock Type Scattered very fine quartz and sandstone. Surface layer of sandy granites, 1-25% pebble, 51-75% gravel.
 Vegetation *Eucalyptus dundasii* open forest over *Eucalyptus urna*, *Eucalyptus platycorys*, *Eucalyptus salubris* low woodland (juveniles) over *Dodonaea stenozyga*, *Acacia hemiteles* open shrubland over *Acacia merrallii*, *Eremophila ionantha*, *Ricinocarpus stylosus*, *Acacia camptoclada* low open shrubland over scattered herbs.
 Veg Condition Pristine.
 Fire Age Very long unburnt.
 Notes Fire 15-20 years.

Species	Cover (%)	Height (cm)	Specimen
<i>Acacia camptoclada</i>	1	65	LSC06-12
<i>Acacia erinacea</i>	0.25	40	LSC03-12=
<i>Acacia hemiteles</i>	1.5	190	LSC01-11=
<i>Acacia merrallii</i>	2	60	LSC06-07
<i>Billardiera lehmanniana</i>	0.1	130	LSC06-16
<i>Calotis hispidula</i>	0.1	5	LSC06-14
<i>Crassula</i> sp.	0.1	5	
<i>Dianella revoluta</i> var. <i>divaricata</i>	0.1	45	
<i>Dodonaea stenozyga</i>	4	110	LSC06-05
<i>Eremophila ionantha</i>	2	45	LSC06-09
<i>Eremophila scoparia</i>	0.1	40	LSC05-06=
<i>Eucalyptus dundasii</i>	18	1200	LSC06-01
<i>Eucalyptus platycorys</i>	9	350-400	LSC06-04
<i>Eucalyptus salubris</i>	9	350-400	LSC06-02
<i>Eucalyptus urna</i>	9	350-400	LSC06-03
<i>Exocarpos aphyllus</i>	0.1	60	LSC05-08=
<i>Grevillea acuaria</i>	0.1	30	OPPABS=
<i>Gunniopsis quadrifida</i>	0.1	10	LSC02-09=
<i>Melaleuca lanceolata</i>	0.1	30	LSC06-06
<i>Melaleuca teuthidoides</i>	0.5	140	LSC06-13
<i>Olearia muelleri</i>	0.1	10	LSC01-04=
<i>Pterostylis mutica</i>	0.1	15	LSC06-15
<i>Ricinocarpus stylosus</i>	0.1	40	LSC06-08
<i>Ricinocarpus stylosus</i>	2	45	LSC06-11
<i>Scaevola spinescens</i>	0.1	20	LSC02-03=
<i>Westringia rigida</i>	0.1	40	LSC06-10
<i>Westringia</i> sp.	0.1	25	LSC-SW06=



LSC06 – Overstorey



LSC06 – Understorey

Site LSC07
 Described by SW, ABS Date 13-Aug-20 Type Quadrat 20 x 20 m
 MGA Zone 384892 mE 6409559 mN
 Habitat Island; raised plain surrounded by salt lake and depression to the west.
 Soil 5YR 4/6 yellowish red sandy clay loam.
 Rock Type Scattered very fine quartz and sandstone. Surface layer of sandy granites; 1-25% pebble, 1-25% gravel.
 Vegetation *Eucalyptus salicola*, *Eucalyptus dundasii*, *Eucalyptus gracilis* open forest over *Exocarpos aphyllus*, *Alyxia buxifolia* tall open shrubland over *Cratystylis conocephala*, (*Acacia prainii*) open shrubland over *Dodonaea stenozyga*, *Chenopodium nitrariaceum*, *Olearia* sp. *Eremicola* (Diels & Pritzel s.n. PERTH 00449628), *Scaevola spinescens* low open shrubland over scattered herbs and sedges.
 Veg Condition Pristine.
 Fire Age No sign of recent fire.

Species	Cover (%)	Height (cm)	Specimen
<i>Acacia prainii</i>	0.5	180	LSC02-04=
<i>Alyxia buxifolia</i>	1	210	LSC01-10=
<i>Atriplex nana</i>	0.1	60	LSC07-11
<i>Calotis hispidula</i>	0.1	2	LSC07-07
<i>Chenopodium nitrariaceum</i>	1.5	25	LSC05-09=
<i>Cratystylis conocephala</i>	6	110	LSC05-03=
<i>Dodonaea stenozyga</i>	1.5	45	LSC06-05=
<i>Eremophila deserti</i>	0.1	40	LSC05-10=
<i>Eremophila psilocalyx</i>	0.1	110	LSC07-10
<i>Eremophila scoparia</i>	0.1	130	LSC05-06=
<i>Eucalyptus dundasii</i>	13	1200	LSC07-01
<i>Eucalyptus gracilis</i>	16	900	LSC07-03
<i>Eucalyptus salicola</i>	22	1300	LSC07-02
<i>Exocarpos aphyllus</i>	4	210	LSC07-06
<i>Grevillea acuaria</i>	0.1	30	OPPABS=
<i>Gunniopsis quadrifida</i>	0.1	15	LSC02-09=
<i>Olearia muelleri</i>	0.25	60	LSC01-04=
<i>Olearia</i> sp. <i>Eremicola</i> (Diels & Pritzel s.n. PERTH 00449628)	1	50	LSC07-05
<i>Podolepis capillaris</i>	0.1	10	LSC07-04
<i>Ptilotus holosericeus</i>	0.1	5	LSC07-13
<i>Scaevola spinescens</i>	1	20	LSC02-03=
<i>Sclerolaena diacantha</i>	0.1	5	LSC07-08
<i>Senna artemisioides</i>	0.1	100	LSC07-09
<i>Thysanotus manglesianus</i>	0.1	10	LSC01-07=
<i>Triglochin nana</i>	0.1	10	LSC07-12



LSC07 – Overstorey



LSC07 – Understorey

Site LSC08
 Described by SW, ABS Date 13-Aug-20 Type Quadrat 20 x 20 m
 MGA Zone 384849 mE 6409690 mN
 Habitat Salt lake margin, ~50 m away from raised *Eucalyptus* woodland.
 Soil 10%: 10YR 3/2 very dark grayish brown loamy sand (saline).
 25% 7.5YR 4/6 strong brown loamy sand.
 65% 7.5YR 5/4 very slightly brown loamy sand.
 Rock Type Salt
 Vegetation *Melaleuca subalaris* tall shrubland over *Tecticornia halocnemoides* subsp. *caudata*, *Maireana* sp., *Maireana amoena*, *Frankenia irregularis* low open samphire heath.
 Veg Condition Pristine.
 Fire Age No sign of recent fire.

Species	Cover (%)	Height (cm)	Specimen
<i>Chenopodium desertorum</i> subsp. <i>microphyllum</i>	0.1	10	LSC02-12=
<i>Exocarpos aphyllus</i>	0.1	45	LSC01-06=
<i>Frankenia irregularis</i>	3	15	LSC02-02=
<i>Maireana amoena</i>	3	20	LSC02-11=
<i>Maireana</i> sp.	9	20	LSC02-15=
<i>Melaleuca subalaris</i>	16	300	LSC02-05=
<i>Rhagodia ulicina</i>	0.1	10	LSC02-06=
<i>Roycea divaricata</i>	0.1	50	LSC08-01
<i>Tecticornia halocnemoides</i> subsp. <i>caudata</i>	27	60	LSC02-07=



LSC08 – Overstorey



LSC08 – Understorey

Site LSC09
 Described by SW, ABS Date 14-Aug-20 Type Quadrat 20 x 20 m
 MGA Zone 384387 mE 6409281 mN
 Habitat Plain, outcropping stone, 3-5% gradient slope towards east. Boulders on crest of hill 300m to the W, exposed basal outcropping, close to breakaway peak.
 Soil 7.5YR 4/4 brown loamy sand.
 Rock Type Basal, outcropping 10-25%.
 Vegetation *Eucalyptus spreta* low open woodland over *Melaleuca hamata*, (*Acacia hemiteles*) tall closed scrub over *Westringia cephalantha* var. *cephalantha*, *Melaleuca laxiflora*, *Eremophila maculata*., *Acacia andrewsii* low shrubland over scattered sedges, herbs and grasses.
 Veg Condition Pristine.
 Fire Age No sign of recent fire (fire age 10-15 years).

Species	Cover (%)	Height (cm)	Specimen	
<i>Acacia andrewsii</i>	1	60	LSC-SW11=	
<i>Acacia hemiteles</i>	3	200	LSC09-12	
<i>Allocasuarina campestris</i>	0.1	80	LSC09-14	
<i>Austrostipa</i> sp.	0.1	20	LSC09-13	
<i>Cryptandra wilsonii</i>	0.1	50	LSC09-17	
<i>Dianella revoluta</i> var. <i>divaricata</i>	0.1	100		
<i>Diuris</i> sp.	0.1	10		
<i>Eremophila maculata</i>	5	60	LSC09-03	
<i>Eucalyptus spreta</i>	6	250	LSC09-01	
<i>Grevillea acuaria</i>	0.25	20	LSC09-16	
<i>Lepidosperma</i> sp.	0.1	30	LSC09-15	? sp. Bandalup Scabrid
<i>Melaleuca hamata</i>	68	150		
<i>Melaleuca laxiflora</i>	7	60	LSC09-10	
<i>Phebalium tuberculosum</i>	0.1	40	LSC09-11	
<i>Pterostylis</i> sp.	0.1	0.1		
<i>Thysanotus patersonii</i>	0.1	30	LSC09-16a	
<i>Westringia cephalantha</i> var. <i>cephalantha</i>	13	60	LSC09-02	



LSC09 – Overstorey



LSC09 – Understorey

Site LSC10
 Described by SW, ABS Date 14-Aug-20 Type Quadrat 20 x 20 m
 MGA Zone 384254 mE 6408889 mN
 Habitat Low-lying secondary salt lake catchment, 0-3% gradient east to west, not well drained with signs of intermittent inundation.
 Soil 7.5YR 4/3 brown loamy sand (eastern half).
 7.5YR 4/6 strong brown weakly loamy sand (western half).
 Soil is heavily compacted below surface, with erosion to the west coming off the woodland (runoff). Algal mats present under top layer of white saline sandy soil.
 Vegetation *Melaleuca subalaris* tall open shrubland over *Tecticornia lylei*, *Melaleuca thyooides* shrubland over scattered low samphire shrubs.
 Veg Condition Pristine.
 Fire Age No sign of recent fire.

Species	Cover (%)	Height (cm)	Specimen
<i>Disphyma crassifolium</i>	0.1	10	
<i>Gunniopsis quadrifida</i>	0.1	30	LSC02-09=
<i>Maireana amoena</i>	0.5	20	LSC10-03
<i>Melaleuca subalaris</i>	3.5	300	LSC10-01
<i>Melaleuca thyooides</i>	9	120	LSC02-14=
<i>Tecticornia halocnemoides</i> subsp. <i>caudata</i>	0.25	40	LSC02-07=
<i>Tecticornia lylei</i>	16	120	LSC10-02



LSC10 – Overstorey

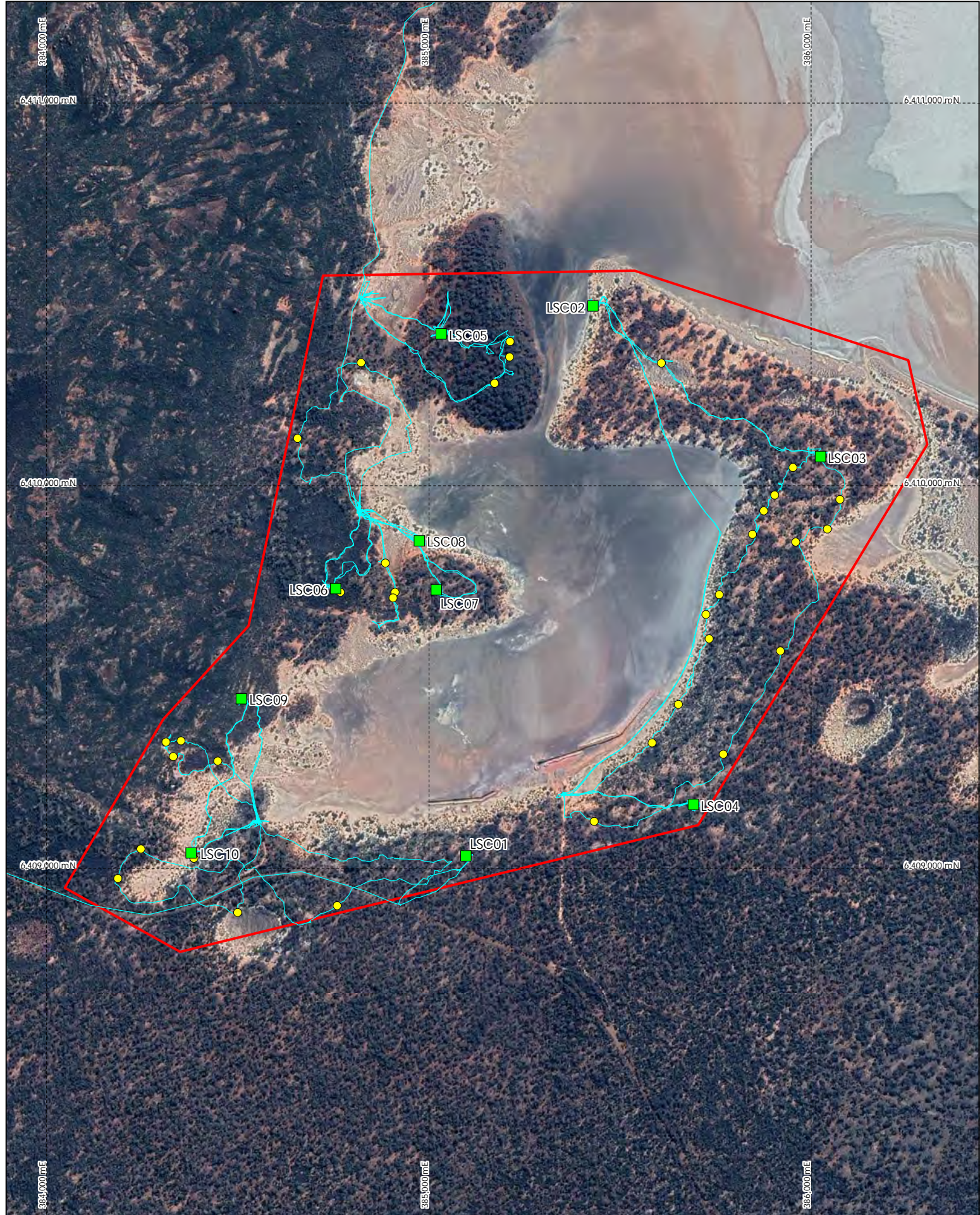


LSC10 – Understorey

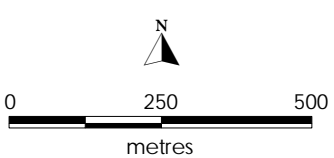
Appendix 6

Survey Effort

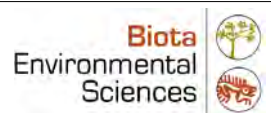




- Study area
- GPS tracklog
- Quadrat site location
- Mapping note location



Norseman Gold (Scotia) Survey Effort



Appendix 7

Combined Vascular Flora List from the Study area



Family	Name	Cons. Status	Biota (August 2020)	Mattiske (Autumn 2020)
Aizoaceae	<i>Disphyma crassifolium</i>		☑	
	<i>Gunniopsis glabra</i>		☑	
	<i>Gunniopsis quadrifida</i>		☑	
Amaranthaceae	<i>Ptilotus holosericeus</i>		☑	
	<i>Ptilotus obovatus</i>		☑	
Apocynaceae	<i>Alyxia buxifolia</i>		☑	☑
Asparagaceae	<i>Chamaexeros fimbriata</i>		☑	
	<i>Thysanotus manglesianus</i>		☑	
	<i>Thysanotus patersonii</i>		☑	
Asteraceae	<i>Calotis hispidula</i>		☑	
	<i>Cratystylis conocephala</i>		☑	
	? <i>Cratystylis conocephala</i>			☑
	<i>Hyalochlamys globifera</i>		☑	
	<i>Olearia muelleri</i>		☑	☑
	<i>Olearia</i> sp. <i>Eremicola</i> (Diels & Pritzel s.n. PERTH 00449628)		☑	☑
	<i>Podolepis capillaris</i>		☑	
	Asteraceae sp. (inadequate material)		☑	☑
Boraginaceae	<i>Halgania andromedifolia</i>		☑	
Boryaceae	<i>Borya constricta</i>		☑	
Brassicaceae	<i>Lepidium rotundum</i>		☑	
Casuarinaceae	<i>Allocasuarina acutivalvis</i> subsp. <i>acutivalvis</i>		☑	
	<i>Allocasuarina acutivalvis</i> (subsp. not determined)		☑	
	<i>Allocasuarina campestris</i>		☑	
Centrolepidaceae	<i>Centrolepis polygyna</i>		☑	
Chenopodiaceae	<i>Atriplex nana</i>		☑	

Family	Name	Cons. Status	Biota (August 2020)	Mattiske (Autumn 2020)
	<i>Atriplex nummularia</i>		☑	
	<i>Atriplex ?vesicaria</i>			☑
	<i>Chenopodium desertorum</i> subsp. <i>microphyllum</i>		☑	
	<i>Chenopodium nitrariaceum</i>		☑	
	<i>Enchylaena tomentosa</i>		☑	
	<i>Maireana amoena</i>		☑	
	<i>Maireana oppositifolia</i>		☑	
	<i>Maireana</i> sp. (inadequate material)		☑	
	<i>Rhagodia ulicina</i>		☑	
	<i>Roycea divaricata</i>		☑	
	<i>Sclerolaena diacantha</i>		☑	☑
	<i>Tecticornia halocnemoides</i> subsp. <i>caudata</i>		☑	
	<i>Tecticornia lylei</i>		☑	
	<i>Chenopodiaceae</i> sp.			☑
Colchicaceae	<i>Wurmbea tenella</i>		☑	
Crassulaceae	<i>Crassula</i> sp. (inadequate material)		☑	
Cupressaceae	<i>Callitris preissii</i>		☑	
Cyperaceae	<i>Lepidosperma ? lyonsii</i> (unable to be confirmed due to taxonomic revision)	P1	☑	
	<i>Lepidosperma</i> sp. (inadequate material and/or lack of taxonomic framework)		☑	☑
	<i>Cyperaceae</i> sp. (inadequate material)			☑
Droseraceae	<i>Drosera andersoniana</i>		☑	
Ericaceae	<i>Conostephium drummondii</i>			☑
	<i>Conostephium preissii</i>		☑	
	<i>Leucopogon</i> sp. Kau Rock (M.A. Burgman 1126)		☑	
	<i>Leucopogon</i> sp. outer wheatbelt (M. Hislop 30)		☑	

Family	Name	Cons. Status	Biota (August 2020)	Mattiske (Autumn 2020)
Euphorbiaceae	<i>Beyeria lechenaultii</i>		✓	
	<i>Beyeria sulcata</i> var. <i>sulcata</i>		✓	
Fabaceae	<i>Acacia acuminata</i>		✓	
	<i>Acacia andrewsii</i>		✓	
	<i>Acacia assimilis</i> subsp. <i>assimilis</i>			✓
	<i>Acacia camptoclada</i>		✓	
	<i>Acacia erinacea</i>		✓	
	<i>Acacia hemiteles</i>			
	<i>Acacia jibberdingensis</i>		✓	
	<i>Acacia lasiocalyx</i>		✓	
	<i>Acacia merrallii</i>		✓	✓
	<i>Acacia ?nyssophylla</i>			✓
	<i>Acacia pachypoda</i>		✓	
	<i>Acacia prainii</i>		✓	
	<i>Acacia</i> sp. (inadequate material)			✓
	<i>Bossiaea barbarae</i>		✓	✓
	<i>Bossiaea walkeri</i>		✓	
	<i>Daviesia argillacea</i>			✓
<i>Senna artemisioides</i>		✓		
Frankeniaceae	<i>Frankenia desertorum</i>		✓	
	<i>Frankenia irregularis</i>		✓	
Geraniaceae	<i>Erodium cygnorum</i>		✓	
Goodeniaceae	<i>Scaevola spinescens</i>		✓	✓
Hemerocallidaceae	<i>Dianella revoluta</i>			✓
	<i>Dianella revoluta</i> var. <i>divaricata</i>		✓	

Family	Name	Cons. Status	Biota (August 2020)	Mattiske (Autumn 2020)
Juncaginaceae	<i>Triglochin nana</i>		✓	
Lamiaceae	<i>Prostanthera grylloana</i>		✓	
	<i>Westringia cephalantha</i> var. <i>cephalantha</i>		✓	
	<i>Westringia rigida</i>		✓	
	? <i>Westringia rigida</i>			✓
	<i>Westringia</i> sp. (inadequate material)		✓	
Lauraceae	<i>Cassytha pomiformis</i>		✓	
Myrtaceae	<i>Eucalyptus aspratilis</i>		✓	
	<i>Eucalyptus dundasii</i>		✓	✓
	<i>Eucalyptus eremophila</i>		✓	
	<i>Eucalyptus</i> ? <i>flocktoniae</i> subsp. <i>flocktoniae</i>			✓
	<i>Eucalyptus gracilis</i>		✓	✓
	<i>Eucalyptus griffithsii</i>		✓	
	<i>Eucalyptus lesouefii</i>		✓	
	<i>Eucalyptus</i> ? <i>lesouefii</i>			✓
	<i>Eucalyptus salicola</i>		✓	
	<i>Eucalyptus</i> ? <i>salicola</i>			✓
	<i>Eucalyptus salubris</i>		✓	
	<i>Eucalyptus spreta</i>		✓	✓
	<i>Eucalyptus torquata</i>		✓	
	<i>Eucalyptus transcontinentalis</i>		✓	
	<i>Eucalyptus urna</i>		✓	
	<i>Eucalyptus</i> sp. (inadequate material)		✓	✓
	<i>Leptospermum incanum</i>		✓	
	<i>Melaleuca eleuterostachya</i>		✓	

Family	Name	Cons. Status	Biota (August 2020)	Mattiske (Autumn 2020)
	<i>Melaleuca hamata</i>		☑	
	<i>Melaleuca ?hamata</i>			☑
	<i>Melaleuca lanceolata</i>			☑
	<i>Melaleuca lateriflora</i>		☑	
	<i>Melaleuca laxiflora</i>		☑	
	<i>Melaleuca pauperiflora</i> subsp. <i>pauperiflora</i>		☑	
	<i>Melaleuca quadrifaria</i>		☑	
	<i>Melaleuca ?sheathiana</i>			☑
	<i>Melaleuca subalaris</i>		☑	
	<i>Melaleuca teuthidoides</i>		☑	
	<i>Melaleuca thyoides</i>		☑	
	<i>Melaleuca</i> sp. (inadequate material)		☑	
Orchidaceae	<i>Diuris hazeliae</i>		☑	
	<i>Diuris</i> sp. (inadequate material)		☑	
	<i>Pterostylis mutica</i>		☑	
	<i>Pterostylis sargentii</i>		☑	
	<i>Pterostylis setulosa</i>		☑	
	<i>Pterostylis</i> sp. (inadequate material)		☑	
Pittosporaceae	<i>Billardiera lehmanniana</i>		☑	☑
	<i>Pittosporum angustifolium</i>		☑	
	<i>Pittosporum</i> sp. (inadequate material)		☑	
Poaceae	<i>Aristida contorta</i>		☑	
	<i>Austrostipa juncifolia</i>		☑	
	<i>Austrostipa trichophylla</i>		☑	
	<i>Austrostipa</i> sp. (inadequate material)		☑	

Family	Name	Cons. Status	Biota (August 2020)	Mattiske (Autumn 2020)
	<i>Eragrostis dielsii</i>		☑	
	* <i>Pentameris airoides</i>		☑	
	Poaceae sp.			☑
Proteaceae	<i>Grevillea acuaria</i>		☑	☑
	<i>Grevillea cagiana</i>		☑	
	<i>Persoonia helix</i>		☑	
Pteridaceae	<i>Cheilanthes austrotenuifolia</i>		☑	
Rhamnaceae	<i>Cryptandra wilsonii</i>		☑	
Rutaceae	<i>Phebalium tuberculosum</i>		☑	
Santalaceae	<i>Exocarpos aphyllus</i>		☑	☑
	<i>Exocarpos sparteus</i>		☑	
	<i>Santalum acuminatum</i>		☑	☑
Sapindaceae	<i>Dodonaea lobulata</i>		☑	
	<i>Dodonaea microzyga</i> var. <i>acrolobata</i>		☑	
	<i>Dodonaea stenozyga</i>		☑	
Scrophulariaceae	<i>Eremophila decipiens</i> subsp. <i>decipiens</i>		☑	
	<i>Eremophila deserti</i>		☑	
	<i>Eremophila glabra</i> subsp. <i>glabra</i>		☑	
	<i>Eremophila ionantha</i>		☑	
	<i>Eremophila maculata</i> subsp. <i>brevifolia</i>		☑	
	<i>Eremophila maculata</i> (subsp. not determined)		☑	
	<i>Eremophila psilocalyx</i>		☑	
	<i>Eremophila ?psilocalyx</i>			☑
	<i>Eremophila purpurascens</i>	P3	☑	
	<i>Eremophila scoparia</i>		☑	☑

Family	Name	Cons. Status	Biota (August 2020)	Mattiske (Autumn 2020)
Solanaceae	<i>Solanum nummularium</i>		☑	
Stylidiaceae	<i>Stylidium dielsianum</i>		☑	
Thymelaeaceae	<i>Pimelea</i> sp. (inadequate material)		☑	
Zygophyllaceae	<i>Roepera apiculata</i>		☑	

**APPENDIX 5: BASIC VERTEBRATE FAUNA AND
TARGETED MALLEEFOWL SURVEY (WESTERN WILDLIFE
2020)**

Norseman Gold Project:

Basic Vertebrate Fauna Survey and Targeted Malleefowl Survey 2020



Prepared for: Pantoro Limited

Prepared by: Western Wildlife
8 Ridgeway Place
Mahogany Creek WA 6072
Ph 0427 510 934



February 2021

Executive Summary

Introduction

Pantoro South Pty Ltd (Pantoro) operate the Norseman Gold Project in the Goldfields region of Western Australia. As they propose to extend their mining footprint, Pantoro commissioned Western Wildlife to carry out a basic vertebrate fauna survey of the expansion areas and associated infrastructure in June 2020. Malleefowl (*Leipoa ocellata*) are known to occur in the region so the survey also included a component to target this species. After the basic survey was completed, the survey area was extended into adjacent areas. These additional areas were subject to a desktop survey, including habitat mapping, in January 2021.

The aims of the fauna survey were to:

- Identify the fauna habitats present in the study area.
- Survey the area for evidence of Malleefowl presence.
- List the vertebrate fauna that were recorded in the study area and/or have the potential to occur in the study area.
- Identify species of conservation significance, or habitats of particular importance for fauna, that potentially occur in the study area.

Methods

The fauna survey was undertaken in accordance with *Environmental factor guideline – terrestrial fauna* (EPA 2016), *Technical guidance: terrestrial vertebrate fauna surveys for environmental impact assessment* (EPA 2020) and relevant State and Federal Guidelines on surveying conservation significant fauna.

The desktop survey included searches of relevant databases, previous fauna reports and literature on the distribution, ecology and status of vertebrate fauna in the region.

The field survey was carried out on the 2nd - 6th June 2020, and included:

- Fauna habitat identification.
- Targeted survey for signs of the Malleefowl (*Leipoa ocellata*), walking 153km of transect.
- Keeping opportunistic records of all vertebrate fauna observed.

Species of conservation significance were classified as: **Threatened** if listed as Extinct in the Wild, Critically Endangered, Endangered or Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and/or *Biodiversity Conservation Act 2016* (BC Act); **Migratory** if listed as Migratory under the EPBC Act and/or BC Act, excluding those species also listed as threatened; **Specially Protected** if listed as Other Specially Protected Species or Conservation Dependent Fauna under the BC Act; **Priority** if listed as Priority by DBCA and **Locally Significant** if considered by the author to potentially be of local significance.

Results and Discussion

Fauna Habitats

Eight fauna habitats were identified across the study areas:

- Eucalypt woodland on rocky hills
- Eucalypt woodland on plains
- Mallee woodland over spinifex
- Shrubland on rocky hills
- Shrubland on sandy lake edges
- Gypsum dunes
- Chenopod shrubland
- Salt lake

The habitats present are common in the region. Habitats that are less common in the region, such as granite outcrops or freshwater wetlands, were absent from the study area. Although all habitats have importance in supporting native fauna, the habitats of the study area are unlikely to be of particular significance as ecological linkages, refugia or supporting important populations of conservation significant vertebrate fauna.

Faunal Assemblage

The faunal assemblage of the Study Area is likely to be largely intact, as the study area is situated within a larger tract of native vegetation. Many of the species that occur are widely distributed through semi-arid Australia. The predicted faunal assemblage includes up to seven frogs, 64 reptiles, 150 birds, 25 native mammals and eight introduced mammals. The observed assemblage on this survey included no frogs or reptiles, 46 birds and five introduced mammals.

Conservation Significant Fauna

Fifteen conservation significant fauna potentially occur in the Study Area; three Threatened, six Migratory, one Specially Protected and five Priority species.

Threatened Species

Three Threatened species potentially occur in the study area:

- Curlew Sandpiper (*Calidris ferruginea*) – EPBC Act (Critically Endangered and Migratory), BC Act (Critically Endangered)
- Chuditch (*Dasyurus geoffroii*) – EPBC Act (Vulnerable), BC Act (Vulnerable)
- Malleefowl (*Leipoa ocellata*) – EPBC Act (Vulnerable), BC Act (Vulnerable)

The Curlew Sandpiper may occur but is unlikely to be a regular visitor as it favours coastal environments. The Chuditch may occur in woodlands and shrublands in low densities, but there are very few records of this species in the region. The Malleefowl is known to occur in the region and may occur. However, no evidence of the Malleefowl was recorded in the study area despite 153km of transects walked, and dense shrubby habitats suitable for nesting were uncommon in the study area.

Migratory species

Six Migratory species potentially occur in the study area:

- Common Sandpiper (*Actitis hypoleucos*) – EPBC Act (Migratory), BC Act (Migratory)
- Sharp-tailed Sandpiper (*Calidris acuminata*) – EPBC Act (Migratory), BC Act (Migratory)
- Common Greenshank (*Tringa nebularia*) – EPBC Act (Migratory), BC Act (Migratory)
- Red-necked Stint – (*Calidris ruficollis*) – EPBC Act (Migratory), BC Act (Migratory)
- Pectoral Sandpiper (*Calidris melanotos*) – EPBC Act (Migratory), BC Act (Migratory)
- Fork-tailed Swift (*Apus pacificus*) – EPBC Act (Migratory), BC Act (Migratory)

Although Migratory shorebirds may occur on occasion, the salt lake habitat of the study area is unlikely to support nationally or internationally significant numbers of any species. The Fork-tailed Swift is a Migratory species that is thought to be almost entirely aerial when visiting Australia, so the study area is not likely to provide important habitat for this species.

Specially Protected species

One Specially Protected species potentially occurs in the study area:

- Peregrine Falcon (*Falco peregrinus*) – BC Act (Other Specially Protected)

The Peregrine Falcon is likely to occur as a foraging visitor and may breed in abandoned open pits.

Priority species

Five Priority species potentially occur in the study area, of which one was recorded:

- Lake Cronin Snake (*Paroplocephalus atriceps*) – Priority 3
- Hooded Plover (*Thinornis cucullata*) – Priority 4
- Inland Western Rosella (*Platycercus icterotis xanthagenys*) – Priority 4
- Central Long-eared Bat (*Nyctophilus major tor*) – Priority 3
- Western Brush Wallaby (*Notamacropus irma*) – Priority 4

The Lake Cronin Snake has a low likelihood of occurrence despite suitable habitat being present, as there are few records in the region and the study area is north of its current known range. The Hooded Plover is known to occur on Lake Dundas, and is likely to occur in salt lake habitats, at least on occasion. The Inland Western Rosella was recorded during this fauna survey and is likely to occur in eucalypt woodlands and shrublands, breeding in tree hollows. The Central Long-eared Bat is known to occur in the region and is likely to occur in eucalypt woodlands. The Western Brush Wallaby may occur in woodland and shrubland habitats, but the study areas represent the extreme eastern edge of this species range.

Table of Contents

Executive Summary	i
1. Introduction	1
1.1 The Study Area	1
1.2 Regional Context	1
1.2.1 Parks and Reserves	1
1.2.2 IBRA Bioregion	2
1.2.3 Botanical Province	5
1.2.4 Land Systems	5
1.2.5 Great Western Woodlands	5
1.3 Climate and Weather	7
2. Methods	8
2.1 Overview	8
2.2 Guidance and Licencing	8
2.3 Personnel	8
2.4 Taxonomy and Nomenclature	9
2.5 Literature Review	9
2.6 Field Studies	11
2.6.1 Basic Fauna Survey	11
2.6.2 Targeted Malleefowl Survey	11
2.7 Habitat Mapping	11
2.8 Likelihood of Occurrence	14
2.9 Assessing Conservation Significance of Fauna	15
2.9.1 Legislative Protection for Fauna	15
2.9.2 Levels of Conservation Significance in this report	17
3. Survey Limitations	17
4. Fauna Habitat	19
4.1 Fauna Habitats in the Study Areas	19
4.1.1 Eucalypt Woodland on Rocky Hills	28
4.1.2 Eucalypt Woodland on Plains	29
4.1.3 Mallee Woodland over Spinifex	31
4.1.4 Shrubland on Rocky Hills	31
4.1.5 Shrubland on Lake Edges	32
4.1.6 Gypsum Dunes	33
4.1.7 Chenopod Shrubland	33
4.1.8 Salt Lake	34
4.1.9 Cleared	34
5. Vertebrate Fauna of the Study Area	35
5.1. Vertebrate Fauna Assemblage	35
5.1.1 Amphibians	35
5.1.2 Reptiles	37
5.1.3 Birds	37
5.1.4 Mammals	39
5.2 Vertebrate Fauna of Conservation Significance	39
5.2.1 Threatened Fauna	40
5.2.2 Migratory Fauna	44
5.2.3 Specially Protected Fauna	46
5.2.4 Priority Fauna	47
5.2.5 Locally Significant Fauna	49
5.3 Important Habitats	49

6. Conclusions	50
7. References	51
Appendices	54
Appendix 1. Frogs that Potentially Occur in the Study Area	54
Appendix 2. Reptiles that Potentially Occur in the Study Area	55
Appendix 3. Birds that Potentially Occur in the Study Area	58
Appendix 4. Mammals that Potentially Occur in the Study Area	64
Appendix 5. EPBC Act Protected Matters Search Tool Results	66

LIST OF FIGURES, TABLES & PLATES

<i>Figure 1. Norseman Gold Project – Regional Location.</i>	3
<i>Figure 2. Norseman Gold Project - Reserves.</i>	4
<i>Figure 3. Norseman Gold Project – Land Systems.</i>	6
<i>Figure 4. Mean Monthly Temperature and Rainfall at Norseman Aero (data from Bureau of Meteorology 2020).</i>	7
<i>Figure 5. Norseman Gold Project – Transects.</i>	12
<i>Figure 6. Norseman Gold Project - Fauna Habitats (North Royal and Haul Roads).</i>	21
<i>Figure 7. Norseman Gold Project - Fauna Habitats (Gladstone).</i>	22
<i>Figure 8. Norseman Gold Project - Fauna Habitats (Cobbler).</i>	23
<i>Figure 9. Norseman Gold Project - Fauna Habitats (TSF4, OK and Camp).</i>	24
<i>Figure 10. Norseman Gold Project - Fauna Habitats (Maybelle).</i>	25
<i>Figure 11. Norseman Gold Project - Fauna Habitats (Scotia).</i>	26
<i>Figure 12. Norseman Gold Project - Fauna Habitats (Scotia Haul Road).</i>	27
<i>Figure 13. Norseman Gold Project – DBCA records of Conservation Significant Fauna.</i>	36
<i>Table 1. Study Areas</i>	2
<i>Table 2. Weather at Norseman Aero During and Prior to the Fauna Survey.</i>	7
<i>Table 3. Personnel Involved in the Fauna Survey.</i>	8
<i>Table 4. Databases used in the preparation of this report.</i>	9
<i>Table 5. Fauna Survey Limitations.</i>	18
<i>Table 6. Fauna Habitats in the Study Area.</i>	19
<i>Table 7. Summary of Vertebrate Fauna Potentially Occurring in the Study Area.</i>	35
<i>Table 8. Birds Recorded in the Study Areas.</i>	38
<i>Table 9. Summary of Conservation Significant Vertebrate Fauna.</i>	41
<i>Table 10. Flyway Population Estimates for Selected Migratory Shorebirds.</i>	44
<i>Plate 1. Eucalypt Woodlands on Rocky Hills (Maybelle).</i>	28
<i>Plate 2. Eucalypt Woodlands on Rocky Hills (Scotia).</i>	28
<i>Plate 3. Eucalypt Woodlands on Plains (TSF4).</i>	29
<i>Plate 4. Eucalypt Woodland on Plains (Scotia).</i>	29
<i>Plate 5. Recently burnt Eucalypt Woodlands (Scotia).</i>	30
<i>Plate 6. Eucalypt Woodland on Plains (Gladstone).</i>	30
<i>Plate 7. Eucalypt Woodland on Plains (North Royal).</i>	30
<i>Plate 8. Mallee Woodland over Spinifex (North Royal Haul Road).</i>	31
<i>Plate 9. Shrubland on Rocky Hills (Scotia and Maybelle).</i>	31
<i>Plate 10. Shrubland on Lake Edges (Gladstone).</i>	32
<i>Plate 11. Shrubland on Lake Edges (North Royal).</i>	32
<i>Plate 12. Gypsum Dunes (Gladstone).</i>	33
<i>Plate 13. Chenopod shrubland (Cobbler and Gladstone).</i>	33
<i>Plate 14. Salt Lake.</i>	34

1. Introduction

Pantoro South Pty Ltd (Pantoro) operate the Norseman Gold Project in the Goldfields region of Western Australia. As they propose to extend their mining footprint, Pantoro commissioned Western Wildlife to carry out a basic vertebrate fauna survey of the expansion areas and associated infrastructure in June 2020. Malleefowl (*Leipoa ocellata*) are known to occur in the region so the survey also included a component to target this species. After the basic survey was completed, the survey area was extended into adjacent areas. These additional areas were subject to a desktop survey, including habitat mapping, in January 2021.

The aims of the fauna survey were to:

- Identify the fauna habitats present in the study area.
- Survey the area for evidence of Malleefowl presence.
- List the vertebrate fauna that were recorded in the study area and/or have the potential to occur in the study area.
- Identify species of conservation significance, or habitats of particular importance for fauna, that potentially occur in the study area.

This report details the combined findings of the desktop survey, basic fauna survey and targeted Malleefowl survey conducted between June 2020 and January 2021.

1.1 The Study Area

The Norseman Gold Project is located in the Shire of Dundas in the Goldfields region of Western Australia. The study area is in the vicinity of the town of Norseman and about 160km south of Kalgoorlie (Figure 1). The overall study area is comprised of several separate areas and their associated infrastructure corridors (Table 1). The original extent of the study area as specified in June 2020 (3,199.80ha) was subject to a basic fauna survey and targeted Malleefowl survey. The additional 980.4ha were subject to a desktop survey, including habitat mapping, to bring the total study area to 4,180.20ha.

1.2 Regional Context

1.2.1 Parks and Reserves

The study area overlaps several reserves, including an un-named Conservation Reserve of 930ha (Figure 2). The southern boundary of the 2,610 ha Brockway Forest Reserve is adjacent to the Maybelle Haul Road and the very large 780,000 ha Dundas Nature Reserve is located 10km east of the Scotia study area.

Table 1. Study Areas

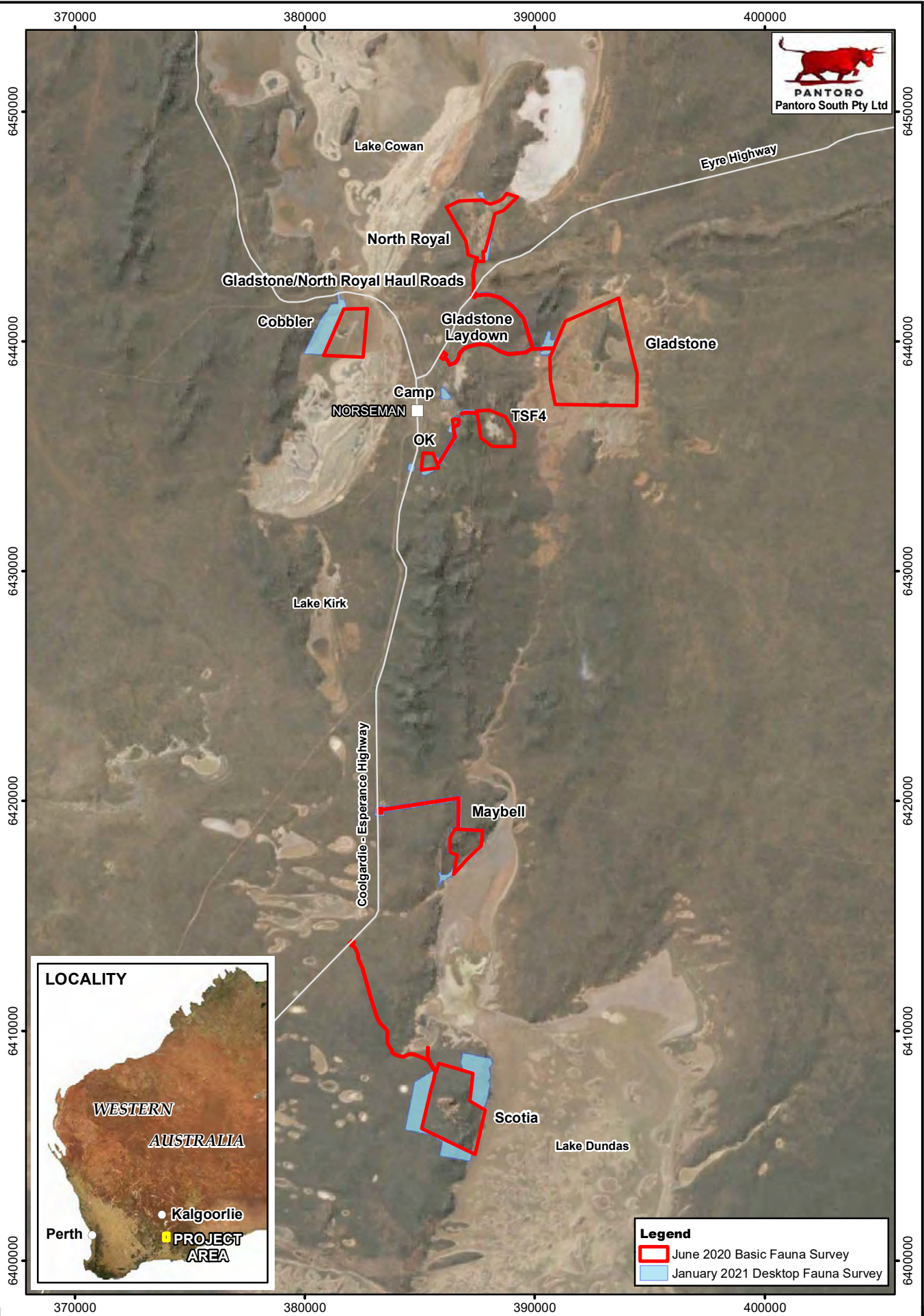
Study Area	Proposed development	Area (ha)
North Royal	Open pit and dewatering	406.45
Gladstone	Open pits, de-watering pipeline (6.8km)	1,430.76
North Royal – Gladstone Haul Road	Haul roads	29.11
Cobbler	Lake-based open pit	476.25
TSF4	Tailings storage facility, pipelines (0.9km)	216.51
OK	Underground mine waste rock dump expansion, de-watering pipelines (1.9km)	120.34
Camp	Accommodation village	14.84
Maybelle	Open pits, haul road (4.8km)	312.33
Scotia	Open pits, haul road (7.4km)	1,173.62
Total Area:		4,180.20

1.2.2 IBRA Bioregion

The Interim Biogeographic Regionalisation for Australia (IBRA) classifies the land surface of Australia into 89 Bioregions and 419 subregions, each defined by a set of environmental influences that impact the occurrence of flora and fauna and their interaction with the physical environment (DoEE 2018).

The study area lies in the Eastern Goldfields Subregion (COO3) of the Coolgardie Bioregion of the IBRA classification system (DoEE 2018). The subregion is characterised by gently undulating plains with low greenstone hills in the east and a series of large playa lakes (Cowan 2001). The vegetation is dominated by mallees, *Acacia* thickets and shrublands, with diverse eucalypt woodlands on the ridges, valleys and around salt lakes (Cowan 2001). The salt lakes also support low samphire shrublands (Cowan 2001).

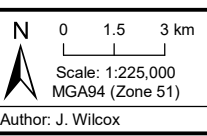
Special fauna values of this subregion include Rowles Lagoon, Clear and Muddy Lakes, a large system of semi-permanent freshwater wetlands that supports up to 41 species of waterbird, and Swan Lake, a semi-permanent freshwater lake in which water persists longer than on surrounding lakes, thus providing a refuge for waterbirds (Cowan 2001).



Legend	
	June 2020 Basic Fauna Survey
	January 2021 Desktop Fauna Survey

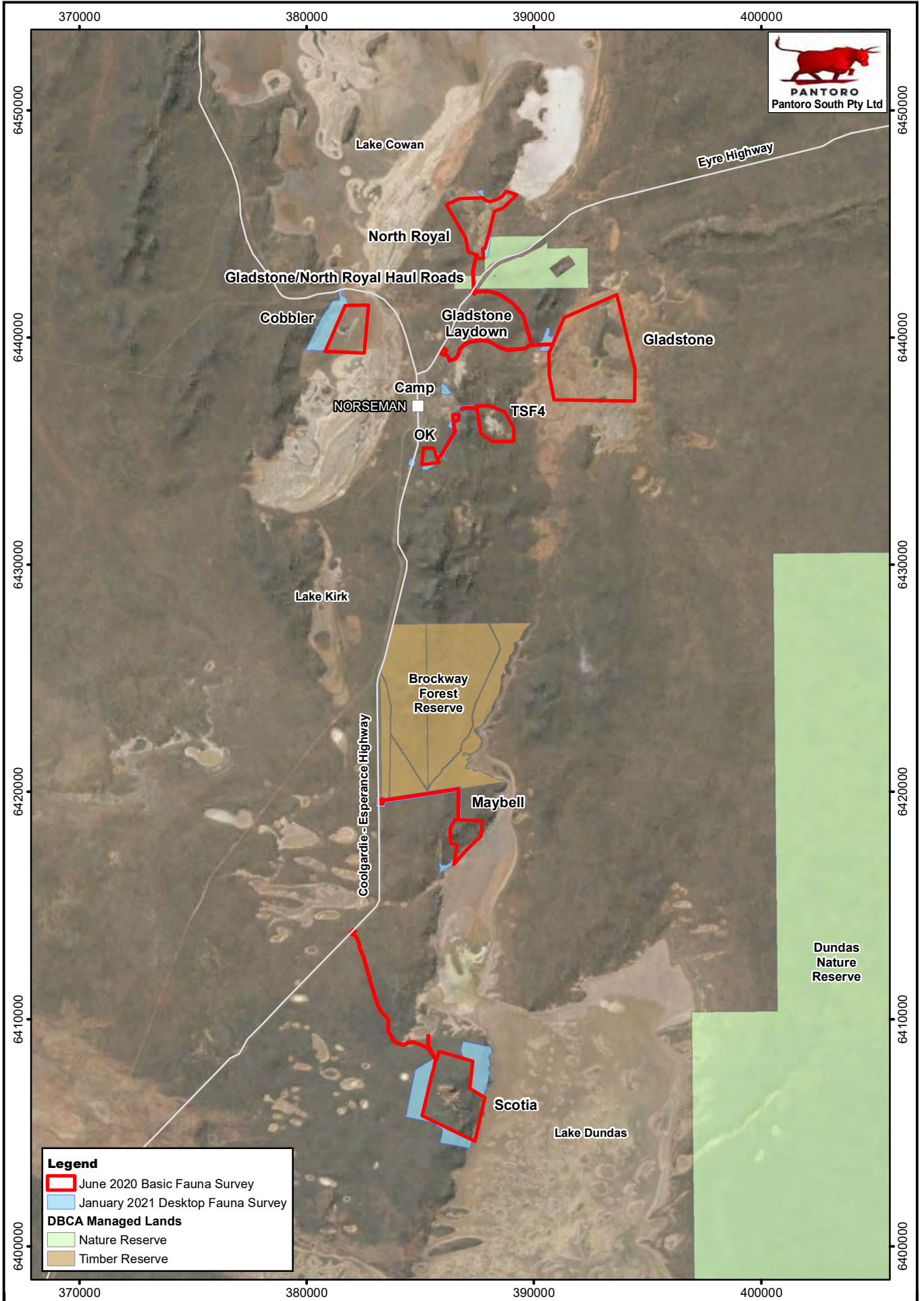
Image: DigitalGlobe (27/11/2016)

Drawn: CAD Resources
 www.cadresources.com.au
 Tel: (08) 9246 3242
 CAD Ref: a2783Fa001 | A4
 Date: February 2021 | Rev: B | Author: J. Wilcox



Norseman Gold Project Regional Location

Figure: 1



Legend

- June 2020 Basic Fauna Survey
- January 2021 Desktop Fauna Survey
- DBCAs Managed Lands**
- Nature Reserve
- Timber Reserve

Image: DigitalGlobe (27/11/2016)

Drawn: CAD Resources
 www.cadresources.com.au
 Tel: (08) 9246 3242
 CAD Ref: a2783Fa002 | A4
 Date: February 2021 | Rev: B | Author: J. Wilcox

N 0 1.5 3 km
 Scale: 1:225,000
 MGA94 (Zone 51)

Western Wildlife

Norseman Gold Project Reserves

Figure: **2**

1.2.3 Botanical Province

The Botanical Provinces are determined by vegetation mapping (Beard 1980) and broadly correspond to climactic regions; the Southwest (Bassian) Province experiencing warm dry summers and cool wet winters, the Northern Province experiencing warm wet summers and cool dry winters and the Eremaean Province experiencing low, irregular rainfall. The study area is in Southwest Interzone, the transitional area between the Bassian and Eremaean Provinces.

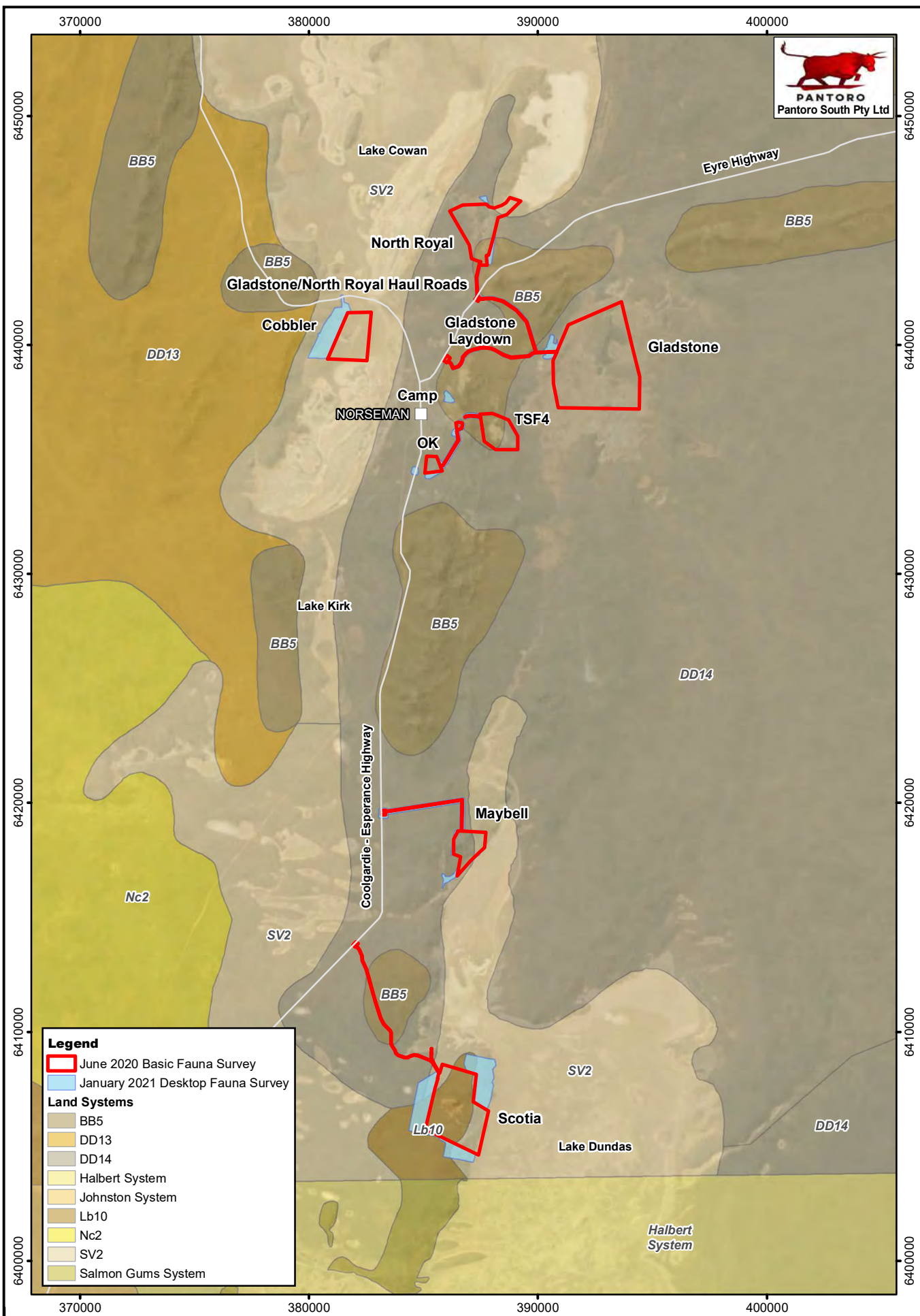
1.2.4 Land Systems

Land systems are broad descriptions of landform, geology and soils. The study areas intersect four land systems (Figure 3), which are characterised as follows:

- **DD14:** Flat to undulating land with small valleys occasionally broken by low narrow rocky hills and ridges, or tors and bosses.
- **BB5:** Rocky ranges and hills of greenstones – basic igneous rocks.
- **Lb10:** Gently undulating plains with some granitic bosses and tors; acid clays common below surface.
- **SV2:** Saline valleys with some dunes including barchan forms – salt lake channels, mostly devoid of true soils, and their fringing areas.

1.2.5 Great Western Woodlands

The study areas are within the Great Western Woodlands (GWW), a 16-million-hectare area extending from the wheatbelt to the edge of the deserts that is the largest intact area of Mediterranean Woodland on earth (DEC 2010). The GWW includes open eucalypt woodlands (63%), mallee eucalypt woodlands, shrublands and grasslands (Fox *et al.* 2016). Less common habitats in the GWW include granite outcrops, banded ironstone formations, salt lakes and freshwater wetlands (Fox *et al.* 2016). The relative intactness of the GWW is recognised as a key value (Fox *et al.* 2016), in that it provides connectivity for birds in a landscape that varies both spatially and temporally. The south-western half of the GWW provides habitat for many birds that are locally extinct or have reduced populations in the adjacent and substantially cleared wheatbelt (Fox *et al.* 2016).



Legend

- June 2020 Basic Fauna Survey
- January 2021 Desktop Fauna Survey

Land Systems

- BB5
- DD13
- DD14
- Halbert System
- Johnston System
- Lb10
- Nc2
- SV2
- Salmon Gums System

Image: DigitalGlobe (27/11/2016)

Drawn: CAD Resources
 www.cadresources.com.au
 Tel: (08) 9246 3242
 CAD Ref: a2783Fa003 | A4
 Date: February 2021 | Rev: B | Author: J. Wilcox

N 0 1.5 3 km
 Scale: 1:225,000
 MGA94 (Zone 51)

Western Wildlife

Norseman Gold Project Land Systems

Figure:
3

1.3 Climate and Weather

The climate of the IBRA subregion is arid to semi-arid with 200 – 300mm annual rainfall, usually in winter (Cowan 2001). The climate statistics for Norseman Aero (Bureau of Meteorology Weather Station 012009) are presented in Figure 4. This weather station has been in operation since 1999, so the longterm monthly rainfall is an average based on 20 years of data. The annual rainfall over this period averages 289.4mm and the annual rainfall in 2019 was below average at 210.4mm. The rainfall in the months prior to the fauna survey were below average, except for March 2020. Weather during the fauna survey ranged from warm and dry to cool and wet, although the short showers of rain did not register at the Norseman Aero Weather Station (Table 2).

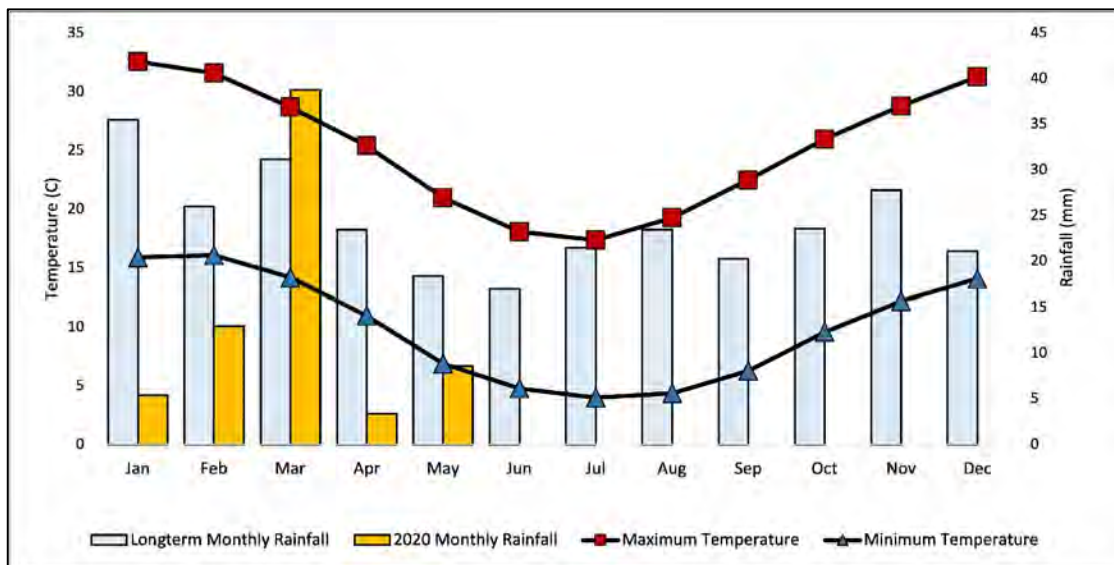


Figure 4. Mean Monthly Temperature and Rainfall at Norseman Aero (data from Bureau of Meteorology 2020).

Table 2. Weather at Norseman Aero During and Prior to the Fauna Survey.

Month	Date	Minimum Temperature °C	Maximum Temperature °C	Rainfall (mm)	Survey Dates
May	29	5.6	21.7	0	
	30	7.8	14.7	7.2	
	31	9.3	19.1	0	
June	1	4.0	19.2	0	
	2	2.3	19.5	0	+
	3	5.6	20.7	0	+
	4	5.4	24.4	0	+
	5	7.9	25.2	0	+
	6	7.1	22.6	0	+



2. Methods

2.1 Overview

The fauna survey included a search of available literature and databases (a ‘desktop’ study), and a field survey. The desktop study was undertaken for the entire 4,180.20ha study area and the field survey was undertaken over the 3,199.80ha area indicated in Figure 1. The field survey comprised a five-day site visit in June 2020 including the following two components: a basic vertebrate fauna survey and a targeted Malleefowl survey. The field survey served to put the desktop study into context, as well as allowing for the identification of fauna habitats and likely fauna assemblages of the site. The targeted survey was designed to provide additional data on a key Threatened species known to occur in the region.

2.2 Guidance and Licencing

The fauna survey was conducted with reference to the following documents:

- Environmental factor guideline – terrestrial fauna (EPA 2016)
- Technical guidance: terrestrial vertebrate fauna surveys for environmental impact assessment (EPA 2020)
- Survey guidelines for Australia’s threatened birds (DEWHA 2010)

As the fauna survey was observational only, no Fauna Taking (Biological Assessment) Licence was required.

2.3 Personnel

Two zoologists from Western Wildlife carried out the fauna survey (Table 3). Each has many years’ experience in fauna studies, have previously undertaken surveys in the bioregion and have undertaken targeted surveys for Malleefowl.

Table 3. Personnel Involved in the Fauna Survey.

Name	Role	Qualification	Experience
Jenny Wilcox	Supervising Zoologist (plan and lead fieldwork, prepare report)	BSc.Biol./Env.Sci., Hons.Biol.	20 years
Brenden Metcalf	Field zoologist (collect data)	BSc.Biol./Env.Sci., Hons.Biol.	20 years

2.4 Taxonomy and Nomenclature

Taxonomy and nomenclature for fauna species used in this report follow the Western Australian Museum checklists, last updated in April 2020.

2.5 Literature Review

Lists of fauna expected to occur in the study area were produced using information from a number of sources. These included publications that provide information on general patterns of distribution of frogs (Tyler *et al.* 2000), reptiles (Storr *et al.* 1983, 1990, 1999 and 2002, Wilson and Swan 2017), birds (Barrett *et al.* 2003; Johnstone and Storr 1998; Johnstone and Storr 2004) and mammals (Churchill 2007, Menkhorst and Knight 2011; Van Dyck and Strahan 2008).

The databases in Table 4 were searched for fauna records in and around the study area. Some species may occur on database results that are not likely to be present in the study area, usually due either to lack of suitable habitat or the study area being outside the known range of the species (i.e. erroneous records or records of vagrants). Where possible, these species are not included in lists of expected fauna.

Table 4. Databases used in the preparation of this Report.

Database	Type of records held on database	Area searched
Western Australian Museum Specimen Database (DBCA 2007-)	Records of specimens held in the WA Museum. Includes historical data.	40km surrounding 32.273°S, 121.780°E.
Fauna Survey Returns Database (DBCA 2007-)	Records of fauna captured, observed or inferred from secondary evidence during fauna surveys.	40km surrounding 32.273°S, 121.780°E.
Birds Australia Atlas Database (DBCA 2007-)	Records of bird observations in Australia, 1998-2009.	40km surrounding 32.273°S, 121.780°E.
Birdata (DBCA 2007-)	Records of bird observations in Australia, 2010-current.	40km surrounding 32.273°S, 121.780°E.
DBCA's Threatened and Priority Fauna Database (DBCA 2020)	Records of Threatened and Priority species in Western Australia, also drawing from the databases above.	100km surrounding 386244 E, 6426452 N (Zone 51)
EPBC Act Protected Matters Search Tool	Records on matters protected under the EPBC Act, including Threatened species.	20km surrounding 32.273°S, 121.780°E.

In addition, the results of the following fauna survey reports were used to compile the fauna lists:



- *The Biological Survey of the Eastern Goldfields of Western Australia Part 9: Norseman Balladonia Study Area* (Hall and McKenzie 1993). One of the sites in this study, at Jyndabinbin Rocks in Dundas Nature Reserve, is located about 45km east of the study area. The survey was undertaken in October 1979, August 1980 and February 1989.
- *Fauna Survey of the Proposed Harlequin Gold Mine Development Site* (Halpern Glick Maunsell 1994). The Harlequin Gold Mine is adjacent to the Slippers survey area. The survey was undertaken in February 1994 and comprised four trapping sites (two with six pitfall traps, 12 Elliott traps and two cage traps; two with 12 Elliott traps only), spot-lighting, hand-searching and bird surveys. A total of seven reptiles, 36 birds, three or four native mammals and two introduced mammals were recorded. No species currently listed as conservation significant were recorded.
- *Fauna Monitoring Program: Baseline Fauna Survey 1998 – 1999* (Ecologia 1999). The survey sites in this study are in the vicinity of the Cobbler, Slippers and Gladstone study areas. The survey was undertaken in October 1998 and March 1999 and comprised eleven trapping sites (each with five pitfall traps and 20 Elliott traps), spot-lighting, hand-searching, mist-netting for bats and bird surveys. A total of six frogs, 42 reptiles, 82 birds 13 native mammals and five introduced mammals were recorded. One species of conservation significance was recorded; the Peregrine Falcon (*Falco peregrinus*).
- *Mt Henry Study Area Baseline Fauna Survey: Level 2 Fauna Survey 2012 & 2013* (Western Wildlife 2013). This survey overlaps the Maybelle study area. The survey was undertaken in November 2012 and February 2013 and comprised trapping at ten sites (each with ten pitfalls, ten funnel traps, ten Elliott traps and two cage traps), spot-lighting, bat survey with bat detectors and mist-nets and bird surveys. A total of one frog, 44 reptiles, 74 birds 13 native mammals and seven introduced mammals were recorded. Four species currently listed as conservation significant were recorded; the Peregrine Falcon (*Falco peregrinus*), Inland Western Rosella (*Platycercus icterotis xanthogenys*), Red-necked Stint (*Calidris ruficollis*) and Hooded Plover (*Thinornis cucullata*). Long-inactive Malleefowl (*Leipoa ocellata*) mounds were also recorded.
- *Flora, vegetation and vertebrate fauna survey on proposed tailings dam* (Mattiske Consulting Pty Ltd and Ninnox Wildlife Consulting 2005). This survey overlaps the TSF4 study area. The survey was undertaken in February 2005 and comprised opportunistic observations only. A total of one reptile, 21 birds, one native mammal and two introduced mammals were recorded. No species currently listed as conservation significant were recorded.
- *Report for Brockway Exploration Area: Flora and Fauna Assessment May 2010* (GHD 2010). This survey was in the Brockway Forest Reserve, located between Norseman and the Maybelle study area. The survey was undertaken in May 2010 and comprised opportunistic observations only. A total of seven reptiles, 31 birds, three native mammal and four introduced mammals were recorded. No species currently listed as conservation significant were recorded.



- *Baseline Environmental Study: Lake Cowan Outback Ecology (2003)*. This survey was undertaken on Lake Cowan in June 2003 and comprised a targeted waterbird survey. Four species were recorded; the Hooded Plover (3 birds), Red-capped Plover (30 birds), Pink-eared Duck (6 birds) and Australian Shelduck (50 birds). One species currently listed as conservation significant was recorded; the Hooded Plover.
- *Biological Monitoring of Lake Cowan, January 2006 (Outback Ecology 2006)*. This survey was undertaken on Lake Cowan in June 2003 and comprised a targeted waterbird survey and opportunistic observations of fauna. A total of 1 reptile, 23 species of bird, one native mammal and 5 introduced mammals were recorded. No species currently listed as conservation significant were recorded.

2.6 Field Studies

2.6.1 Basic Fauna Survey

The basic fauna survey was undertaken in the areas indicated on Figure 5.

The field study component of a basic fauna survey aims to inventory, so far as possible, the habitats and vertebrate fauna present on the site. As no trapping is undertaken, observations of fauna are restricted to larger diurnal species such as birds, and evidence of other species such as tracks, scats and diggings. The site was surveyed on the 2nd - 6th June 2020. All vertebrate fauna encountered were recorded and notes were made on the fauna habitats present on the site.

2.6.2 Targeted Malleefowl Survey

The targeted fauna survey was undertaken in the areas indicated on Figure 5.

Malleefowl were targeted by walking transects across a proportion of each study area, totalling approximately 153 km (Figure 5). Any mounds identified were recorded with a GPS location, photograph, description of the habitat, estimated age of the mound and any evidence of shell fragments. Excavations or diggings that were not used for nesting (i.e. the mound attempt abandoned or site deemed unsuitable by the Malleefowl) were also recorded as evidence of Malleefowl activity in the area.

2.7 Habitat Mapping

Habitat mapping was undertaken for the entire study area using existing vegetation mapping (Mattiske Consulting 2020a and 2020b), observations made by fauna personnel in the field and interpretation of aerial photography. CAD Resources produced the maps from shapefiles and information provided by Western Wildlife.

Elements of each habitat likely to be important for fauna were identified. Important habitat elements may include, but are not limited to, rocky crevices, caves, tree hollows, tree crevices, accumulations of leaf litter or sands suitable for burrowing.



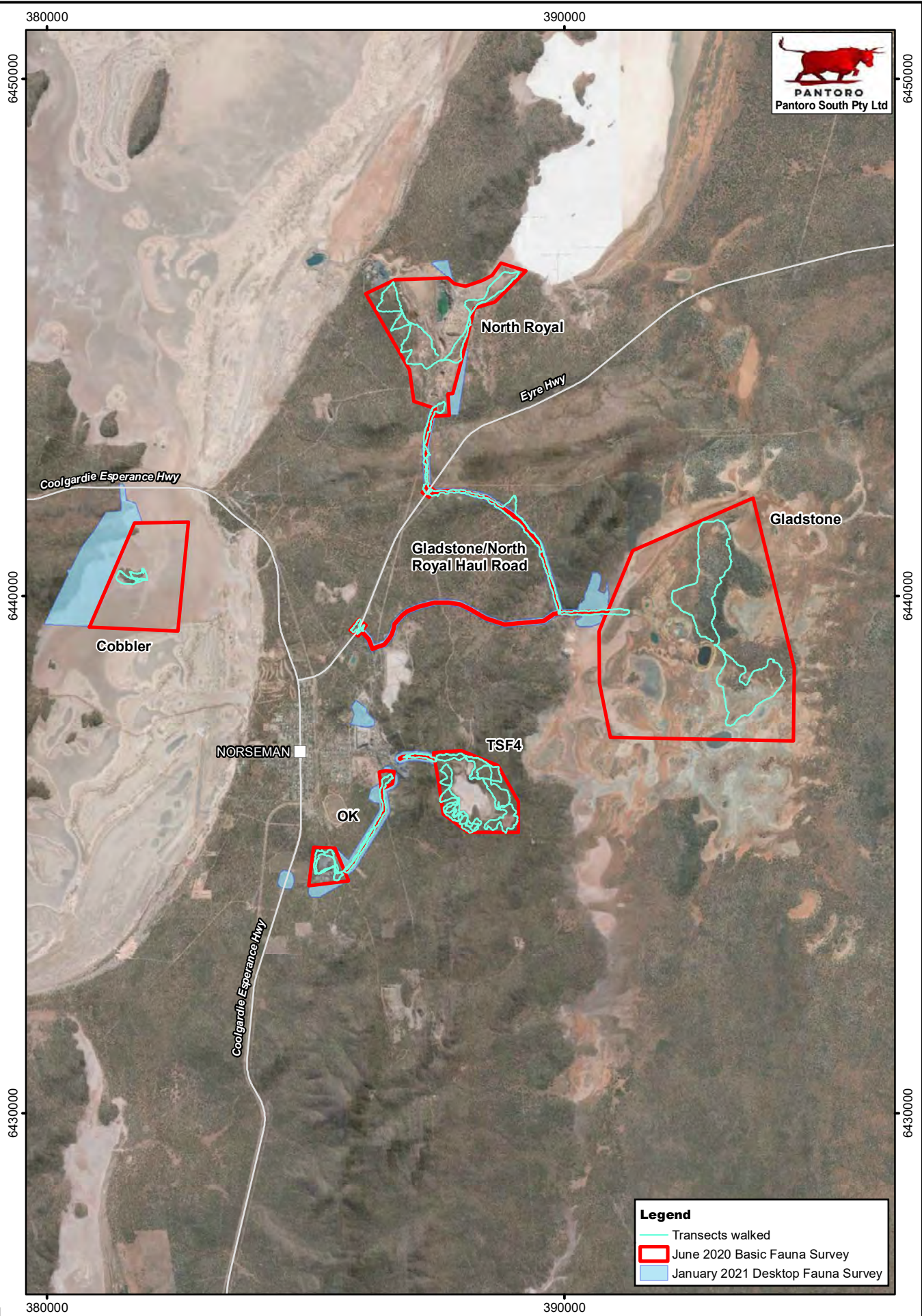
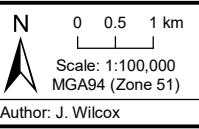


Image: DigitalGlobe (27/11/2016)

Drawn: CAD Resources
 www.cadresources.com.au
 Tel: (08) 9246 3242
 CAD Ref: a2783Fa005 | A4
 Date: February 2021 | Rev: B | Author: J. Wilcox



**Norseman Gold Project
 Transects
 Sheet 1 of 2**

Figure:
5

380000

390000



6420000

6420000

6410000

6410000



Legend

- Transects walked
- June 2020 Basic Fauna Survey
- January 2021 Desktop Fauna Survey

380000

390000

Image: DigitalGlobe (27/11/2016)

Drawn: CAD Resources
 www.cadresources.com.au
 Tel: (08) 9246 3242

CAD Ref: a2783Fa005	A4
Date: February 2021	Rev: B

N 0 0.5 1 km
 Scale: 1:100,000
 MGA94 (Zone 51)

Western Wildlife

**Norseman Gold Project
 Transects
 Sheet 2 of 2**

Figure:
5

2.8 Likelihood of Occurrence

Fauna of conservation significance were assessed and ranked for their likelihood of occurrence in the study area, according to the following criteria:

- **Very Low:** The study area is outside the current known distribution of the species as presented in the literature; no suitable habitat was identified as being present during the field survey; for some species, individuals may occur occasionally as vagrants, especially if suitable habitat is located nearby, but the study area itself would not support the species; includes species generally accepted as being locally extinct.
- **Low:** The study area is within or just outside the current known distribution of the species, as presented in the literature; any habitat present is either limited in extent or of marginal quality at best; no recent or nearby records of the species on databases; the species is generally known to be less common in the vicinity of the study area (e.g. for inland sites, where the species usually occurs on the coast).
- **Moderate:** The study area is within the current known distribution of the species, as presented in the literature; habitat of reasonable quality was identified as being present during the field survey; some recent and/or nearby records of the species of databases;
- **High:** The study area is well within the current known distribution of the species, as presented in the literature; habitat of good quality was identified as being present during the field survey; many recent and nearby records of the species on databases.
- **Known to Occur:** The species was positively identified in the study area during this field survey or recorded as occurring in the study area on previous recent field surveys. Note that for a species 'known to occur', the habitat may still be marginal and therefore the population may be small, or the species may visit the site irregularly.



2.9 Assessing Conservation Significance of Fauna

2.9.1 Legislative Protection for Fauna

The Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) is the Commonwealth Government's primary piece of environmental legislation. Listed under Part 3 of the EPBC Act are 'Matters of National Environmental Significance' (MNES); these include threatened species, threatened ecological communities and migratory species. Threatened fauna species are assessed against categories based on International Union for Conservation of Nature (IUCN) criteria.

The migratory species listed under the EPBC Act are those recognised under international agreements. These agreements are the China-Australia Migratory Bird Agreement (CAMBA), the Japan-Australia Migratory Bird Agreement (JAMBA), the Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA), or species listed under the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) for which Australia is a range state.

Matters of National Environmental Significance (MNES) include the following categories:

- **Extinct in the wild (EW):** Taxa known to survive only in captivity.
- **Critically Endangered (Cr):** Taxa facing an extremely high risk of extinction in the wild in the immediate future.
- **Endangered (En):** Taxa facing a very high risk of extinction in the wild in the near future.
- **Vulnerable (Vu):** Taxa facing a very high risk of extinction in the wild in the medium-term future.
- **Migratory (Mi):** Taxa listed under international agreements to which Australia is a party.

Reports on the conservation status of most vertebrate fauna species were produced in the form of Action Plans by the Department of Agriculture, Water and the Environment (DAWE). An Action Plan is a review of the conservation status of a taxonomic group against IUCN categories. Action Plans have been prepared for amphibians (Tyler 1998), reptiles (Cogger *et al.* 1993), birds (Garnett *et al.* 2011) and mammals (Woinarski *et al.* 2014). These publications also use categories similar to those used by the EPBC Act. The information presented in some of the earlier Action Plans may be out of date due to changes since publication.

The *Biodiversity Conservation Act 2016* (BC Act) is State legislation that aims to conserve and protect biodiversity and biodiversity components in Western Australia, including threatened fauna. It is administered by the Department of Biodiversity, Conservation and Attractions (DBCA). In addition to threatened fauna, the BC Act has scope to protect threatened ecological communities and important habitats.

Fauna species are listed under the BC Act as threatened species using IUCN categories, or as specially protected species, as described below.



Threatened Species:

- **Extinct in the wild (EW):** Taxa known to survive only in captivity.
- **Critically Endangered (Cr):** Taxa facing an extremely high risk of extinction in the wild in the immediate future.
- **Endangered (En):** Taxa facing a very high risk of extinction in the wild in the near future.
- **Vulnerable (Vu):** Taxa facing a very high risk of extinction in the wild in the medium-term future.

Specially Protected Species:

- **Migratory (Mi):** A subset of the migratory fauna that are known to visit Western Australia that are protected under the international agreements or treaties, excluding species that are listed as Threatened species.
- **Conservation dependent fauna (CD):** Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened
- **Other specially protected species (OS):** fauna in need of special protection to ensure their conservation.

The BC Act supersedes the *Western Australian Wildlife Conservation Act 1950* (WC Act).

Priority species are not listed under State or Commonwealth Acts. In Western Australia, DBCA maintains a list of Priority Fauna made up of species that are possibly Threatened but do not meet adequacy of survey requirements or are otherwise data deficient. There are four levels of Priority as defined by DBCA, as listed below.

- **Priority 1:** Poorly known species (on threatened lands)
- **Priority 2:** Poorly known species in few locations (some on conservation lands)
- **Priority 3:** Poorly known species in several locations (some on conservation lands)
- **Priority 4:** Rare, near threatened and other species in need of monitoring



2.9.2 Levels of Conservation Significance in this report

Five levels of conservation significance are used within this report to indicate the level of significance of fauna species, according to the following criteria:

- **Threatened (T):** Taxa listed as Extinct in the Wild, Critically Endangered, Endangered or Vulnerable under the EPBC Act and/or BC Act. These species are grouped as they are all species considered to be at risk of extinction, are often rare and are likely to be subject to on-going threatening processes.
- **Migratory (Mi):** Taxa listed as Migratory under the EPBC Act and/or BC Act, excluding those species also listed as threatened. These species are grouped as they are not necessarily rare but may be dependent on specific habitats for a portion of their life-cycle. For these species, loss of important foraging, breeding or stop-over sites may have a disproportionately large impact on populations.
- **Specially Protected (SP):** Taxa listed as Other Specially Protected Species or Conservation Dependent Fauna under the BC Act. These species are not necessarily rare but may be dependent on on-going conservation to ensure their protection.
- **Priority (P):** Taxa listed as Priority by DBCA. These species are grouped as they are either conservation dependent or data deficient and in need of further survey.
- **Locally Significant (LS):** Locally significant taxa are not listed under State or Commonwealth Acts or in publications on threatened fauna or as Priority species by DBCA, but are considered by the author to potentially be of local significance because, for example, they are at the limit of their distribution in the area, they have a very restricted range or they occur in breeding colonies (e.g. some waterbirds). This level of significance has no legislative recognition and is based on interpretation of information on the species patterns of distribution. For example, the Government of Western Australia (2000) used this sort of interpretation to identify significant bird species in the Perth metropolitan area as part of Bush Forever. Recognition of such species is consistent with the aim of preserving regional biodiversity.

3. Survey Limitations

All fauna surveys have limitations. Examples of possible limitations are given in the Technical Guidelines (EPA 2020) and have been addressed in Table 5.

Not all fauna species present on the site are likely to be sampled during a survey. Fauna may not be recorded because they are rare, they are difficult to trap or observe, or because they are only present on the site for part of the year. In the case of the study area, there were no limitations other than those in common with all surveys of this type.



Table 5. Fauna Survey Limitations.

Potential Limitation	Extent of limitation for the fauna survey	
Availability of data and information	Not limiting	Few studies have been undertaken in the region, leading to a paucity of nearby recent records of fauna, making it difficult to place records in the Study Area into a regional context. This is somewhat ameliorated for many species as arid zone fauna typically have wide distributions.
Competency/experience of the survey team, including experience in the bioregion surveyed	Not limiting	Both personnel have over 20 years' experience with fauna surveys in Western Australia and are experienced with targeted Malleefowl surveys. Both personnel have undertaken previous surveys, including detailed trapping surveys, in the bioregion.
Scope of survey (e.g. faunal groups excluded from the survey)	Minor limitation	The level of survey restricted fauna records mainly to opportunistic observations of diurnal species, and observations in a single season. Although a limitation to describing the known faunal assemblage of the study area, this is ameliorated by the literature review and is not considered part of a basic survey. Key conservation significant species (Malleefowl) were targeted.
Timing, weather and season	Not limiting	A basic fauna survey and targeted Malleefowl survey are not overly dependent on timing, weather or season. The weather during the survey was cool with some rain, and adequate for opportunistically observing birds. Malleefowl mounds can be observed in any season.
Disturbance that may have affected the results	Minor limitation	Although parts of the study area were recently burnt, this is unlikely to have significantly affected the outcome of the survey. Malleefowl mounds persist in the landscape for many years, and the key purpose of the basic survey was habitat assessment. It is likely that fewer fauna species were recorded than if the study area was unburnt, but the majority of species are predicted on the basis of the literature review.
The proportion of fauna identified, recorded or collected	Minor limitation	As a basic fauna survey, the fauna identified were mostly restricted to diurnal birds and mammals. Reptiles, frogs, small terrestrial mammals and bats were not sampled as part of this survey, and their likely presence was determined with a review of the available literature.
The adequacy of the survey intensity and proportion of survey achieved (e.g. extent to which the area was surveyed)	Not limiting	The intensity and coverage of the fauna survey was adequate and appropriate for the level of survey. All habitats were visited and all study areas were surveyed.
Access problems	Not limiting	Within the survey period all areas were accessible on foot and/or by vehicle (see Figure 5).
Problems with data and analysis, including sampling biases	Not limiting	No complex analyses were undertaken, and no problems were noted.



4. Fauna Habitat

4.1 Fauna Habitats in the Study Areas

Eight broad fauna habitats were identified in study areas (Tables 6 and 7). The habitats are described in the sections below, with the vegetation descriptions after Mattiske Consulting (2020a, 2020b).

Table 6. Fauna Habitats and Key Habitat Elements.

Fauna Habitat	Key Habitat Elements
Eucalypt woodland on rocky hills	<ul style="list-style-type: none"> • Eucalypts provide crevices and tree hollows for arboreal reptiles, mammals and birds. • Hollow logs provide reptile and small mammal habitat. • Seasonal nectar resource (<i>Eucalyptus</i> and <i>Eremophila</i> spp.).
Eucalypt woodland on plains	<ul style="list-style-type: none"> • Eucalypts provide crevices and tree hollows for arboreal reptiles, mammals and birds. • Hollow logs provide reptile and small mammal habitat. • Seasonal nectar resource (<i>Eucalyptus</i> and <i>Eremophila</i> spp.).
Mallee woodland over Spinifex	<ul style="list-style-type: none"> • Spinifex and rocky areas provide shelter for reptiles.
Shrubland on rocky hills	<ul style="list-style-type: none"> • Shrubby vegetation provides nesting habitat for small birds. • Seasonal nectar resource (<i>Eucalyptus</i> and <i>Eremophila</i> spp.).
Shrubland on lake edges	<ul style="list-style-type: none"> • Shrubby vegetation provides nesting habitat for small birds. • Seasonal nectar resource (<i>Eremophila</i> spp.).
Gypsum dunes	<ul style="list-style-type: none"> • Dense aggregations of leaf litter under she-oaks. • Seasonal nectar resource (<i>Grevillea</i> and <i>Eremophila</i> spp.)
Chenopod shrubland	<ul style="list-style-type: none"> • None noted.
Salt lake (bare lakebed)	<ul style="list-style-type: none"> • May support shorebirds or other waterbirds when inundated.
Cleared	<ul style="list-style-type: none"> • Abandoned open pits may provide nesting habitat for birds of prey.

The fauna habitats of the study area are relatively common in the subregion. There is disturbance to some areas from illegal timber cutting, historical mining activities, firebreaks and recent fires. Feral mammals, including Rabbits (*Oryctolagus cuniculus*), Goats (*Capra hircus*) and Cats (*Felis catus*) were recorded from the study areas.

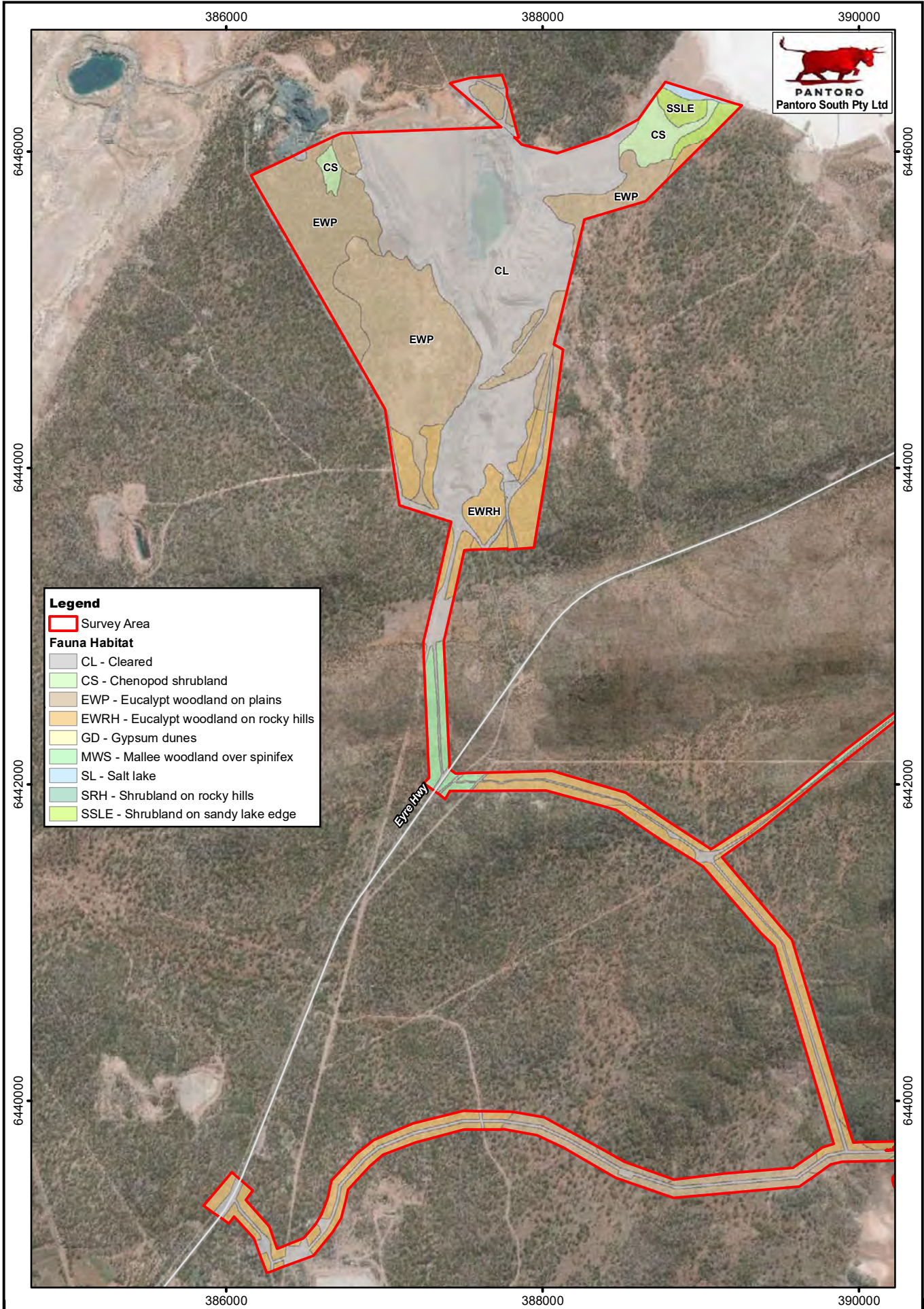


Eucalypt woodland on plains were the most common habitat type in the study area at 2,035.92ha (48% of the area surveyed), comprising 529.39ha on rocky hills and 1,506.53ha on plains (Table 7). The least common habitat was Mallee woodland over spinifex at 34.18ha (0.8% of the area surveyed), however, this is unlikely to be rare in the region. A total of 541.50ha (12.9%) of the study areas were cleared.

Table 7. Fauna Habitats – Extent in Each Study Area.

Study Area	Area of each habitat (ha)									
	Cleared	Chenopod shrubland	Eucalypt woodland on plains	Eucalypt woodland on rocky hills	Gypsum dunes	Mallee woodland over spinifex	Salt lake	Shrubland on rocky hills	Shrubland on sandy lake edge	Total
North Royal	195.27	13.96	151.51	34.87	-	-	1.97	-	8.87	406.45
Gladstone	110.64	316.44	194.43	64.53	132.52	31.75	424.04	-	156.41	1,430.76
North Royal – Gladstone Haul Road	20.69	-	-	5.99	-	2.43	-	-	-	29.11
Cobbler	8.71	14.89	28.20	46.48	-	-	363.44	14.53	-	476.25
TSF4	79.09	-	4.09	112.96	-	-	-	20.37	-	216.51
OK	38.51	-	-	81.82	-	-	-	-	-	120.34
Camp	10.24	-	-	4.60	-	-	-	-	-	14.84
Maybelle	7.72	9.11	211.09	49.28	-	-	9.83	25.30	-	312.33
Scotia	70.62	8.41	917.22	128.88	-	-	11.41	36.92	0.17	1,173.62
Total:	541.50	362.81	1,506.53	529.39	132.52	34.18	810.70	97.12	165.45	4,180.20





Legend

Survey Area

Fauna Habitat

- CL - Cleared
- CS - Chenopod shrubland
- EWP - Eucalypt woodland on plains
- EWRH - Eucalypt woodland on rocky hills
- GD - Gypsum dunes
- MWS - Mallee woodland over spinifex
- SL - Salt lake
- SRH - Shrubland on rocky hills
- SSLE - Shrubland on sandy lake edge

Fauna Habitats: Western Wildlife, Image: DigitalGlobe (27/11/2016)

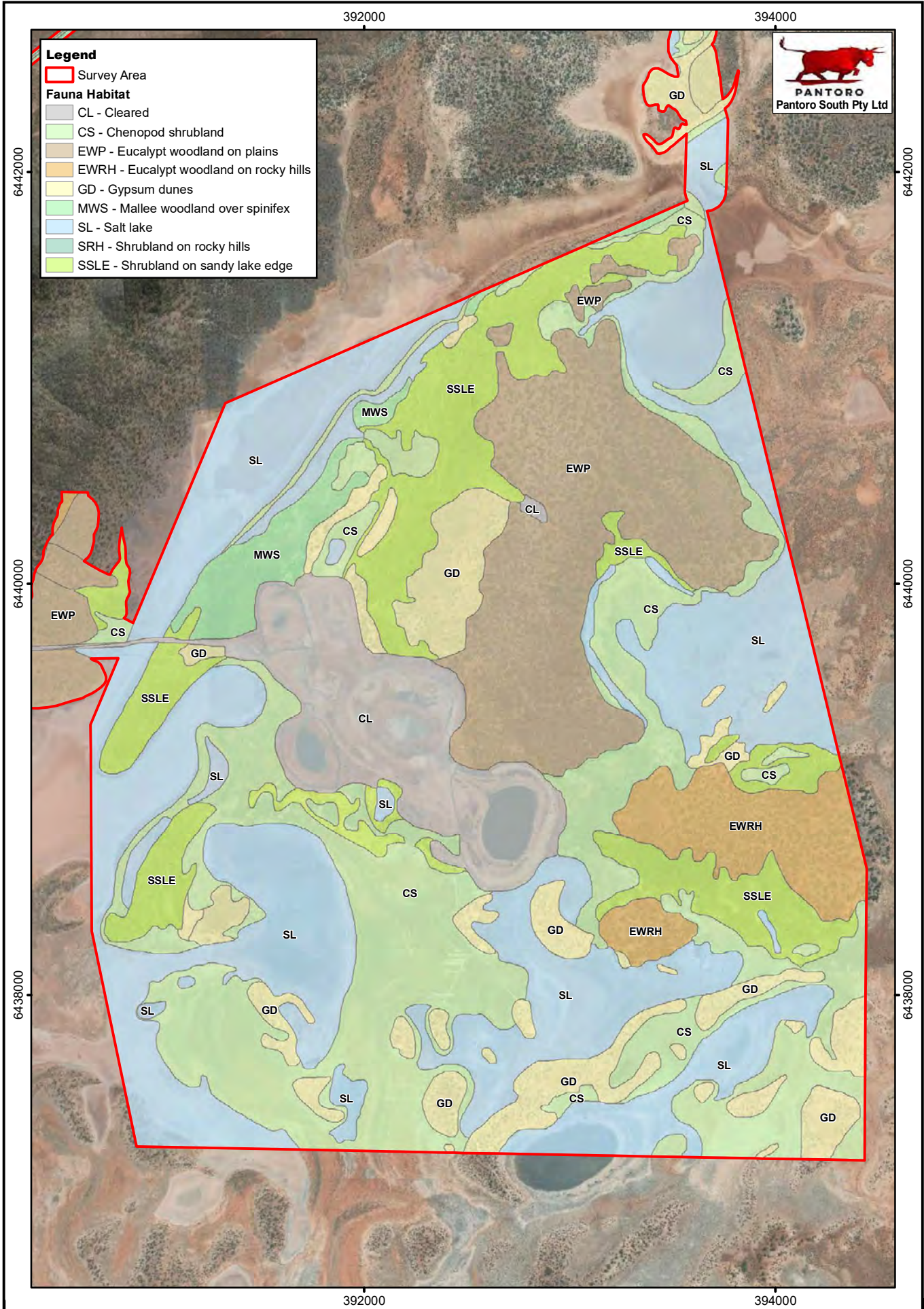
Drawn: CAD Resources
 www.cadresources.com.au
 Tel: (08) 9246 3242
 CAD Ref: a2783Fa006 | A4
 Date: February 2021 | Rev: B | Author: J. Wilcox

N 0 250 500 m
 Scale: 1:32,500
 MGA94 (Zone 51)



**Norseman Gold Project
 Fauna Habitats
 North Royal and Haul Roads**

Figure:
6



Legend

Survey Area

Fauna Habitat

- CL - Cleared
- CS - Chenopod shrubland
- EWP - Eucalypt woodland on plains
- EWRH - Eucalypt woodland on rocky hills
- GD - Gypsum dunes
- MWS - Mallee woodland over spinifex
- SL - Salt lake
- SRH - Shrubland on rocky hills
- SSLE - Shrubland on sandy lake edge



Fauna Habitats: Western Wildlife, Image: DigitalGlobe (27/11/2016)

Drawn: CAD Resources
 www.cadresources.com.au
 Tel: (08) 9246 3242
 CAD Ref: a2783Fa007 | A4
 Date: February 2021 | Rev: B | Author: J. Wilcox

N 0 190 380 m
 Scale: 1:25,000
 MGA94 (Zone 51)



**Norseman Gold Project
 Fauna Habitats
 Gladstone**

Figure: **7**

380000

382000



6442000

6442000

Coolgardie Esperance Hwy

6440000

6440000

380000

382000

Legend

- Survey Area
- Fauna Habitat**
- CL - Cleared
- CS - Chenopod shrubland
- EWP - Eucalypt woodland on plains
- EWRH - Eucalypt woodland on rocky hills
- GD - Gypsum dunes
- MWS - Mallee woodland over spinifex
- SL - Salt lake
- SRH - Shrubland on rocky hills
- SSLE - Shrubland on sandy lake edge

Fauna Habitats: Western Wildlife, Image: DigitalGlobe (27/11/2016)

Drawn: CAD Resources
 www.cadresources.com.au
 Tel: (08) 9246 3242

CAD Ref: a2783Fa0011 | A4

Date: February 2021 | Rev: B | Author: J. Wilcox

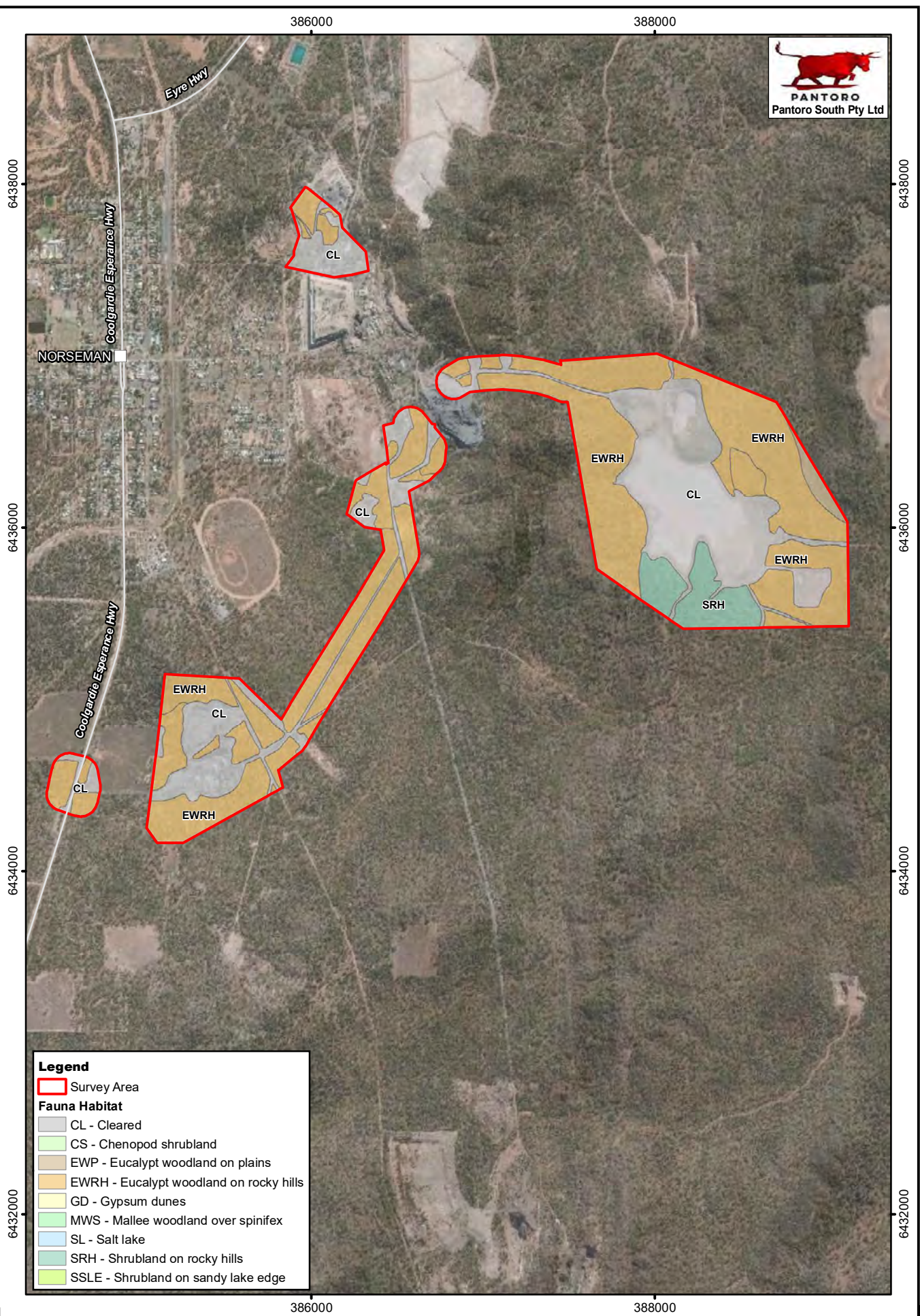
N 0 150 300 m

Scale: 1:20,000
 MGA94 (Zone 51)



**Norseman Gold Project
 Fauna Habitats
 Cobbler**

Figure:
8



Legend

- Survey Area

Fauna Habitat

- CL - Cleared
- CS - Chenopod shrubland
- EWP - Eucalypt woodland on plains
- EWRH - Eucalypt woodland on rocky hills
- GD - Gypsum dunes
- MWS - Mallee woodland over spinifex
- SL - Salt lake
- SRH - Shrubland on rocky hills
- SSLE - Shrubland on sandy lake edge

Fauna Habitats: Western Wildlife, Image: DigitalGlobe (27/11/2016)

Drawn: CAD Resources
 www.cadresources.com.au
 Tel: (08) 9246 3242
 CAD Ref: a2783Fa0012
 Date: February 2021

N 0 230 460 m
 Scale: 1:30,000
 MGA94 (Zone 51)
 Rev: B Author: J. Wilcox



**Norseman Gold Project
 Fauna Habitats
 TSF4, OK and Camp**

384000

386000



6420000

6420000

6418000

6418000

6416000

6416000

Coolgardie Esperance Hwy

EWP

EWP

SRH

EWRH

EWRH

SRH

EWP

SL

Legend

Survey Area

Fauna Habitat

CL - Cleared

CS - Chenopod shrubland

EWP - Eucalypt woodland on plains

EWRH - Eucalypt woodland on rocky hills

GD - Gypsum dunes

MWS - Mallee woodland over spinifex

SL - Salt lake

SRH - Shrubland on rocky hills

SSLE - Shrubland on sandy lake edge

384000

386000

Fauna Habitats: Western Wildlife, Image: DigitalGlobe (27/11/2016)

Drawn: CAD Resources
www.cadresources.com.au
Tel: (08) 9246 3242



0 230 460 m
Scale: 1:30,000
MGA94 (Zone 51)

Western Wildlife



**Norseman Gold Project
Fauna Habitats
Maybell**

Figure:

10

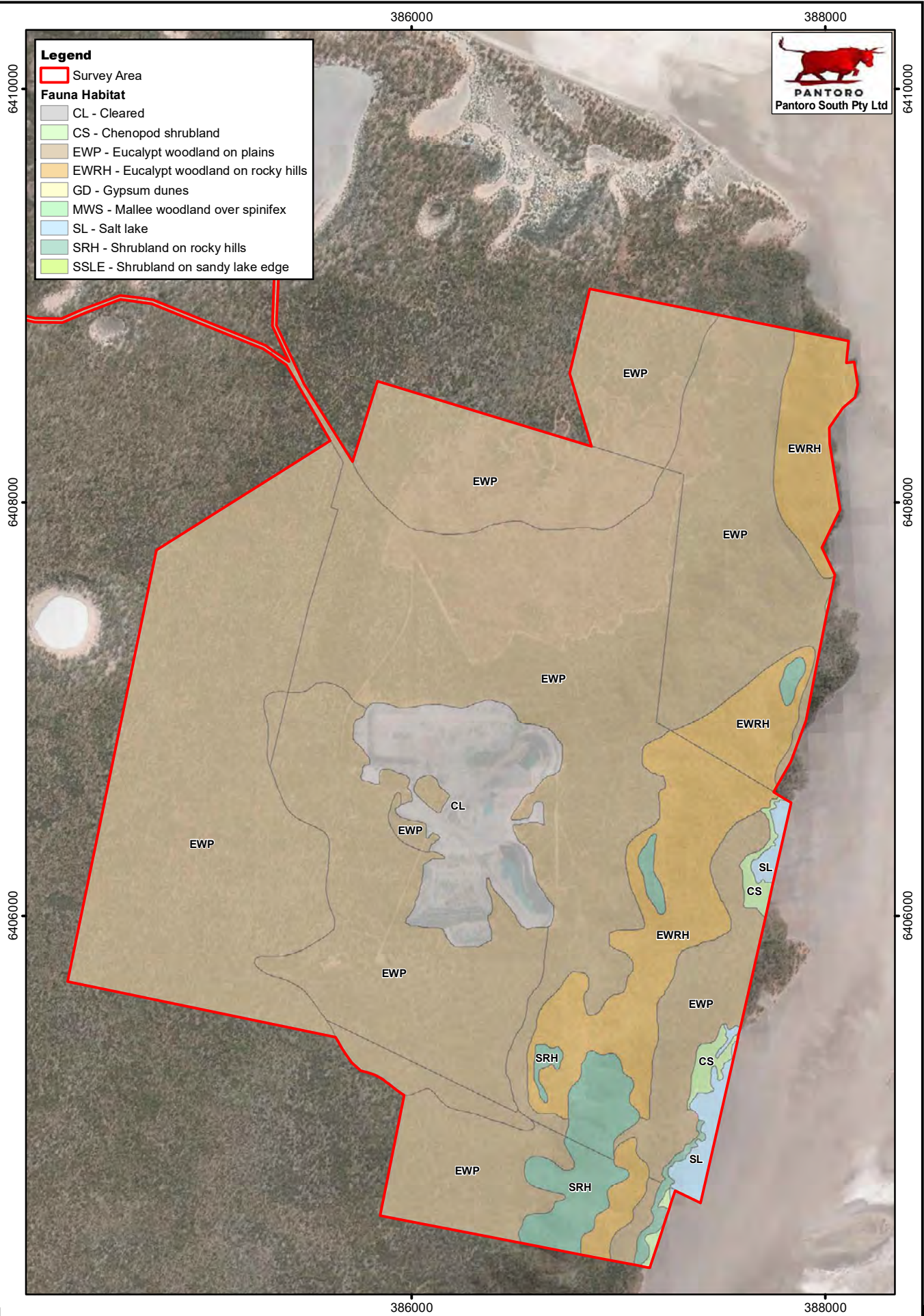
CAD Ref: a2783Fa0013

A4

Date: February 2021

Rev: B

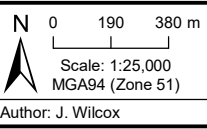
Author: J. Wilcox



- Legend**
- Survey Area
- Fauna Habitat**
- CL - Cleared
 - CS - Chenopod shrubland
 - EWP - Eucalypt woodland on plains
 - EWRH - Eucalypt woodland on rocky hills
 - GD - Gypsum dunes
 - MWS - Mallee woodland over spinifex
 - SL - Salt lake
 - SRH - Shrubland on rocky hills
 - SSLE - Shrubland on sandy lake edge

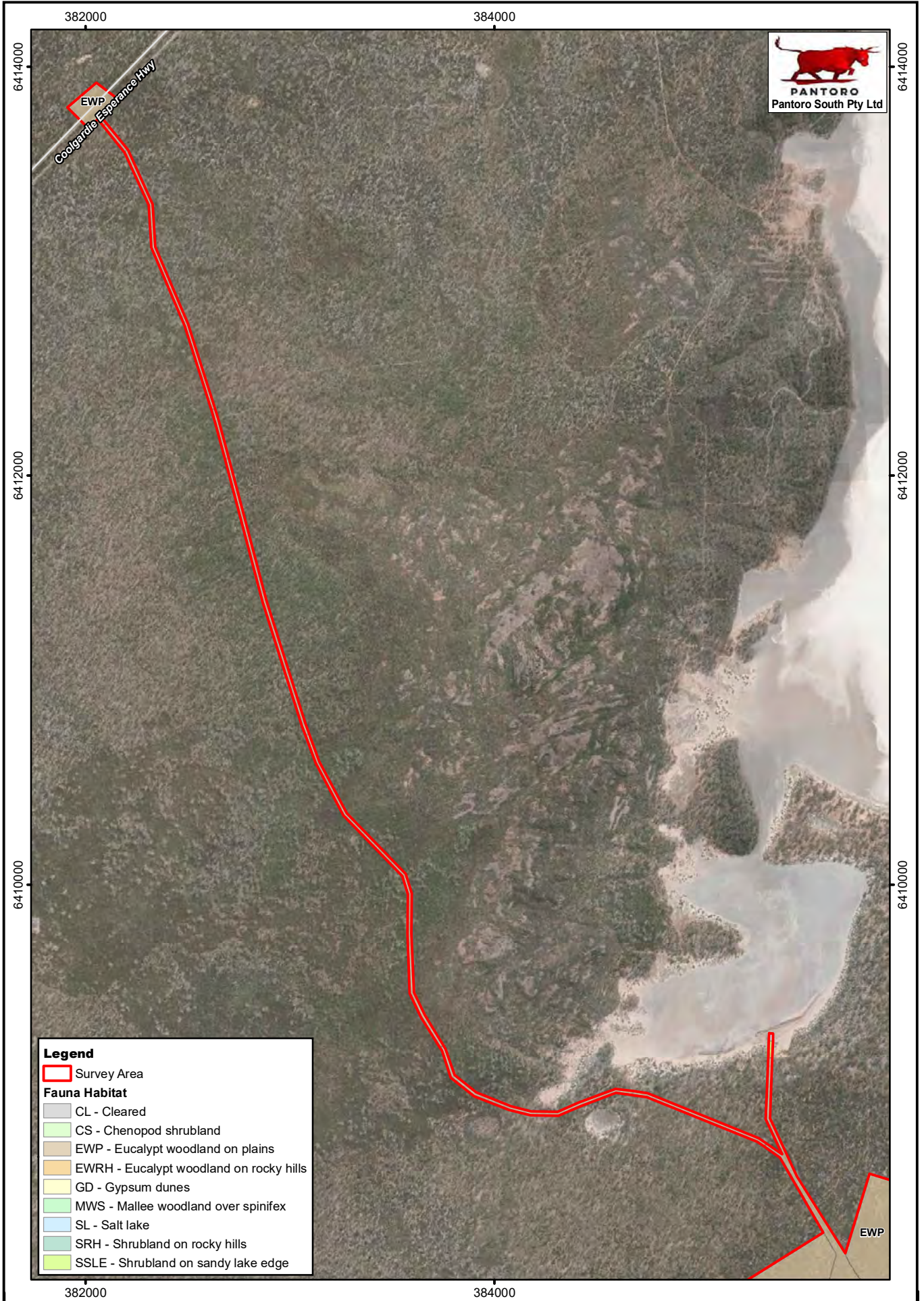
Fauna Habitats: Western Wildlife, Image: DigitalGlobe (27/11/2016)

Drawn: CAD Resources
 www.cadresources.com.au
 Tel: (08) 9246 3242
 CAD Ref: a2783Fa008 | A4
 Date: February 2021 | Rev: B | Author: J. Wilcox



**Norseman Gold Project
 Fauna Habitats
 Scotia**

Figure:
11



Legend

Survey Area

Fauna Habitat

- CL - Cleared
- CS - Chenopod shrubland
- EWP - Eucalypt woodland on plains
- EWRH - Eucalypt woodland on rocky hills
- GD - Gypsum dunes
- MWS - Mallee woodland over spinifex
- SL - Salt lake
- SRH - Shrubland on rocky hills
- SSLE - Shrubland on sandy lake edge

Fauna Habitats: Western Wildlife, Image: DigitalGlobe (27/11/2016)

Drawn: CAD Resources
 www.cadresources.com.au
 Tel: (08) 9246 3242

CAD Ref: a2783Fa009	A4
Date: February 2021	Rev: B

N 0 190 380 m

Scale: 1:25,000
MGA94 (Zone 51)

Western Wildlife

**Norseman Gold Project
 Fauna Habitats
 Scotia Haul Road**

Figure:
12

4.1.1 Eucalypt Woodland on Rocky Hills

A series of low rocky hills run north-south along the western shore of Lake Dundas, intersecting the Maybelle and Scotia study areas (Plates 1 – 2). The hills have surface rocks and occasional small outcroppings on a clay-loam soil, but lack caves or areas of deep rock crevices. The rocky hills support a woodland of Coral Gum (*Eucalyptus torquata*) over shrubs such as Boree (*Melaleuca sheathiana*), Brilliant Hopbush (*Dodonaea microzyga*) and Sea Box (*Alyxia buxifolia*).

Conservation significant fauna likely to use this habitat include the Inland Western Rosella (*Platycercus icterotis xanthagenys*), Central Long-eared Bat (*Nyctophilus major tor*) and possibly the Malleefowl (*Leipoa ocellata*) or Chuditch (*Dasyurus geoffroii*).



Plate 1. Eucalypt Woodlands on Rocky Hills (Maybelle).



Plate 2. Eucalypt Woodlands on Rocky Hills (Scotia).



4.1.2 Eucalypt Woodland on Plains

Extensive red-brown clay-loam plains, sometimes with surface pebbles, support eucalypt woodlands. Plates 3 – 7 demonstrate the variation inherent in this habitat. The canopy varies, including one or more of Merrit (*Eucalyptus flocktoniae*), Red Morrel (*Eucalyptus longicornis*), Gimlet (*Eucalyptus salubris*), Dundas Blackbutt (*Eucalyptus dundasii*), Mallett (*Eucalyptus prolixa*) and Goldfields Blackbutt (*Eucalyptus lesouefii*). The understory can be relatively open or support a range of shrubs.

Conservation significant fauna likely to use this habitat include the Inland Western Rosella (*Platycercus icterotis xanthagenys*), Central Long-eared Bat (*Nyctophilus major tor*) and possibly the Malleefowl (*Leipoa ocellata*) or Chuditch (*Dasyurus geoffroii*).



Plate 3. Eucalypt Woodlands on Plains (TSF4).



Plate 4. Eucalypt Woodland on Plains (Scotia).





Plate 5. Recently burnt Eucalypt Woodlands (Scotia).



Plate 6. Eucalypt Woodland on Plains (Gladstone).



Plate 7. Eucalypt Woodland on Plains (North Royal).



4.1.3 Mallee Woodland over Spinifex

An open mallee eucalypt woodland over Spinifex occurs on gently sloping sandy-clays and occasional rock outcrops (Plate 8). The open canopy is of *Eucalyptus planipes* with *Eucalyptus oleosa* in the creeklines. The understory is of mixed shrubs, such as *Allocasuarina helmsii*, *Eremophila* spp. and/or *Acacia* spp., over a spinifex (*Triodia scariosa*) hummock grassland. No conservation significant fauna are likely to be particularly reliant on this habitat.



Plate 8. Mallee Woodland over Spinifex (North Royal Haul Road).

4.1.4 Shrubland on Rocky Hills

Patches of shrubland occur in the rocky hills, particularly in small drainages and valleys. The shrublands are tall, dense and variable, consisting of she-oaks (*Allocasuarina acutivalvis* or *Allocasuarina campestris*), *Grevillea nematophylla* and/or *Acacia neurophylla*. Shrublands may support the Malleefowl (*Leipoa ocellata*).



Plate 9. Shrubland on Rocky Hills (Scotia and Maybelle).



4.1.5 Shrubland on Lake Edges

Flats and low rises of saline red sandy-clays occur on the salt lake margins. The low rises support an open shrubland of Sticky Hopbush (*Dodonaea viscosa*), Currant Bush (*Scaevola spinescens*), *Eremophila* sp. and mixed chenopods, sometimes with scattered Rottneest Island Pine (*Callitris preisii*) (Plate 10). No conservation significant fauna are likely to be particularly reliant on this habitat.



Plate 10. Shrubland on Lake Edges (Gladstone).



Plate 11. Shrubland on Lake Edges (North Royal).



4.1.6 Gypsum Dunes

Low gypsum dunes occur in association with salt lakes. Sparsely vegetated, they support a very open woodland of Swamp She-oak (*Casuarina obesa*) or *Eucalyptus spreta* over scattered shrubs and grasses (Plate 12). This habitat is likely to support a small but distinct faunal assemblage. No conservation significant fauna are likely to be particularly reliant on this habitat.



Plate 12. Gypsum Dunes (Gladstone).

4.1.7 Chenopod Shrubland

The low-lying saline sandy flats on salt lake edges support a low chenopod shrubland comprising Saltbushes (*Atriplex* spp.), Bluebushes (*Maireana* spp.) and Samphires (*Tecticornia* spp.) (Plate 13). No conservation significant fauna are likely to be particularly reliant on this habitat. Migratory shorebirds may occur on occasion but are more likely to roost and forage at the water's edge.



Plate 13. Chenopod shrubland (Cobbler and Gladstone).



4.1.8 Salt Lake

The study areas extend onto two large salt lakes; Lake Cowan and Lake Dundas (Plate 14). The lakebed within the study areas was dry at the time of survey. A small pool of water remained north of the causeway on Lake Dundas, but this was outside the study areas. The bare lakebed lacks vegetation, but may support waterbirds, including shorebirds, when inundated.

Several conservation significant species may occur on salt lakes. This habitat may provide breeding and foraging habitat for the Hooded Plover (*Thinornis cucullata*), and foraging habitat only for the following Migratory shorebirds; Curlew Sandpiper (*Calidris ferruginea*), Sharp-tailed Sandpiper (*Calidris acuminata*), Pectoral Sandpiper (*Calidris melanotos*), Common Sandpiper (*Tringa hypoleucos*) and Common Greenshank (*Tringa nebularia*).



Plate 14. Salt Lake.

4.1.9 Cleared

Cleared areas were primarily comprised of tracks, existing open pits and waste rock landforms. These areas have limited value for fauna, although a few native species are still likely to occur in low numbers.

A conservation significant species that may occur in cleared areas is the Peregrine Falcon (*Falco peregrinus*).



5. Vertebrate Fauna of the Study Area

5.1. Vertebrate Fauna Assemblage

The results of the desktop survey and the field survey were combined to form lists of the vertebrate fauna potentially occurring in the study area. The lists of frogs, reptiles, birds and mammals that potentially occur in the study area are presented in Appendices 1 – 4 and are summarised below in Table 8.

Table 8. Summary of Vertebrate Fauna Potentially Occurring in the Study Area.

Taxon	Total species	Introduced species	Recorded on this survey	Conservation significant species				
				Threatened	Migratory	Specially Protected	Priority	Locally Significant
Amphibians	7	-	-	-	-	-	-	-
Reptiles	64	-	-	-	-	-	1	-
Birds	150	2	46	2	6	1	-	-
Mammals	33	8	5	1	-	-	2	-
Totals:	254	10	51	3	6	1	2	0

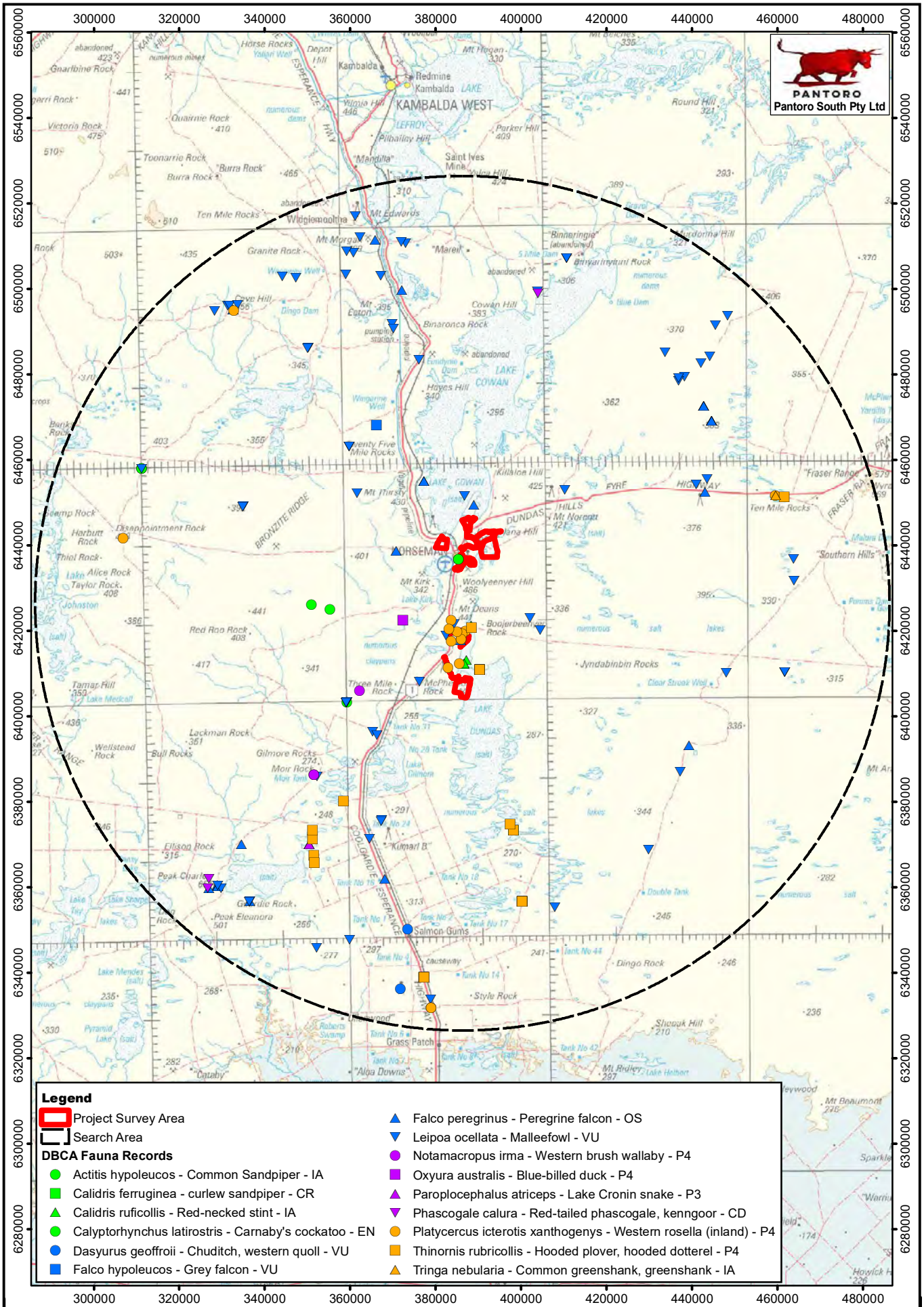
As it is situated in a larger tract of native vegetation, the study area is likely to support a relatively intact faunal assemblage, with only regionally extinct species likely to be missing. The study area is in Southwest Interzone, the transitional area between the Bassian and Eremaean Provinces. Therefore, the faunal assemblage of the area is likely to be relatively diverse, including both Eremaean and Bassian components.

The predicted faunal assemblages and fauna of conservation significance are discussed in the sections below. The results of the EPBC Act Protected Matters search are given in Appendix 5. The results of the DBCA Threatened and Priority Fauna Database search are shown in Figure 13.

5.1.1 Amphibians

There are seven frog species that potentially occur in the study area (Appendix 1). Most of the species expected to occur are burrowing frogs that use seasonal or ephemeral wetlands for breeding. Some species are likely to breed in pools on granite outcrops, however, although they occur in the region there are no granite outcrops in the study area. Frogs are also likely to breed opportunistically in man-made depressions and in the study area frogs may breed anywhere that holds fresh water after rainfall. During the non-breeding season burrowing frogs are likely to forage in terrestrial habitats in the study area.

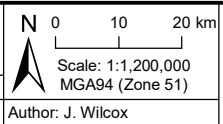




Legend	
	Project Survey Area
	Search Area
DBCA Fauna Records	
	Actitis hypoleucos - Common Sandpiper - IA
	Calidris ferruginea - curlew sandpiper - CR
	Calidris ruficollis - Red-necked stint - IA
	Calyptorhynchus latirostris - Carnaby's cockatoo - EN
	Dasyurus geoffroi - Chuditch, western quoll - VU
	Falco hypoleucos - Grey falcon - VU
	Falco peregrinus - Peregrine falcon - OS
	Leipoa ocellata - Malleefowl - VU
	Notamacropus ima - Western brush wallaby - P4
	Oxyura australis - Blue-billed duck - P4
	Paroplocephalus atriceps - Lake Cronin snake - P3
	Phascogale calura - Red-tailed phascogale, kenngoor - CD
	Platycercus icterotis xanthogenys - Western rosella (inland) - P4
	Thinornis rubricollis - Hooded plover, hooded dotterel - P4
	Tringa nebularia - Common greenshank, greenshank - IA

Fauna Records: DBCA, Image: DigitalGlobe (27/11/2016)

Drawn: CAD Resources
 www.cadresources.com.au
 Tel: (08) 9246 3242
 CAD Ref: a2783Fa0010 | A4
 Date: February 2021 | Rev: B | Author: J. Wilcox



Norseman Gold Project
DBCA records of
conservation significant fauna

Figure:
13

5.1.2 Reptiles

There are up to 64 species of reptile that potentially occur in the study area (Appendix 2). None were observed opportunistically during the site visit, but this is unsurprising during a brief site visit in cool weather. Given its setting in a large, continuous tract of native vegetation, the study area is likely to support a relatively intact reptile assemblage in each habitat.

The reptile assemblage of each habitat is likely to be influenced by the substrate (e.g. rocky, clayey or sandy), but there is also likely to be considerable overlap with many species being widely distributed and occurring across several habitats. Few reptiles are likely to occur in the chenopod shrublands, but the Salt Lake Dragon (*Ctenophorus salinarum*) favours this habitat and can be locally common. Tree-dwelling reptiles, such as the Reticulated Velvet Gecko (*Hespeodura reticulata*), are likely to be restricted to the Eucalypt woodland habitats. Hollow logs in eucalypt woodlands potentially provide shelter habitat for the Carpet Python (*Morelia spilota imbricata*) and other species. As the only habitat in the study area containing a spinifex understory, the mallee woodland over spinifex is likely to support a distinct reptile assemblage.

5.1.3 Birds

There are 150 species of bird that potentially occur in the study area, of which 46 were observed during the fauna survey (Table 9, Appendix 3). As the study area is in the Southwest Interzone, the bird assemblage includes both Eremaean and Bassian components. Eremaean species are widespread, occurring across the inland arid areas of Australia, while Bassian species are likely to be on the north-eastern limit of their range in the vicinity study area, with their distributions extending into the wetter southwest.

While many bird species occur across all habitats, others are more dependent on a single habitat or habitat characteristic. Species that favour woodland habitats, such as the Rufous Treecreeper (*Climacteris rufus*) and Yellow-plumed Honeyeater (*Ptilotula ornata*) are likely to be restricted to the eucalypt woodlands on plains or rocky hills. The eucalypt trees are also likely to have hollows suitable for nesting birds.

Honeyeaters and the Purple-crowned Lorikeet (*Parvipsitta porphyrocephala*) feed on nectar and move to take advantage of seasonal flowering resources. These species are likely to fluctuate in abundance, both seasonally and between years, and are likely to be abundant in the study area when the shrublands or eucalypt canopy is flowering.

A dense cover of shrubs is favoured by the Shy Heathwren (*Hylacola cauta*), Blue-breasted Fairy-wren (*Malurus pulcherrimus*), Southern Scrub-robin (*Drymodes brunneopygia*) and Copperback Quail-thrush (*Cinclosoma clarum*). These and other species nest in dense vegetation in shrubland habitats or shrubby understorey in woodlands, some, such as the Southern Scrub-Robin, on the ground and many, such as the Inland Thornbill (*Acanthiza apicalis*), within a metre of the ground. These nests can be vulnerable to feral predators, (foxes and cats), when dense habitats are fragmented.



Table 9. Birds Recorded in the Study Areas.

Species	Study Area								
	Cobbler	Gladstone	Gladstone – North Royal Haul Roads	Lake Dundas	Maybelle	OK	Scotia	TSF4	North Royal
Australian Raven							+		+
Australian Ringneck			+		+	+	+	+	+
Black-faced Cuckoo-shrike	+	+					+		
Blue-breasted Fairy-wren			+		+		+	+	+
Brown Falcon								+	
Brown Honeyeater					+	+	+	+	+
Brown-headed Honeyeater			+		+	+	+		+
Brush Bronzewing						+		+	
Collared Sparrowhawk							+		
Dusky Woodswallow						+	+		
Gilbert's Whistler			+						
Grey Butcherbird								+	
Grey Currawong			+		+	+	+		+
Grey Shrike-thrush					+	+	+		
Inland Thornbill	+	+	+		+	+		+	
Inland Western Rosella (P4)						+			
Jacky Winter		+							+
Purple-crowned Lorikeet	+		+		+	+	+		+
Purple-gaped Honeyeater					+				
Red Wattlebird	+	+	+		+	+	+	+	+
Red-capped Plover				+					
Red-capped Robin									+
Redthroat	+		+		+	+	+	+	+
Regent Parrot					+				
Restless Flycatcher							+		
Rufous Treecreeper		+			+	+	+		+
Rufous Whistler			+		+				
Silvereye					+				
Singing Honeyeater	+	+							+
Southern Boobook Owl							+		
Spiny-cheeked Honeyeater					+				
Spotted Pardalote					+		+		
Striated Pardalote		+			+	+	+	+	+
Tree Martin							+		
Varied Sittella					+		+	+	
Weebill		+	+		+	+	+	+	+
Welcome Swallow						+			+
Western Golden Whistler		+			+		+	+	+
Western Yellow Robin					+	+	+	+	+
White-backed Swallow							+		
White-browed Babbler			+		+		+		
White-eared Honeyeater			+		+	+	+	+	+
White-winged Fairy-wren			+						



Table 9. (cont.)

Species	Study Area								
	Cobbler	Gladstone	Gladstone – North Royal Haul Roads	Lake Dundas	Maybelle	OK	Scotia	TSF4	North Royal
Willie Wagtail		+	+		+				+
Yellow-plumed Honeyeater		+	+		+	+	+	+	+
Yellow-throated Miner					+				
Total species:	6	11	16	1	27	19	27	16	21

Several waterbirds, including swans, ducks, herons, stilts and migratory shorebirds, potentially occur in the region and may occur in the study area (Appendix 3). These are only likely to be present on occasion, when water is present in the lakes. As the salt lake habitat in the study areas was dry at the time of survey, no waterbirds were present. A small pool on Lake Dundas was visited (near the Maybelle study area), and only the Red-capped Plover was recorded (Table 9).

5.1.4 Mammals

There are 33 mammals with the potential to occur in the study area, of which 25 are native and eight are introduced (Appendix 4). Only introduced mammals were observed opportunistically during the site visit. The mammal assemblage also demonstrates both Bassian and Eremaean influences. Species such as the Ooldea Dunnart (*Sminthopsis ooldea*) have an arid distribution, contrasted to species such as the Western Pygmy Possum (*Cercartetus concinnus*), with a distribution that extend into the south-west.

The mammal assemblage is likely to be relatively intact, missing only those species extinct in the bioregion. Many of the critical weight range mammals, including species such as the Common Brushtail Possum (*Trichosurus vulpecula*), were noted to be lost from the semi-arid and arid regions in the vicinity of the study area by 1906 (Short 2004).

5.2 Vertebrate Fauna of Conservation Significance

There are 15 vertebrate fauna of conservation significance that potentially occur in the study area; three Threatened, six Migratory, one Specially Protected and five Priority species. No Locally Significant species were identified. Each species is summarised in Table 10 and discussed in the sections below.



Several birds listed on database searches in the area have been omitted from Appendix 3 and the discussion below. The Night Parrot (*Pezoporus occidentalis*) is an extremely rare species for which suitable breeding habitat (e.g. old-growth spinifex) is absent from the study area. Records of Carnaby's Cockatoo (*Calyptorhynchus latirostris*) in Norseman are from 1905 to 1975, and the study area is well outside the current known range of the species. The Osprey (*Pandion haliaetus*) has been omitted as this is a bird of coasts, large rivers and off-shore islands. The Grey Wagtail (*Motacilla cinerea*) is a vagrant in the region.

Several mammal species are locally extinct from the region. Although records of these species occur on databases, they have been omitted from the list of potentially occurring mammals in Appendix 4 and the discussion below. This includes the Bilby (*Macrotis lagotis*) and Numbat (*Myrmecobius fasciatus*), both only known from undated historical records in the region on DBCA's Threatened and Priority Fauna Database.

5.2.1 Threatened Fauna

Threatened species are those that are considered in danger of extinction as their populations have declined and/or are still declining, and their total population size is small and/or fragmented or geographically restricted. Sites that support these species may be important for their long-term conservation, particularly if the site supports a resident breeding population.

Curlew Sandpiper – *Calidris ferruginea*

The Curlew Sandpiper is listed as Critically Endangered under the BC Act and EPBC Act. It is also listed as a Migratory species under these Acts.

The Curlew Sandpiper usually occurs on intertidal mudflats, but also occurs less frequently on inland wetlands (Geering *et al.* 2007). This species is a non-breeding visitor to southwest Western Australia, mostly between October and March (Johnstone and Storr 1998). They mainly forage in shallow water and roost on bare ground (DoE 2015). A site is deemed nationally important for this species if it regularly supports at least 90 birds (Table 11). Threats to this species within Australia, generally in more populated parts of the south and south-east, include human disturbance, habitat loss, pollution, changes to water regimes and invasive plants (DoE 2015). Outside Australia, this species is threatened by loss of wetland habitats in East Asia (DoE 2015). There is a single record of the Curlew Sandpiper within 100km on DBCA's Threatened and Priority Fauna Database, from Burraminya, 34km south of the study area (Figure 13). Although this species may be an occasional visitor to the study area, the study area is unlikely to support more than a few individuals.



Table 10. Summary of Conservation Significant Vertebrate Fauna.

Key to Status: Mig = Migratory, En = Endangered, Vu = Vulnerable, OS = Other Specially Protected Fauna, P = Priority, LS = locally significant.

Species	Status				Likelihood of Occurrence	Habitat							Notes
	EPBC Act	BC Act	DBCA Priority	Locally Significant		Eucalypt Woodland on Rocky Hills	Eucalypt Woodland on Plains	Mallee Woodland over Spinifex	Shrubland on Rocky Hills	Shrubland on Salt Lake Edges	Gypsum Dunes	Chenopod Shrubland	
REPTILES													
<i>Paroplocephalus atriceps</i> Lake Cronin Snake			P3		Very Low		✓						Although the habitats present are potentially suitable, its distribution is not currently known to extend as far north as the study areas.
BIRDS													
<i>Calidris ferruginea</i> Curlew Sandpiper	Cr	Cr			Moderate							✓	Although it may occur on occasion, this species is not likely to be present in significant numbers.
<i>Leipoa ocellata</i> Malleefowl	Vu	Vu			Moderate	✓	✓		✓				This species is known to occur in the region, but no evidence of its presence was recorded during the field survey despite extensive searching.
<i>Falco peregrinus</i> Peregrine Falcon		OS			High	✓	✓	✓		✓	✓	✓	Although likely to occur, foraging in most open habitats, the study area is unlikely to be of particular significance to this species.
<i>Actitis hypoleucos</i> Common Sandpiper	Mi	Mi			High							✓	Although likely to occur on occasion, this species is not likely to be present in significant numbers.
<i>Calidris acuminata</i> Sharp-tailed Sandpiper	Mi	Mi			High							✓	Although likely to occur on occasion, this species is not likely to be present in significant numbers.
<i>Tringa nebularia</i> Common Greenshank	Mi	Mi			High							✓	Although likely to occur on occasion, this species is not likely to be present in significant numbers.

Table 10. (cont.)

Species	Status				Likelihood of Occurrence	Habitat								Notes
	EPBC Act	BC Act	DBCA Priority	Locally Significant		Eucalypt Woodland on Rocky Hills	Eucalypt Woodland on Plains	Mallee Woodland over Spinifex	Shrubland on Rocky Hills	Shrubland on Salt Lake Edges	Gypsum Dunes	Chenopod Shrubland	Salt Lake	
<i>Calidris ruficollis</i> Red-necked Stint	Mi	Mi			High								✓	Although likely to occur on occasion, this species is not likely to be present in significant numbers.
<i>Calidris melanotos</i> Pectoral Sandpiper	Mi	Mi			Low								✓	This species may occur but prefers vegetated freshwater wetlands.
<i>Apus pacificus</i> Fork-tailed Swift	Mi	Mi			Moderate									This species is largely aerial in Australia, and although it may overfly the area the terrestrial habitats of the study area are not likely to be important for this species.
<i>Thinornis cucullata</i> Hooded Plover			P4		High								✓	Known to occur on Lake Dundas, this species is likely to occur in the study area, at least on occasion.
<i>Platycercus icterotis xanthagenys</i> Inland Western Rosella			P4		Known to occur	✓	✓		✓					This species was recorded in the OK study area during the 2020 field survey and is likely to be a breeding resident.
MAMMALS														
<i>Dasyurus geoffroii</i> Chuditch	Vu	Vu			Low	✓	✓		✓					Although the habitats present are suitable, there are few records of this species in the region.
<i>Nyctophilus major tor</i> Central Long-eared Bat			P3		Moderate	✓	✓							This species is known to occur in the region and its favoured woodland habitats are present.
<i>Notamacropus irma</i> Western Brush Wallaby			P4		Low	✓	✓		✓					This species may occur at low densities in the region, although it is likely to be at the very eastern limit of its distribution in the vicinity of the study areas.

Malleefowl – *Leipoa ocellata*

The Malleefowl is listed as Vulnerable under the BC Act and EPBC Act.

The Malleefowl is a bird of dense shrublands, mulga woodlands and mallee woodlands, and used to be common in the southern arid and semi-arid areas of Western Australia (Johnstone and Storr 1998). In order to construct their nest mounds, the Malleefowl requires leaf litter on sandy substrates (Garnett and Crowley 2010). The mounds are usually constructed intermittently by a pair of birds between autumn and spring. Between early spring and mid to late summer, 15 - 25 eggs are laid in the mound by the female, while the male continues to tend the mound. The chicks emerge between November and January (sometimes as late as March), and as they receive no parental care, chick mortality can be high (Benshemesh 2007). Malleefowl will often breed in the same general area year after year, and new mounds may be constructed, or old mounds re-used. The adult birds have been found to range over one to many square kilometres, and these home ranges overlap (Benshemesh 2007).

As Malleefowl nest on the ground, the eggs and flightless chicks are vulnerable to predation by feral predators. However, the main threat to Malleefowl is habitat loss and the fragmentation and degradation of remaining habitat, as well as the death of adults on roads (Benshemesh 2007, Garnett *et al.* 2011). Fire can have a significant impact on populations, by killing adult birds, causing local extinctions in fragmented habitats and causing a cessation in breeding activity for many years after a fire (Benshemesh 2007).

There are many records of Malleefowl within the 100km of the study area on DBCA's Threatened and Priority Fauna Database, ranging from 1938 to 2018 (Figure 13). The most recent records include one from Bromus Dam in 2015 (about 9.5km west of the study area) and two from the Redross Project in 2018 (about 48km north of the study area). The closest records, about 3.7km north-west of Maybelle, are of long-inactive mounds recorded in 2012/2013 (Western Wildlife 2013). All woodland and shrubland habitats in the study area are potential foraging habitat for Malleefowl. Possible breeding habitat in the study area is mainly in the Eucalypt woodlands and shrublands on rocky hills and in adjacent parts of the Eucalypt woodland on plains. Despite extensive searching (Figure 5), no Malleefowl mounds were detected in the study area during the field survey. If present, the Malleefowl appears to be uncommon.

Chuditch – *Dasyurus geoffroii*

The Chuditch is listed as Vulnerable under the BC Act and EPBC Act.

The Chuditch used to occur across much of the continent but is now restricted to the southwest of Western Australia. Although they used to occupy a range of habitats, the majority of Chuditch now occur in the Jarrah forest with some wheatbelt/goldfields populations in drier woodlands, heath and mallee shrublands (Van Dyck and Strahan 2008; Orrell and Morris 1994). Up until recently, there were only occasional records of the Chuditch from the wheatbelt and goldfields, with this population estimated at 2,000 mature individuals (Woinarski *et al.* 2014, DoEE 2016). In recent years a substantial population has been recorded at Forrestiana (pers. obs., Raynor *et al.* 2011), about 180km south-west of the study area.



Chuditch are highly mobile, and typically have large home-ranges (Woinarski *et al.* 2014). In the study at Forrestiana, the average distance travelled between consecutive refuge sites was 500 m for females and 3.3km for males, with the maximum distance travelled 1.5 km for females and 4.5 - 12 km for males (Rayner *et al.* 2011). Males were found to occur across large core home ranges averaging 2,125 ha which overlapped with other males and females. Females inhabited a smaller core home range of 189 ha (Rayner *et al.* 2011). The core home range describes the area contained by den locations, and the actual area over which individuals can range is much higher (DEC 2012). As Chuditch use up to 180 different dens sites within their core home range (Woinarski *et al.* 2014), no particular den site is likely to be of particular importance.

The current major threats to Chuditch are land clearing (including fragmentation of continuous habitat), predation by and competition with feral predators (foxes and cats) and deliberate and accidental mortality from poisoning, trapping, illegal shooting or road kills (DEC 2012). There are two certain records of Chuditch within 100km of the study area on DBCA’s Threatened and Priority Fauna Database, from Salmon Gums in 1998 and 2008 (Figure 13). Although the Chuditch may occur in the study area, the likelihood is low. If present it is likely to use all woodland and shrubland habitats.

5.2.2 Migratory Fauna

Migratory species are not always present at a site, but a particular site may have significance as a seasonal or ephemeral foraging, breeding or shelter area. Impacts to these sites may then impact the population both within the site and further afield. For Migratory shorebirds, a site is deemed internationally important if it regularly supports more than 1% of the flyway population of a species, or a total abundance of at least 20,000 shorebirds, and nationally important if it regularly supports more than 0.1% of the flyway population of a species, at least 2,000 shorebirds or at least 15 shorebird species (Hansen *et al.* 2016, Commonwealth of Australia 2017). The flyway population estimates, 1% and 0.1% criteria for selected shorebirds are given in Table 11.

Table 11. Flyway Population Estimates for Selected Migratory Shorebirds.

Species	Flyway Population Estimate*	1% Flyway Population Criterion*	0.1% Flyway Population Criterion*
Common Sandpiper	190,000	1,900	190
Curlew Sandpiper	90,000	900	90
Sharp-tailed Sandpiper	85,000	850	85
Common Greenshank	110,000	1,100	110
Red-necked Stint	475,000	4,750	475
Pectoral Sandpiper	1,220,000 – 1,930,000	12,200	1,220

*Data from Hansen *et al.* (2016).



Common Sandpiper – *Tringa hypoleucos*

The Common Sandpiper is listed as Migratory under the BC Act and EPBC Act.

Although it may be present at any time of the year, the Common Sandpiper is most common in the southwest from September to March (Johnstone and Storr 1998). This species occurs in a range of salt and freshwater habitats, including coasts, river pools, drying swamps and floodwaters (Johnstone and Storr 1998), however, it is most common on the coast (Geering *et al.* 2007). A site is deemed nationally important for this species if it regularly supports at least 190 birds (Table 11). Although this species is likely to be a visitor to the region, the study area is unlikely to support more than a few individuals at a time.

Sharp-tailed Sandpiper – *Calidris acuminata*

The Sharp-tailed Sandpiper is listed as Migratory under the BC Act and EPBC Act.

The Sharp-tailed Sandpiper favours non-tidal freshwater or brackish wetlands, though it also occurs in other habitats (Geering *et al.* 2007). This species is a visitor to the southwest, mostly between September and March (Johnstone and Storr 1998). A site is deemed nationally important for this species if it regularly supports at least 85 birds (Table 11). Although this species may be an occasional non-breeding visitor to Lake Dundas or Lake Cowan, the study area is unlikely to support more than a few individuals.

Common Greenshank – *Tringa nebularia*

The Common Greenshank is listed as Migratory under the BC Act and EPBC Act.

The Common Greenshank breeds in the northern hemisphere and is a visitor to Australia generally between September and March (Johnstone and Storr 1998). It inhabits a range of fresh and salt waters both on the coast and inland (Geering *et al.* 2007, Johnstone and Storr 1998). A site is deemed nationally important for this species if it regularly supports at least 110 birds (Table 11). Although this species may be a non-breeding visitor to Lake Dundas or Lake Cowan, the study area is unlikely to support more than a few individuals.

Red-necked Stint – *Calidris ruficollis*

The Red-necked Stint is listed as Migratory under the BC Act and EPBC Act.

The Red-necked Stint occurs across a wide range of fresh and saltwater habitats, including freshwater wetlands (Geering *et al.* 2007). It is a non-breeding visitor to southwest Australia, between October and March (Johnstone and Storr 1998). A site is deemed nationally important for this species if it regularly supports at least 475 birds (Table 11). Very small flocks of up to four birds were observed on Lake Dundas in 2012 (Western Wildlife 2013). These records are also captured on DBCA's Threatened and Priority Fauna Database and are shown on Figure 13.



Pectoral Sandpiper – *Calidris melanotos*

The Pectoral Sandpiper is listed as Migratory under the BC Act and EPBC Act.

The Pectoral Sandpiper favours freshwater wetlands, although it may also occur on brackish waters or samphire flats (Geering et al. 2007, Johnstone and Storr 1998). It is a non-breeding visitor to south-west Australia between December and March (Johnstone and Storr 1998). A site is deemed nationally important for this species if it regularly supports at least 1,220 birds (Table 11). There are no records of this species within 100km on DBCA's Threatened and Priority Fauna Database.

Fork-tailed Swift – *Apus pacificus*

The Fork-tailed Swift is listed as Migratory under the BC Act and EPBC Act.

The Fork-tailed Swift is a non-breeding visitor to Australia between September and April (Boehm 1962). While it can be common further north, in southwest Australia this species is generally scarce (Johnstone and Storr 1998). The bird is primarily observed foraging for insects in proximity to cyclonic weather (Boehm 1962). Although a migratory species, the Fork-tailed Swift has a large range and a large population that appears to be stable (Birdlife International 2020). There are no records of this species within 100km on DBCA's Threatened and Priority Fauna Database (Figure 13). Although it is likely to occur periodically, in Western Australia the Fork-tailed Swift is a largely an aerial species and study area is not likely to be of particular importance to the species.

5.2.3 Specially Protected Fauna

The populations of Specially Protected species are large enough that they are not considered to be Threatened. However, they require on-going conservation intervention (i.e. Conservation Dependent) or be specially protected in order to prevent them from becoming Threatened.

Peregrine Falcon – *Falco peregrinus*

The Peregrine Falcon is listed as Other Specially Protected Fauna under the BC Act.

The Peregrine Falcon is a widespread bird of prey that globally has a very large range and a very large population that appears to be secure (BirdLife International 2020). In Western Australia the population is secure, though this species may experience reductions at a local level due to human disturbance at nesting sites (Debus 1998). The Peregrine Falcon nests mainly on ledges on cliffs or rocky outcrops, and it may also use tall trees (Johnstone and Storr 1998). This species often takes advantage of man-made structures such as abandoned open pits or quarries.



There are several records of the Peregrine Falcon within 100km of the study area on DBCA's Threatened and Priority Fauna Database (Figure 13), with the nearest record less than 1km from the Maybelle study area. This species is likely to occur in the study area and breeding habitat may be present, particularly in existing open pits. If a pair nests nearby, they are likely to forage in the study area.

5.2.4 Priority Fauna

Priority 1, 2 or 3 species are considered to be in need of further survey, as insufficient data exist to adequately determine their status. Many Priority 1, 2 and 3 species are known from only a few records in a limited number of locations, thus determining their status in the study area may be problematic. Priority 4 species are considered to require regular monitoring, as although they are adequately known, they are either rare, near threatened or recently removed from the threatened list.

Lake Cronin Snake – *Paroplocephalus atriceps*

The Lake Cronin Snake is listed as Priority 3 by DBCA.

The Lake Cronin Snake is known from very few localities in the semi-arid southern interior of Western Australia (Storr *et al.* 2002). The Lake Cronin Snake has been recorded from areas of woodland (including Salmon Gum woodlands) and tall shrubland and, although not known to have declined, this species may be threatened by clearing for agriculture and mining (Cogger *et al.* 1993, Bush *et al.* 2007). There is a single record of this species within 100km of the study area on the DBCA Threatened Fauna Database, from Salmon Gums in 2002 (Figure 13). The Lake Cronin Snake possibly occurs in the study area, however, the low number of records in the region makes its status difficult to ascertain and its range is not currently known to extend as far north as Norseman.

Hooded Plover – *Thinornis cucullata*

The Hooded Plover is listed as Priority 4 by DBCA.

The Hooded Plover is a small shorebird that inhabits both coastal areas and salt lakes. This bird often occurs in pairs or small groups but is also known to form large flocks of up to 400 birds in the Esperance area (Johnstone and Storr 1998). The Hooded Plover has been recorded breeding at Lake Dundas and at Norseman (Raines 2002). The Hooded Plover is vulnerable to predation by introduced predators and to human disturbance, as it nests on the ground in the open on the beach or on the margins of salt lakes. The eggs take about a month to hatch and then the young are flightless for the first 6 weeks of life (Raines 2002).



The Hooded Plover was recorded on Lake Dundas on DBCA's Threatened and Priority Fauna Database, as well as on salt lakes further south (Figure 13). Hooded Plover may breed on the sandy margins of Lake Dundas or Lake Cowan. Foraging habitat on the lake is likely to change, in both location and abundance, depending on the amount of water in the lakes. When full of water, the foraging habitat may be very close to the lake shores, while at other times, foraging habitat may be in the centre of the lake, or absent.

Inland Western Rosella – *Platycercus icterotis xanthagenys*

The Inland Western Rosella is listed as Priority 4 by DBCA.

The Inland Western Rosella is endemic to southern Western Australia. The population of this species is thought to be declining in the western wheatbelt due to clearing, but stable in the western woodlands (Garnett and Crowley 2000). Although still listed as a Priority species, the Inland Western Rosella was not listed in the 2010 Action Plan for Australian Birds as the population is considered too large and the decline too slow to be designated Near Threatened (Garnett *et al.* 2011). This species occurs in eucalypt and casuarina woodlands, nesting in tree hollows (Johnstone and Storr 1998). The Inland Western Rosella was recorded in the OK study area during the fauna survey and is also known from several records on DBCA's Threatened and Priority Fauna Database (Figure 13). The Inland Western Rosella is likely to forage in woodland and shrubland habitats in the study area, potentially breeding in woodland habitats with tree hollows.

Western Brush Wallaby – *Notamacropus irma*

The Western Brush Wallaby is listed as Priority 4 by DBCA.

The Western Brush Wallaby is endemic to the southwest of Western Australia and occurs in open forests or woodlands (Van Dyck and Strahan 2008). The home-range size of this species has been estimated at about 9.9 ha for males and 5.3 ha for females (Bamford and Bamford 1999), so the study area potentially supports many individuals. However, this species is only known from two locations within 100km on DBCA's Threatened and Priority Fauna Database, the nearest about 24km to the west of the study area (Figure 13). These are both reliable records from 1990 and 2017, suggesting that this species occurs in low densities in the region. Although this species may occur in the study area, the likelihood is low as the study areas represent the eastern extremity of this species known range. If present, it may occur in woodland and shrubland habitats.



Central Long-eared Bat – *Nyctophilus major tor*

The Central Long-eared Bat is listed as Priority 3 by DBCA.

The Central Long-eared Bat is widespread across the arid south of Australia, and though thought to have a population of substantially more than 10,000 individuals, the reliability of this estimate is low (Woinarski *et al.* 2014). It is considered locally common in some Bioregions, including the Coolgardie Bioregion (Duncan *et al.* 1999). It occurs in eucalypt woodlands with a tall shrub understorey and around granite outcrops, roosting beneath bark, in tree crevices or in the foliage of trees (Duncan *et al.* 1999, Van Dyck and Strahan 2008, Churchill 2008). Current threats to this species are inferred and include habitat loss and fragmentation or inappropriate fire regimes leading to a loss of habitat and/or roost sites (Woinarski *et al.* 2014). There are no records of this species within 100km of the study area on DBCA's Threatened and Priority Fauna Database (Figure 13), however, this is unsurprising as records of this bat are reliant on captures as it is not possible to distinguish it from related species on the basis of its call. The Central Long-eared Bat may occur in the woodlands of the study area.

5.2.5 Locally Significant Fauna

No Locally Significant fauna were identified. As the study area is within the relatively intact vegetation of the Great Western Woodlands, most species in this region remain common and widespread. The study area lacks restricted habitats and is not known to support significant congregations of any species.

5.3 Important Habitats

All habitats have some importance in that they support native fauna, however, habitats may be of particular importance if they:

- support very diverse or unique faunal assemblages
- are restricted or rare in the region (and thus the associated faunal assemblages are restricted or rare)
- are refugia (e.g. from drought or fire)
- provide ecological linkage
- support conservation significant fauna

The habitats in the study area are common and widespread in the IBRA subregion and are unlikely to function as ecological linkages or refugia, except on a very local level. Although the habitats may support conservation significant fauna, the likelihood of most species occurring is moderate to low, or if they are likely to occur, it is unlikely to be in significant numbers.



6. Conclusions

The study areas contain eight broad fauna habitats. Although all habitats have importance in supporting native fauna, the habitats of the study area are unlikely to be of particular significance as ecological linkages, refugia or supporting important populations of conservation significant vertebrate fauna.

The faunal assemblage of the Study Area is likely to be largely intact, as the study area is situated within a larger tract of native vegetation. Many of the species that occur are widely distributed through semi-arid Australia. The predicted faunal assemblage includes up to seven frogs, 64 reptiles, 150 birds, 25 native mammals and eight introduced mammals. The observed assemblage on this survey included no frogs or reptiles, 46 birds and five introduced mammals.

Fifteen conservation significant fauna potentially occur in the study area; three Threatened, six Migratory, one Specially Protected and five Priority species. The only species recorded during this survey was the Inland Western Rosella (*Platycercus icterotis xanthogenys*). This Priority 4 species is likely to occur in the eucalypt woodlands and shrublands, potentially breeding in eucalypt hollows.

The species that have a high likelihood of occurrence are the Peregrine Falcon (*Falco peregrinus*) and five species of shorebird; the Common Sandpiper (*Actitis hypoleucos*), Sharp-tailed Sandpiper (*Calidris acuminata*), Common Greenshank (*Tringa nebularia*), Red-necked Stint (*Calidris ruficollis*) and the Hooded Plover (*Thinornis cucullata*). Although likely to occur, the study area is unlikely to be important for the Peregrine Falcon. The shorebirds are likely to occur on Lake Cowan and Lake Dundas, but the EPBC-listed Migratory species are not likely to occur in nationally or internationally significant numbers within the salt lake portions of the study area.

The Curlew Sandpiper (*Calidris ferruginea*), Malleefowl (*Leipoa ocellata*), Fork-tailed Swift (*Apus pacificus*) and Central Long-eared Bat (*Nyctophylus major tor*) are all moderately likely to occur in the study area. The Curlew Sandpiper has been recorded in the region before but favours coastal environments and is therefore not likely to occur in nationally or internationally significant numbers within the salt lake portions of the study area. The Malleefowl was targeted as part of this survey, but despite walking 153km of transect, no mounds were recorded. Although it may overfly the region, the study area is unlikely to be important for the Fork-tailed Swift as it is a primarily aerial species in Australia. The Central Long-eared Bat may occur in the eucalypt woodlands.

The remaining species have a low or very low likelihood of occurrence and include the Lake Cronin Snake (*Paraplocephalus atriceps*), Pectoral Sandpiper (*Calidris melanotos*), Chuditch (*Dasyurus geoffroii*) and Western Brush Wallaby (*Notamacropus irma*).



7. References

- Bamford, M.J. and Bamford, A.R. (1999). *A Study of the Brush or Black-gloved Wallaby Macropus irma (Jourdan 1837) in Whiteman Park*. Whiteman Park Technical Series No.1, Western Australia.
- Barrett, G., Silcocks, A., Barry, S., Cunningham, R. and Poulter, R. (2003). *The New Atlas of Australian Birds*. Royal Australasian Ornithologists Union, Victoria.
- Benshemesh, J. (2007). *National Recovery Plan for Malleefowl*. Department for Environment and Heritage, South Australia.
- BirdLife International (2020). IUCN Red List for birds. URL: <http://www.birdlife.org>
- Boehm, E.F. (1962). Some habits of the Fork-tailed Swift. *Emu* 61(4) 281-282.
- Bureau of Meteorology (2020). URL: <http://www.bom.gov.au>
- Bush, B., Maryan, B., Browne-Cooper, R. and Robinson, D. (2007). *Reptiles and Frogs in the Bush: Southwestern Australia*. University of Western Australia Press, Crawley, Western Australia.
- Churchill, S. (2007). *Australian Bats*. Second Edition. Reed New Holland, Sydney.
- Cogger, H.G., Cameron, E.E., Sadler, R.A. and Egger, P. (1993). *The Action Plan for Australian Reptiles*. Endangered Species Programme Project Number 124, Australian Nature Conservation Agency, Canberra.
- Commonwealth of Australia (2017). *EPBC Act Policy Statement 3.21—Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species*. URL: <http://www.environment.gov.au/system/files/resources/67d7eab4-95a5-4c13-a35e-e74cca47c376/files/bio4190517-shorebirds-guidelines.pdf>
- Cowan, M. (2001). Coolgardie 3 (COO3 – Eastern Goldfields Subregion). In: “*A Biodiversity Audit of Western Australia’s 53 Biogeographical Subregions in 2002*”. Ed by J.E. May and N.L. McKenzie. Department of Conservation and Land Management, Western Australia.
- Debus, S. (1998). *The Birds of Prey of Australia: A Field Guide*. Oxford University Press, Australia.
- DEC (2010). *A Biodiversity and Cultural Conservation Strategy for the Great Western Woodlands*. November, URL: <http://www.dec.wa.gov.au/content/view/6115/2183/>
- DEC (2012). *Chuditch (Dasyurus geoffroii) Recovery Plan*. Wildlife Management Program No. 54. Department of Environment and Conservation, Perth, Western Australia.
- DoE (Department of the Environment) (2015). *Conservation Advice Calidris ferruginea curlew sandpiper*. Canberra. URL: <http://www.environment.gov.au/biodiversity/threatened/species/pubs/856-conservation-advice.pdf>.
- DoEE (2019). Species Profile and Threats Database, Department of the Environment, Canberra. URL: <http://www.environment.gov.au/sprat>.
- DoEE (Department of Environment and Energy) (2018). *Interim Biogeographic Regionalisation for Australia (IBRA), Version 7.0 (Subregions)*. Commonwealth of Australia.
- DEWHA (2010). *Survey guidelines for Australia’s threatened birds: Guidelines for detecting birds listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999*. Commonwealth of Australia, Canberra.
- DBC (2007-). *NatureMap: Mapping Western Australia’s Biodiversity*. Department of Biodiversity, Conservation and Attractions. URL: <https://naturemap.dpaw.wa.gov.au/>
- DBC (2020). *Threatened and Priority Fauna Database extract*. May 2020.



- Duncan, A., Baker, G.B. and Montgomery, N. (1999). *The Action Plan for Australian Bats*. Environment Australia, Canberra.
- Ecologia (1999). *Central Norseman Gold Corp. Fauna Monitoring Program. Baseline Survey 1998 – 1999*. Unpublished report to Central Norseman Gold.
- EPA (Environmental Protection Authority) (2016). *Environmental Factor Guideline – Terrestrial Fauna*. EPA, Western Australia.
- EPA (2020). *Technical Guidance – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment*. EPA, Western Australia.
- Fox, E., McNee, S. and Douglas, T. (2016). *Birds of the Great Western Woodlands*. Report for The Nature Conservancy. BirdLife Australia, Melbourne.
- Garnett, S and Crowley, G.M. (2000). *The Action Plan for Australian Birds 2000*. Environment Australia, Canberra.
- Garnett, S., Szabo, J.K. and Dutson, G. (2011). *The Action Plan for Australian Birds 2010*. CSIRO Publishing, Collingwood, Victoria.
- GHD (2010). *Masta Resources Pty Ltd Report for Brockway Exploration Area: Flora and Fauna Assessment May 2010*. Unpublished report to Masta Resources Pty Ltd.
- Government of Western Australia (2000). *Bush Forever Volume 2*. Department of Environmental Protection, Perth.
- Hansen, B.D., Fuller, R.A., Watkins, D., Rogers, D.I., Clemens, R.S., Newman, M., Woehler, E.J. and Weller, D.R. (2016) *Revision of the East Asian-Australasian Flyway Population Estimates for 37 listed Migratory Shorebird Species*. Unpublished report for the Department of the Environment. BirdLife Australia, Melbourne.
- Johnstone, R.E. & Storr, G.M. (1998). *Handbook of Western Australian Birds. Volume 1: Non-passerines (Emu to Dollarbird)*. Western Australian Museum, Perth.
- Johnstone, R.E. & Storr, G.M. (2004). *Handbook of Western Australian Birds. Volume 2: Passerines (Blue-winged Pitta to Goldfinch)*. Western Australian Museum, Perth.
- Hall, N.J and McKenzie, N.L. (Eds.)(1993). *The Biological Survey of the Eastern Goldfields of Western Australia: Part 9. Norseman – Balladonia study area*. Records of the Western Australian Museum Supplement 42.
- Halpern Glick Maunsell (1994). *Fauna Survey of the Proposed Harlequin Gold Mine Development Site*. Unpublished report to Central Mining Gold Corporation.
- Mattiske Consulting Pty Ltd and Ninnox Wildlife Consulting (2005). *Flora, vegetation and vertebrate fauna survey on proposed tailings dam area*. Unpublished report to Croesus Mining NL.
- Mattiske Consulting Pty Ltd (2020a). *Flora and Vegetation Assessment: Norseman Gold Project*. Unpublished report to Pantoro Limited.
- Mattiske Consulting Pty Ltd (2020b). *Flora and Vegetation Assessment – Spring 2020: Norseman Gold Project, Norseman, WA*. Unpublished report to Pantoro Limited.
- Menkhorst, P. and Knight, F. (2011). *A field guide to the mammals of Australia*. 3rd Edition. Oxford University Press, South Melbourne.
- Orell, P. and Morris, K. (1994). *Chuditch recovery plan*. Wildlife Management Program No 13. Department of Conservation and Land Management.
- Outback Ecology (2003). *Baseline Environmental Study: Lake Cowan*. Unpublished report to Central Norseman Gold Mine.



- Outback Ecology (2006). *Biological Monitoring of Lake Cowan, January 2006*. Unpublished report to Croesus Mining NL.
- Raines, J. (2002). Hooded Plover Management Plan (2002 – 2012) Western Australia. *Western Australian Bird Notes* Supplement No. 7, July 2002.
- Rayner, K., Chambers, B., Johnson, B., Morris, K.D. and Mills, H. (2011). Spatial and dietary requirements of the Chuditch (*Dasyurus geoffroii*) in a semi-arid climactic zone. *Australian Mammalogy*
- Serena, M., and Soderquist, T. R. (1989). Spatial organization of a riparian population of the carnivorous marsupial *Dasyurus geoffroii*. *Journal of Zoology* 219, 373–383
- Short, J. (2001). Mammal decline in southern Western Australia – perspectives from Shortridge’s collections of mammals in 1904-07. *Australian Zoologist* 32(4) 605 – 628.
- Storr, G.M., Smith, L.A. and Johnstone, R.E. (1983). *Lizards of Western Australia. II. Dragons and Monitors*. W.A. Museum, Perth.
- Storr, G.M., Smith, L.A. and Johnstone, R.E. (2002). *Snakes of Western Australia*. W.A. Museum, Perth.
- Storr, G.M., Smith, L.A. and Johnstone, R.E. (1990). *Lizards of Western Australia. III. Geckoes and Pygopods*. W.A. Museum, Perth.
- Storr, G.M., Smith, L.A. and Johnstone, R.E. (1999). *Lizards of Western Australia. I. Skinks*. 2nd edition. W.A. Museum, Perth.
- Tyler, M.J. (1998). *The Action Plan for Australian Frogs*. Environment Australia, Canberra.
- Tyler, M.J., Smith, L.A. and Johnstone, R.E. (2000). *Frogs of Western Australia*. W.A. Museum, Perth.
- Van Dyck, S. and Strahan, R. (Eds.) (2008). *The Mammals of Australia*. 3rd Edition. Australian Museum/Reed Books, Sydney.
- Western Wildlife (2013). *Mt Henry Study Area Baseline Fauna Survey: Level 2 Fauna Survey 2012 & 2013 – Final Report*. Unpublished report to Panoramic Resources Limited.
- Wilson, S. and Swan, G. (2017). *A Complete Guide to the Reptiles of Australia*. 5th Edition. New Holland Publishers (Australia), Sydney.
- Woinarski, J.C.Z., Burbidge, A.A. and Harrison, P.L. (2014). *The Action Plan for Australian Mammals 2012*. CSIRO Publishing.



Appendices

Appendix 1. Frogs that Potentially Occur in the Study Area

Key to records:

This survey = species recorded in the survey area in May 2020.

Mt Henry = species recorded in and adjacent to the southern part of the survey area, 2012 - 2013 (Western Wildlife 2013).

Norseman Gold = species recorded in and adjacent to the survey area, 1998 – 1999 (Ecologia 1999).

Harlequin Mine = species recorded in and adjacent to the northern part of the survey area in 1994 (Halpern Glick Maunsell 1994).

Dundas NR = species recorded in Dundas Nature Reserve 1977 – 1980, 45km east of the survey area (Hall and McKenzie 1993)

WA Museum = species records from the Western Australian Museum Database (see Table 2).

Fauna Survey DB = species records from the Fauna Survey Database (see Table 2).

DBCA = species records from the DBCA Threatened and Priority Species Database (see Table 2).

EPBC = species & species habitat from the EPBC Protected Matters Search Tool (see Table 2).

Species	Conservation status	Records								
		This survey	Mt Henry	Norseman Gold	Harlequin Gold	Dundas NR	WA Museum	Fauna Survey DB	DBCA	EPBC
Limnodynastidae (burrowing frogs)										
Western Banjo Frog <i>Limnodynastes dorsalis</i>				+			+			
White-footed Trilling Frog <i>Neobatrachus albipes</i>				+			+			
Kunapalari Frog <i>Neobatrachus kunapalari</i>				+			+	+		
Humming Frog <i>Neobatrachus pelobatoides</i>							+			
Shoemaker Frog <i>Neobatrachus sutor</i>										
Myobatrachidae (ground frogs)										
Bleating Froglet <i>Crinia pseudinsignifera</i>				+			+			
Western Toadlet <i>Pseudophryne occidentalis</i>				+	+		+			
Number of frog species predicted:							7			



Appendix 2. Reptiles that Potentially Occur in the Study Area

Key to records:

This survey = species recorded in the survey area in May 2020.

Mt Henry = species recorded in and adjacent to the southern part of the survey area, 2012 - 2013 (Western Wildlife 2013).

Norseman Gold = species recorded in and adjacent to the survey area, 1998 – 1999 (Ecologia 1999).

Harlequin Mine = species recorded in and adjacent to the northern part of the survey area in 1994 (Halpern Glick Maunsell 1994).

Dundas NR = species recorded in Dundas Nature Reserve 1977 – 1980, 45km east of the survey area (Hall and McKenzie 1993)

WA Museum = species records from the Western Australian Museum Database (see Table 2).

Fauna Survey DB = species records from the Fauna Survey Database (see Table 2).

DBCA = species records from the DBCA Threatened and Priority Species Database (see Table 2).

EPBC = species & species habitat from the EPBC Protected Matters Search Tool (see Table 2).

Species	Conservation Status	Records								
		This survey	Mt Henry	Norseman Gold	Harlequin Mine	Dundas NR	WA Museum	Fauna Survey	DBCA	EPBC
Carphodactylidae (knob-tailed geckoes)										
Barking Gecko	<i>Underwoodisaurus milii</i>		+	+			+	+		
Diplodactylidae (ground geckos)										
Clawless Gecko	<i>Crenadactylus ocellatus</i>		+	+		+		+		
Wheatbelt Stone Gecko	<i>Diplodactylus granariensis</i>		+	+		+		+		
Western Saddled Ground Gecko	<i>Diplodactylus pulcher</i>			+						
	<i>Lucasium maini</i>		+	+	+	+		+		
Reticulated Velvet Gecko	<i>Hesperoedura reticulata</i>		+			+		+		
Goldfields Spiny-tailed Gecko	<i>Strophurus assimilis</i>			+						
Gekkonidae (geckoes)										
Marbled Gecko	<i>Christinus marmoratus</i>		+	+		+	+	+		
Variiegated Dtella	<i>Gehyra variegata</i>		+	+		+	+	+		
Bynoe's Gecko	<i>Heteronotia binoei</i>		+	+		+	+	+		
Pygopodidae (legless lizards)										
	<i>Delma australis</i>		+	+		+	+	+		
	<i>Delma butleri</i>									
Fraser's Legless Lizard	<i>Delma fraseri</i>		+	+			+	+		
Burton's Legless Lizard	<i>Lialis burtonis</i>		+	+		+	+	+		
Keeled Legless Lizard	<i>Pletholax gracilis</i>							+		
Common Scaly-foot	<i>Pygopus lepidopodus</i>		+	+			+	+		
Agamidae (dragon lizards)										
Eastern Heath Dragon	<i>Ctenophorus chapmani</i>					+				
Crested Dragon	<i>Ctenophorus cristatus</i>		+	+	+	+	+	+		
Spotted Military Dragon	<i>Ctenophorus maculatus</i>									
Ornate Crevice Dragon	<i>Ctenophorus ornatus</i>		+				+	+		
Western Netted Dragon	<i>Ctenophorus reticulatus</i>						+			
Salt Lake Dragon	<i>Ctenophorus salinarum</i>		+	+	+	+	+	+		
Lozenge-marked Dragon	<i>Ctenophorus scutulatus</i>						+			
Thorny Devil	<i>Moloch horridus</i>		+	+		+	+	+		
Bearded Dragon	<i>Pogona minor</i>		+	+		+	+	+		
Goldfields Pebble Dragon	<i>Tympanocryptis pseudopsephos</i>			+			+			



Appendix 2. (cont.)

Species	Conservation Status	Records								
		This survey	Mt Henry	Norseman Gold	Harlequin Mine	Dundas NR	WA Museum	Fauna Survey	DBCA	EPBC
Scincidae (skink lizards)										
Fence Skink	<i>Cryptoblepharus buchananii</i>		+	+		+	+	+		
	<i>Ctenotus atlas</i>			+		+	+			
	<i>Ctenotus schomburgkii</i>		+			+	+	+		
	<i>Ctenotus uber</i>		+	+		+	+	+		
	<i>Cyclodomorphus melanops</i>		+	+		+	+	+		
	<i>Egernia formosa</i>						+			
	<i>Egernia richardi</i>		+	+		+	+	+		
Desert Skink	<i>Liopholis inornata</i>					+				
	<i>Liopholis multiscutata</i>		+	+		+	+	+		
Five-toed Earless Skink	<i>Hemiergis initialis</i>		+	+	+	+	+	+		
	<i>Lerista dorsalis</i>		+			+	+	+		
	<i>Lerista kingi</i>		+					+		
	<i>Lerista picturata</i>		+	+		+	+	+		
	<i>Lerista timida</i>		+				+	+		
	<i>Lerista tridactyla</i>			+			+			
Dwarf Skink	<i>Menetia greyii</i>		+	+		+	+	+		
	<i>Morethia butleri</i>		+	+		+	+	+		
Dusky Morethia	<i>Morethia obscura</i>		+	+		+	+	+		
Western Blue-tongue	<i>Tiliqua occipitalis</i>		+		+	+	+	+		
Bobtail	<i>Tiliqua rugosa</i>		+	+		+	+			
Varanidae (monitor-lizards)										
Gould's Goanna	<i>Varanus gouldii</i>		+	+	+	+	+	+		
Southern Heath Monitor	<i>Varanus rosenbergi</i>					+				
Black-tailed Monitor	<i>Varanus tristis</i>		+	+			+	+		
Typhlopidae (blind-snakes)										
Southern Blind Snake	<i>Anilius australis</i>		+	+			+	+		
	<i>Anilius bicolor</i>		+					+		
	<i>Anilius bituberculatus</i>			+			+			
Pythonidae (Australian pythons)										
Carpet Python (south-west)	<i>Morelia spilota imbricata</i>			+			+			



Appendix 2. (cont.)

Species	Conservation Status	Records								
		This survey	Mt Henry	Norseman Gold	Harlequin Mine	Dundas NR	WA Museum	Fauna Survey	DBCA	EPBC
Elapidae (front-fanged snakes)										
Southern Shovel-nosed Snake <i>Brachyurophis semifasciatus</i>			+						+	
Bardick <i>Echiopsis curta</i>										
Black-naped Snake <i>Neelaps bimaculatus</i>			+			+	+	+		
Lake Cronin Snake <i>Paroplocephalus atriceps</i>	P								+	
Gould's Hooded Snake <i>Parasuta gouldii</i>			+	+		+	+	+		
Monk Snake <i>Parasuta monachus</i>										
Black-backed Snake <i>Parasuta nigriceps</i>			+						+	
Mulga Snake <i>Pseudechis australis</i>			+	+					+	
Dugite <i>Pseudonaja affinis</i>					+	+				
Gwardar <i>Pseudonaja mengdeni</i>			+	+			+	+		
Jan's Banded Snake <i>Simoselaps bertholdi</i>			+					+	+	
Number of reptile species predicted:		64								



Appendix 3. Birds that Potentially Occur in the Study Area

Key to records:

This survey = species recorded in the survey area in May 2020.

Mt Henry = species recorded in and adjacent to the southern part of the survey area, 2012 - 2013 (Western Wildlife 2013).

Brockway Reserve = species recorded in Brockway Timber Reserve, adjacent to the survey area, 2010 (GHD 2010).

Norseman Gold = species recorded in and adjacent to the survey area, 1998 – 1999 (Ecologia 1999).

Harlequin Mine = species recorded in and adjacent to the northern part of the survey area in 1994 (Halpern Glick Maunsell 1994).

Dundas NR = species recorded in Dundas Nature Reserve 1977 – 1980, 45km east of the survey area (Hall and McKenzie 1993)

Birdata = species records from the Birdata Database (see Table 2).

Bird Atlas = species records from the Birds Australia Atlas Database (see Table 2).

WA Museum = species records from the Western Australian Museum Database (see Table 2).

Fauna Survey DB = species records from the Fauna Survey Database (see Table 2).

DBCA = species records from the DBCA Threatened and Priority Species Database (see Table 2).

EPBC = species & species habitat from the EPBC Protected Matters Search Tool (see Table 2).

Species	Conservation status	Records												
		This survey	Mt Henry	Brockway Reserve	Norseman Gold	Harlequin Mine	Dundas NR	Birdata	Birds Atlas	WA Museum	Fauna Survey DB	DBCA	EPBC	
Dromaiidae (emus)														
Emu <i>Dromaius novaehollandiae</i>		+	+	+	+	+	+	+	+		+			
Anatidae (ducks & swans)														
Musk Duck <i>Biziura lobata</i>										+				
Black Swan <i>Cygnus atratus</i>					+			+						
Australian Shelduck <i>Tadorna tadornoides</i>		+	+	+				+	+		+			
Australian Wood Duck <i>Chenonetta jubata</i>					+				+					
Grey Teal <i>Anas gracilis</i>				+	+			+	+					
Chestnut Teal <i>Anas castanea</i>										+				
Pacific Black Duck <i>Anas superciliosa</i>					+			+	+					
Australasian Shoveler <i>Anas rhynchotis</i>														
Pink-eared Duck <i>Malacorhynchus membranaceus</i>				+	+									
Hardhead <i>Aythya australis</i>														
Blue-billed Duck <i>Oxyura australis</i>	P									+			+	
Megapodiidae (mound-builders)														
Malleefowl <i>Leipoa ocellata</i>	T		?				+	+					+	+
Phasianidae (pheasants and quails)														
Stubble Quail <i>Coturnix pectoralis</i>					+					+				
Podicipedidae (grebes)														
Australasian Grebe <i>Tachybaptus novaehollandiae</i>									+	+				
Hoary-headed Grebe <i>Poliiocephalus poliocephalus</i>					+					+				
Ardeidae (herons, egrets & bitterns)														
White-necked Heron <i>Ardea pacifica</i>														
White-faced Heron <i>Ardea novaehollandiae</i>				+	+					+				
Pelecanidae (pelicans)														
Australian Pelican <i>Pelecanus conspicillatus</i>					+									



Appendix 3. (cont.)

Species	Conservation status	Records												
		This survey	Mt Henry	Brockway Reserve	Norseman Gold	Harlequin Mine	Dundas NR	Birdata	Birds Atlas	WA Museum	Fauna Survey DB	DBCA	EPBC	
Accipitridae (kites, hawks and eagles)														
Black-shouldered Kite	<i>Elanus caeruleus</i>									+				
Square-tailed Kite	<i>Hamiostra isura</i>		+			+	+			+		+		
Whistling Kite	<i>Haliastur sphenurus</i>						+	+		+				
Black Kite	<i>Milvus migrans</i>													
Spotted Harrier	<i>Circus assimilis</i>													
Brown Goshawk	<i>Accipiter fasciatus</i>		+		+					+		+		
Collared Sparrowhawk	<i>Accipiter cirrocephalus</i>	+						+			+			
Wedge-tailed Eagle	<i>Aquila audax</i>				+		+	+		+				
Little Eagle	<i>Hieraetus morphnoides</i>						+			+				
Otididae (bustards)														
Australian Bustard	<i>Ardeotis australis</i>													
Rallidae (crakes, rails & gallinules)														
Black-tailed Native-Hen	<i>Tribonyx ventralis</i>													
Eurasian Coot	<i>Fulica atra</i>			+						+				
Turnicidae (button-quails)														
Little Button-quail	<i>Turnix velox</i>													
Burhinidae (stone-curlews)														
Bush Stone-curlew	<i>Burhinus grallarius</i>													
Recurvirostridae (stilts & avocets)														
Black-winged Stilt	<i>Himantopus himantopus</i>			+										
Banded Stilt	<i>Cladorhynchus leucocephalus</i>									+				
Red-necked Avocet	<i>Recurvirostra novaehollandiae</i>							+	+					
Charadriidae (lapwings and plovers)														
Banded Lapwing	<i>Vanellus tricolor</i>						+							
Red-capped Plover	<i>Charadrius ruficapillus</i>	+	+					+		+	+			
Black-fronted Dotterel	<i>Euseyornis melanops</i>													
Hooded Plover	<i>Thinornis cucullatus</i>	P	+							+	+	+		
Inland Dotterel	<i>Peltohyas australis</i>	LS												
Scolopacidae (snipe, godwits, sandpipers & stints)														
Common Sandpiper	<i>Tringa hypoleucos</i>	Mi										+	+	
Common Greenshank	<i>Tringa nebularia</i>	Mi										+	+	
Curlew Sandpiper	<i>Calidris ferruginea</i>	Mi,Cr										+	+	
Red-necked Stint	<i>Calidris ruficollis</i>	Mi	+								+			
Sharp-tailed Sandpiper	<i>Calidris acuminata</i>	Mi											+	
Pectoral Sandpiper	<i>Calidris melanotos</i>	Mi												+
Laridae (gulls, terns, skuas, jaegers & noddies)														
Silver Gull	<i>Larus novaehollandiae</i>													



Appendix 3. (cont.)

Species	Conservation status	Records												
		This survey	Mt Henry	Brockway Reserve	Norseman Gold	Harlequin Mine	Dundas NR	Birdata	Birds Atlas	WA Museum	Fauna Survey DB	DBCA	EPBC	
Columbidae (pigeons and doves)														
Domestic Pigeon <i>Columba livia</i>	Int.							+	+					
Common Bronzewing <i>Phaps chalcoptera</i>			+	+	+		+	+	+	+				
Brush Bronzewing <i>Phaps elegans</i>		+				+								
Crested Pigeon <i>Ocyphaps lophotes</i>			+		+			+	+		+			
Laughing Turtle-dove <i>Streptopelia chinensis</i>									+	+				
Cuculidae (cuckoos)														
Pallid Cuckoo <i>Cacomantis pallidus</i>						+	+	+	+	+				
Fan-tailed Cuckoo <i>Cacomantis flabelliformis</i>									+	+	+			
Black-eared Cuckoo <i>Chrysococcyx osculans</i>			+									+		
Horsfield's Bronze-Cuckoo <i>Chrysococcyx basalus</i>					+									
Shining Bronze-Cuckoo <i>Chrysococcyx lucidus</i>			+							+	+			
Tytonidae (barn owls)														
Eastern Barn Owl <i>Tyto javanica</i>														
Strigidae (hawk-owls)														
Southern Boobook Owl <i>Ninox boobook</i>		+	+		+		+	+	+		+			
Podargidae (frogmouths)														
Tawny Frogmouth <i>Podargus strigoides</i>			+			+	+	+	+		+			
Caprimulgidae (nightjars)														
Spotted Nightjar <i>Eurostopodus argus</i>			+				+		+		+			
Aegothelidae (owlet-nightjars)														
Australian Owlet-Nightjar <i>Aegotheles cristatus</i>			+				+		+		+			
Apodidae (swifts)														
Fork-tailed Swift <i>Apus pacificus</i>	Mi													+
Alcedinidae (forest kingfishers)														
Red-backed Kingfisher <i>Todiramphus pyrrhopygius</i>							+			+				
Sacred Kingfisher <i>Todiramphus sanctus</i>			+				+	+	+		+			
Meropidae (bee-eaters)														
Rainbow Bee-eater <i>Merops ornatus</i>			+		+	+	+	+	+	+	+			
Falconidae (falcons)														
Peregrine Falcon <i>Falco peregrinus</i>	OS		+		+				+	+	+	+		
Australian Hobby <i>Falco longipennis</i>							+	+	+					
Brown Falcon <i>Falco berigora</i>		+	+				+	+	+	+	+			
Australian Kestrel <i>Falco cenchroides</i>			+		+		+	+	+		+			
Cacatuidae (cockatoos)														
Galah <i>Cacatua roseicapilla</i>										+				



Appendix 3. (cont.)

Species	Conservation status	Records												
		This survey	Mt Henry	Brockway Reserve	Norseman Gold	Harlequin Mine	Dundas NR	Birdata	Birds Atlas	WA Museum	Fauna Survey DB	DBCA	EPBC	
Psittacidae (lorikeets & parrots)														
Budgerigah	<i>Melopsittacus undulatus</i>							+						
Scarlet-chested Parrot	<i>Neophema splendida</i>	LS	+					+			+			
Purple-crowned Lorikeet	<i>Parvipsitta porphyrocephala</i>		+	+	+	+	+	+	+	+	+	+	+	
Regent Parrot	<i>Polytelis anthopeplus</i>		+	+				+	+	+		+		
Inland Western Rosella	<i>Platycercus icterotis xanthogenys</i>	P	+	+				+	+	+	+	+	+	
Australian Ringneck	<i>Platycercus zonarius</i>		+	+		+	+	+			+	+		
Mulga Parrot	<i>Platycercus varius</i>							+	+		+			
Climacteridae (treecreepers)														
Rufous Treecreeper	<i>Climacteris rufus</i>		+	+	+	+		+	+	+		+		
Maluridae (fairy-wrens)														
Splendid Fairy-wren	<i>Malurus splendens</i>					+			+					
Blue-breasted Fairy-wren	<i>Malurus pulcherrimus</i>		+	+	+	+		+	+	+	+	+		
White-winged Fairy-wren	<i>Malurus leucopterus</i>		+			+			+	+	+			
Meliphagidae (honeyeaters)														
Black Honeyeater	<i>Sugomel niger</i>													
Red Wattlebird	<i>Anthochaera carunculata</i>		+	+	+	+	+	+	+	+		+		
Spiny-cheeked Honeyeater	<i>Acanthagenys rufogularis</i>		+	+	+	+	+	+	+	+	+	+	+	
Yellow-throated Miner	<i>Manorina flavigula</i>		+	+		+		+	+	+		+		
Singing Honeyeater	<i>Gavialis virescens</i>		+		+	+	+	+	+	+	+	+	+	
Tawny-crowned Honeyeater	<i>Glyciphila melanops</i>						+		+	+	+			
Purple-gaped Honeyeater	<i>Lichenostomus cratitius</i>		+	+					+			+		
White-eared Honeyeater	<i>Lichenostomus leucotis</i>		+	+	+	+	+	+	+	+	+	+	+	
Yellow-plumed Honeyeater	<i>Ptilotula ornata</i>		+	+	+	+	+	+	+	+	+	+	+	
Brown-headed Honeyeater	<i>Melithreptus brevirostris</i>		+	+		+		+	+	+	+	+	+	
Brown Honeyeater	<i>Lichmera indistincta</i>		+	+	+	+		+	+	+		+	+	
White-fronted Honeyeater	<i>Purnella albifrons</i>			+		+	+	+	+	+	+	+	+	
White-cheeked Honeyeater	<i>Phylidonyris niger</i>						+							
New Holland Honeyeater	<i>Phylidonyris novaehollandiae</i>			+					+	+		+		
Pied Honeyeater	<i>Certhionyx variegatus</i>													
Crimson Chat	<i>Epthianura tricolor</i>								+					
White-fronted Chat	<i>Epthianura albifrons</i>					+		+	+	+	+			
Pardalotidae (pardalotes)														
Spotted Pardalote	<i>Pardalotus punctatus</i>		+	+				+	+	+		+		
Striated Pardalote	<i>Pardalotus striatus</i>		+	+		+	+	+	+	+	+	+		



Appendix 3. (cont.)

Species	Conservation status	Records												
		This survey	Mt Henry	Brockway Reserve	Norseman Gold	Harlequin Mine	Dundas NR	Birdata	Birds Atlas	WA Museum	Fauna Survey DB	DBCA	EPBC	
Acanthizidae (thornbills, gerygones & allies)														
White-browed Scrubwren	<i>Sericornis frontalis</i>		+						+				+	
Shy Heathwren	<i>Calamanthus cautus</i>		+		+		+	+	+	+		+		
Rufous Fieldwren	<i>Calamanthus campestris</i>													
Redthroat	<i>Pyrrholaemus brunneus</i>	+	+	+	+	+	+	+	+	+	+	+		
Weebill	<i>Smicronis brevirostris</i>	+	+	+	+	+	+	+	+	+	+	+		
Western Gerygone	<i>Gerygone fusca</i>			+		+	+	+	+					
Inland Thornbill	<i>Acanthiza apicalis</i>	+	+	+	+	+	+	+	+			+		
Slender-billed Thornbill	<i>Acanthiza iredalei</i>													
Chestnut-rumped Thornbill	<i>Acanthiza uropygialis</i>		+		+	+			+			+		
Yellow-rumped Thornbill	<i>Acanthiza chrysorrhoa</i>		+	+	+	+			+	+	+	+		
Pomatostomidae (Australian babblers)														
White-browed Babbler	<i>Pomatostomus superciliosus</i>	+	+	+	+		+	+	+	+	+	+		
Psophodidae (whipbirds, wedgebills and quail-thrush)														
Chestnut (Copper-back) Quail-Thrush	<i>Cinlosoma clarum</i>		+				+				+	+		
Artamidae (woodswallows)														
Masked Woodswallow	<i>Artamus personatus</i>		+						+			+		
Black-faced Woodswallow	<i>Artamus cinereus</i>			+	+		+	+	+			+		
Dusky Woodswallow	<i>Artamus cyanopterus</i>	+	+	+			+	+	+	+	+	+		
Cracticidae (butcherbirds, currawongs & magpie)														
Grey Butcherbird	<i>Cracticus torquatus</i>	+	+	+	+	+	+	+	+	+	+	+		
Pied Butcherbird	<i>Cracticus nigrogularis</i>		+		+		+	+	+			+		
Australian Magpie	<i>Cracticus tibicen</i>		+		+			+	+			+		
Grey Currawong	<i>Strepera versicolor</i>	+	+		+	+	+	+	+			+		
Campephagidae (cuckoo-shrikes and trillers)														
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>	+	+		+	+	+	+	+			+		
White-winged Triller	<i>Lalage tricolor</i>		+											
Neosittidae (sittellas)														
Varied Sittella	<i>Daphoenositta chrysoptera</i>	+	+	+	+		+	+	+	+	+	+		
Oreoicidae (bellbird)														
Crested Bellbird	<i>Oreoica gutturalis</i>		+		+	+	+	+	+	+	+	+		
Pachycephalidae (whistlers)														
Crested Shrike-tit	<i>Falcunculus frontatus</i>		+				+					+		
Gilbert's Whistler	<i>Pachycephala inornata</i>	+	+		+		+	+	+	+	+	+		
Western Golden Whistler	<i>Pachycephala occidentalis</i>	+	+		+		+	+	+	+	+	+		
Rufous Whistler	<i>Pachycephala rufiventris</i>	+	+		+				+			+		
Grey Shrike-thrush	<i>Colluricincla harmonica</i>	+	+	+	+		+	+	+	+	+	+		



Appendix 3. (cont.)

Species	Conservation status	Records										
		This survey	Mt Henry	Brockway Reserve	Norseman Gold	Harlequin Mine	Dundas NR	Birdata	Birds Atlas	WA Museum	Fauna Survey DB	DBCA
Rhipiduridae (wagtails and fantails)												
Grey Fantail	<i>Rhipidura albiscapa</i>		+						+		+	
Willie Wagtail	<i>Rhipidura leucophrys</i>	+	+		+		+	+		+		
Monarchidae (monarchs and flycatchers)												
Maggie-lark	<i>Grallina cyanoleuca</i>				+			+	+			
Restless Flycatcher	<i>Myiagra inquieta</i>	+					+			+		
Corvidae (ravens and crows)												
Australian Raven	<i>Corvus coronoides</i>	+	+	+	+	+	+	+			+	
Little Crow	<i>Corvus bennetti</i>					+	+	+	+			
Petroicidae (Australian robins)												
Jacky Winter	<i>Microeca fascinans</i>	+	+		+	+	+	+	+	+	+	
Hooded Robin	<i>Melanodryas cucullata</i>		+					+	+	+	+	
Red-capped Robin	<i>Petroica goodenovii</i>	+	+	+	+		+	+	+	+	+	
Western Yellow Robin	<i>Eopsaltria australis griseogularis</i>	+	+	+			+		+	+	+	
Southern Scrub-robin	<i>Drymodes brunneopygia</i>				+		+		+			
Hirundinidae (swallows)												
White-backed Swallow	<i>Cheramoeca leucosterna</i>	+			+	+		+	+	+		
Fairy Martin	<i>Hirundo ariel</i>				+			+	+			
Welcome Swallow	<i>Hirundo neoxena</i>	+						+	+			
Tree Martin	<i>Petrochelidon nigricans</i>	+	+			+	+	+	+	+	+	
Locustellidae (Old World warblers, songlarks & grassbirds)												
Brown Songlark	<i>Cincloramphus cruralis</i>							+	+			
Rufous Songlark	<i>Cincloramphus mathewsi</i>								+			
Zosteropidae (white-eyes)												
Silvereye	<i>Zosterops lateralis</i>	+	+			+	+	+	+	+	+	
Dicaeidae (flower-peckers)												
Mistletoebird	<i>Dicaeum hirundinaceum</i>		+						+		+	
Motacillidae (pipits and true wagtails)												
Australian Pipit	<i>Anthus australis</i>				+	+	+				+	
Number of bird species predicted:		150										



Appendix 4. Mammals that Potentially Occur in the Study Area

Key to records:

This survey = species recorded in the survey area in May 2020.

Mt Henry = species recorded in and adjacent to the southern part of the survey area, 2012 - 2013 (Western Wildlife 2013).

Norseman Gold = species recorded in and adjacent to the survey area, 1998 – 1999 (Ecologia 1999).

Harlequin Mine = species recorded in and adjacent to the northern part of the survey area in 1994 (Halpern Glick Maunsell 1994).

Dundas NR = species recorded in Dundas Nature Reserve 1977 – 1980, 45km east of the survey area (Hall and McKenzie 1993)

Birdata = species records from the Birdata Database (see Table 2).

Bird Atlas = species records from the Birds Australia Atlas Database (see Table 2).

WA Museum = species records from the Western Australian Museum Database (see Table 2).

Fauna Survey DB = species records from the Fauna Survey Database (see Table 2).

DBCA = species records from the DBCA Threatened and Priority Species Database (see Table 2).

EPBC = species & species habitat from the EPBC Protected Matters Search Tool (see Table 2).

Species	Conservation status	Records								
		This survey	Mt Henry	Norseman Gold	Harlequin Mine	Dundas NR	WA Museum	Fauna Survey DB	DBCA	EPBC
Tachyglossidae (echidnas)										
Echidna <i>Tachyglossus aculeatus</i>				+			+			
Dasyuridae (carnivorous marsupials)										
Kultarr <i>Antechinomys laniger</i>	T									
Chuditch <i>Dasyurus geoffroii</i>									+	+
Southern Ningau <i>Ningau yvonneae</i>			+	+						+
Fat-tailed Dunnart <i>Sminthopsis crassicaudata</i>			+			+	+	+		
Little Long-tailed Dunnart <i>Sminthopsis dolichura</i>			+	+		+	+	+		
Gilbert's Dunnart <i>Sminthopsis gilberti</i>										
Ooldea Dunnart <i>Sminthopsis ooldea</i>				+					+	
Burramyidae (pygmy possums)										
Western Pygmy Possum <i>Cercartetus concinnus</i>			+	+	+	+	+	+		
Macropodidae (kangaroos and wallabies)										
Euro <i>Osphranter robustus</i>	P		+						+	
Western Grey Kangaroo <i>Macropus fuliginosus</i>				+		+	+			
Western Brush Wallaby <i>Notamacropus irma</i>									+	
Muridae (rodents)										
House Mouse <i>Mus musculus</i>	Int.		+	+		+	+	+		+
Mitchell's Hopping-Mouse <i>Notomys mitchellii</i>			+	+		+	+	+		
Bolam's Mouse <i>Pseudomys bolami</i>			+	+	?	+		+		
Black Rat <i>Rattus rattus</i>	Int.		+				+	+		+
Molossidae (free-tailed bats)										
White-striped Free-tailed Bat <i>Austronomus australis</i>			+	+		+	+	+		
Western Free-tailed Bat <i>Ozimops kitcheneri</i>										
Inland Free-tailed Bat <i>Ozimops petersi</i>										



Appendix 4. (cont.)

Species	Conservation status	Records								
		This survey	Mt Henry	Norseman Gold	Harlequin Mine	Dundas NR	WA Museum	Fauna Survey DB	DBCA	EPBC
Vespertilionidae (evening bats)										
Gould's Wattled Bat			+	+		+		+		
Chocolate Wattled Bat			+	+		+	+	+		
Lesser Long-eared Bat						+				
Central Long-eared Bat						+	+			
Inland Broad-nosed Bat			+					+		
Inland Forest Bat										
Southern Forest Bat			+	+		+		+		
Canidae (dogs & foxes)										
Dingo					+	+				
Dog	Int.	+	+			+		+		+
Fox	Int.			+		+	+			+
Felidae (cats)										
Feral Cat	Int.	+	+		+			+		+
Camelidae (camels)										
Dromedary Camel	Int.	+	+			+				+
Bovidae (goats & cows)										
Goat	Int.	+						+		
Leporidae (rabbits)										
European Rabbit	Int.	+	+	+	+	+	+	+		+
Number of mammal species predicted:		33 (25 native, 8 introduced)								



Appendix 5. EPBC Act Protected Matters Search Tool Results

Fauna species listed for the area within a 20km radius of -32.273°S, 121.780°E, excluding marine species.

Species	Status	Type of presence
Curlew Sandpiper <i>Calidris ferruginea</i>	Critically Endangered & Migratory	Species or species habitat MAY occur within area
Malleefowl <i>Leipoa ocellata</i>	Vulnerable	Species or species habitat LIKELY to occur within area
Night Parrot <i>Pezoporus occidentalis</i>	Endangered	Species or species habitat MAY occur within area
Chuditch <i>Dasyurus geoffroi</i>	Vulnerable	Species or species habitat MAY occur within area
Fork-tailed Swift <i>Apus pacificus</i>	Migratory (marine)	Species or species habitat LIKELY to occur within area
Grey Wagtail <i>Motacilla cinerea</i>	Migratory (terrestrial)	Species or species habitat MAY occur within area
Common Sandpiper <i>Tringa hypoleucos</i>	Migratory (wetland)	Species or species habitat MAY occur within area
Sharp-tailed Sandpiper <i>Calidris acuminata</i>	Migratory (wetland)	Species or species habitat MAY occur within area
Pectoral Sandpiper <i>Calidris melanotos</i>	Migratory (wetland)	Species or species habitat MAY occur within area
Osprey <i>Pandion haliaeetus</i>	Migratory (wetland)	Species or species habitat MAY occur within area

