Chalice Mining Limited

Conservation Management Plan

Hartog and Baudin Low Impact Exploration Drilling Program – Julimar State Forest

E 70/5119

Level 2, 1292 Hay Street
West Perth, Western Australia
GPO Box 2890, Perth WA 6001

T: +61 8 9322 3960
F: +61 8 9322 5800

info@chalicemining.com
www.chalicemining.com

@chalicemining
chalice-mining

Table of Contents

1. Introduction 5
1.1 CMP Scope and Objectives 5
1.2 Planning and Consultation 9

2. Land Tenure, Use and Access 13
2.1 Land Tenure 13
2.2 Land Use, Location and Access 13
2.2.1 Julimar State Forest 13
2.2.2 Nature Reserves and National Parks 14
2.2.3 Private Agricultural Land 14
2.2.4 Location and Access 14

3. Statutory Compliance 16
3.1 Mining Act 16
3.1.1 Tenement Conditions 16
3.1.2 Programme of Work 16
3.2 Environmental Protection Act 16
3.3 Biodiversity Conservation Act 17
3.4 Aboriginal Heritage Act 17

4. Proposed Exploration Activities 20
4.1 Vegetation Disturbance 20
4.2 Diamond Drilling 25
4.3 Support Activities 28
4.4 Program Schedule 28
4.5 Public Access and Security 28
4.6 Rehabilitation 29
4.6.1 Rehabilitation Requirements 29
4.6.2 Monitoring 30
4.6.3 Rectification 30

5. Existing Environment 31
5.1 Climate 31
5.2 Land Systems 32
5.3 Flora and Vegetation 33
5.3.1 Previous Assessments 33
5.3.2 Hartog and Baudin Reconnaissance and Targeted Survey 33
5.3.3 Phytophthora Dieback 47
5.4 Fauna and Habitat 47
5.4.1 Previous Assessments 47
5.4.2 Hartog and Baudin Basic Vertebrate and Targeted Mammal Survey 48
5.5 Hydrology 59
5.6 Aboriginal and Cultural Heritage 61
5.7 Values of Julimar State Forest 61
5.7.1 Conservation Values 61
5.7.2 Tourism, Recreation and Aesthetics 62

6. Risk Assessment and Management 63

7. Roles and Responsibilities 82
7.1 GM Environment and Community 82
7.2 GM Development 82
7.3 Exploration Project Geologist 82
7.4 All Employees and Contractors 83

8. Inductions and Training 84

9. Reporting and Communications 85
9.1 Internal Communication 85
9.2 External Communication 85
9.3 Internal Reporting 85
9.3.1 Incidents 85
9.3.2 Fauna Sightings 86
9.4 External Reporting 86
9.4.1 General 86
9.4.2 Incident Reporting 86
9.4.3 Fauna Sightings 87
9.4.4 Reporting to DMIRS 87

10. References 88

Appendices 90

Tables

Table 1: Proposed Exploration Program and CMP Scope 8
Table 2: Summary of Consultation 9
Table 3: Julimar Exploration Project Tenement Details 13
Table 4: Land Systems of the Hartog and Baudin Targets 32
Table 5: Overview and Potential Impact on Vegetation Communities 35
Table 6: Potentially Occurring and Recorded Conservation Significant Flora within Proposed Exploration Drilling Program Area 40
Table 7: Potential Impact on Conservation Significant Flora (Biologic 2021) 46
Table 8: Overview and Proposed Impact on Fauna Habitats 50
Table 9: Potentially Occurring and Recorded Conservation Significant Fauna of the Hartog and Baudin Targets 56
Table 10: Potential Introduced Species and Declared Pest Organisms 58
Table 11: Invertebrate Fauna of Conservation Significance 58
Table 12: Risk Assessment and Management Commitments 65
Table 13: Key Contact Details 86

Figures

Figure 1: Project Location 6

Figure 2: Location of Hartog and Baudin Targets 7
Figure 3: Land Use and Access 15
Figure 4: Hartog and Baudin Proposed Drill Program 22
Figure 5: Proposed Drill Site and Access Route Layouts 23
Figure 6: Climate Data for the proposed Julimar exploration area (BoM 2020) 31
Figure 7: Vegetation Communities Mapped Within the Hartog and Baudin Targets 37
Figure 8: Conservation Significant Flora Recorded Within the Hartog and Baudin Targets 45
Figure 9: Fauna Habitats Mapped Within the Hartog and Baudin Targets 53
Figure 10: Conservation Significant Fauna Records 55
Figure 11: Surface Water Drainage and Heritage Sites within the Hartog and Baudin Targets 60
Figure 12: Hierarchy of Controls 63

Plates

Plate 1: Drill site pre-drilling (drilling on private farmland May 2021) 24
Plate 2: Drill site post drilling (drilling on private farmland May 2021) 24
Plate 3: Track Mounted Diamond Drill Rig 26
Plate 4: Track Mounted Support Trailer and Core Tray 26
Plate 5: Track Mounted Waste Unit 27
Plate 6: Track Mounted Waste Unit with Lighting Plant 27

Appendices

Appendix 1 Dieback Management Plan
Appendix 2 Public Access and Traffic Management Plan
Appendix 3 Reconnaissance Flora Survey of the Hartog and Baudin Targets (Biologic 2021)
Appendix 4 Targeted Flora Survey of the Hartog and Baudin Targets (Biologic 2021a)
Appendix 5 Basic and Targeted Vertebrate Fauna Survey (Western Wildlife 2021)
Appendix 6 Black Cockatoo Habitat Survey (Western Wildlife 2021a)
Appendix 7 Risk Assessment Tools
Appendix 8 Exploration Environmental Checklist
Appendix 9 PoW Rehabilitation Reporting Form
Appendix 10 Chalice Incident Reporting Form

1. Introduction

Chalice Mining Limited (Chalice) is a mineral exploration company headquartered in Perth, Western Australia and listed on the Australian Securities Exchange (ASX: CHN). Chalice owns 100% of the tenements associated with the Julimar Project, which is located ~80km north-east of Perth in the Shire of Toodyay (Figure 1).

The Julimar Project commenced as part of Chalice's global search for high-potential nickel sulphide exploration opportunities. Following the identification of a 26 km long magnetic anomaly, now known as the Julimar Complex, Chalice commenced a reconnaissance exploration program on a section of private land on tenements E70/5118 and E70/5119. In March 2020, drilling intersected high-grade nickel-copper-cobalt-PGE mineralisation in the very first drill hole. Subsequent drilling has intersected further significant mineralisation, leading to the announcement of a discovery named Gonneville.

The remaining 24 km of the Julimar Complex extends north-east from Gonneville into the Julimar State Forest. In 2020, Chalice defined an exploration corridor that aligned with the Complex, covering an area of 7,387 ha or 20% of the Julimar State Forest, on E70/5119 (Figure 2). Chalice commenced low impact non-ground disturbing activities, comprising soil sampling and geophysical surveys, within this corridor in January 2021. These activities were strictly governed by a Conservation Management Plan (Stage 1) endorsed by the Minister of Environment in December 2020.

The exploration activities pertaining to the Stage 1 CMP have further demonstrated the presence of potential mineralisation, of which Chalice seek to continue to explore. These exploration activities require the submission of an additional Conservation Management Plan (this document). There is a formal requirement under Section 24 (6B) of the *Mining Act 1978* for the Minister responsible for State Forest (the Minister for Environment) to provide their prior concurrence to any consent for proposed mining (or exploration) activities in State Forest within the south-west mineral field area. Pending the outcomes of the decision, the CMP will inform additional tenement conditions relevant to E70/5119 and consent will be provided exclusively for the activities described within this document.

1.1 CMP Scope and Objectives

The proposed exploration activities covered by this Conservation Management Plan (CMP) involve access to Julimar State Forest to conduct wide-spaced, low-impact exploration drilling for nickel, copper, cobalt, gold, and Platinum Group Elements (PGEs) within E70/5119. The exploration area covers approximately 2,023 ha, or approximately 7% of the total Julimar State Forest across two target areas known as Hartog and Baudin (Figure 2).

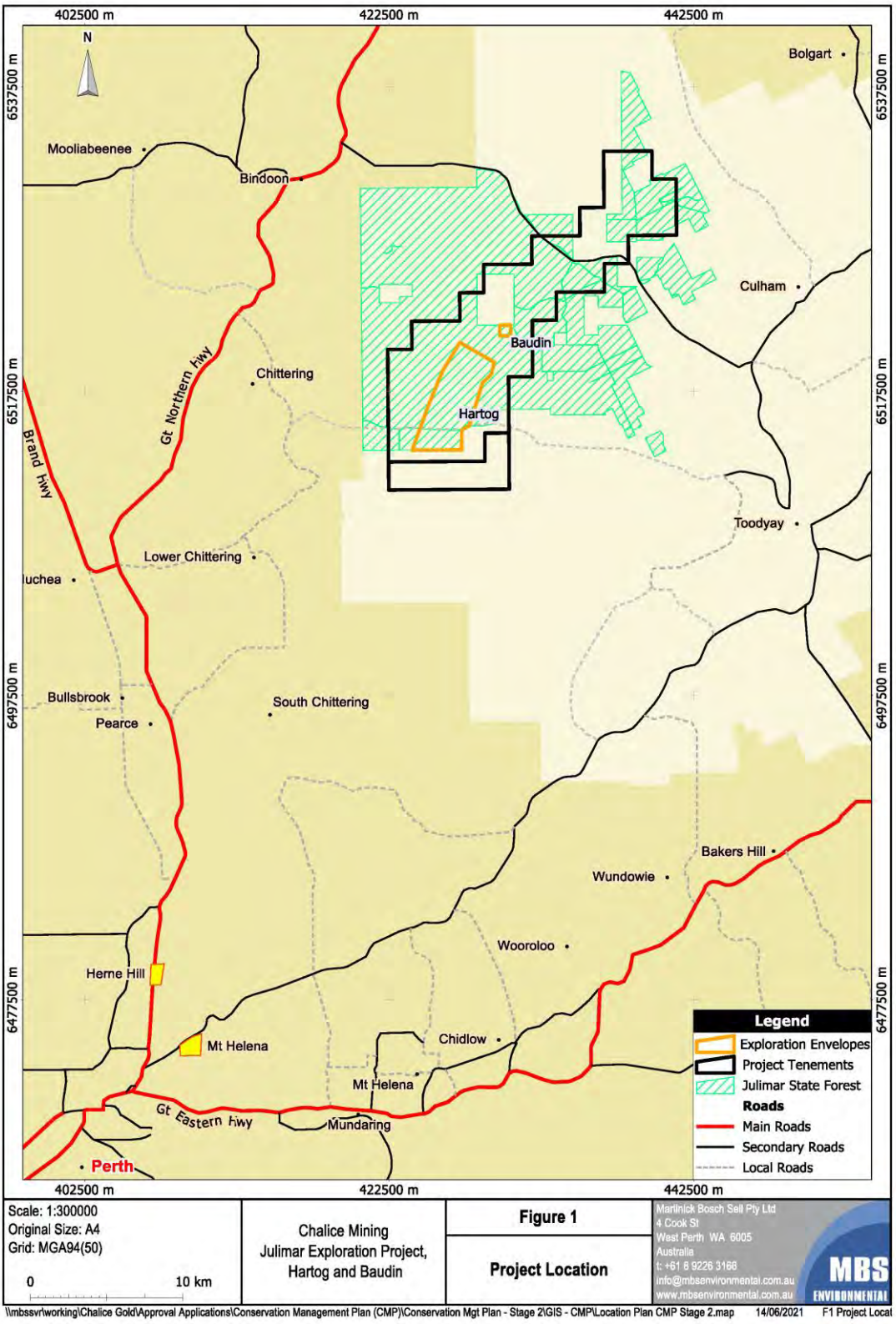


Figure 1: Project Location

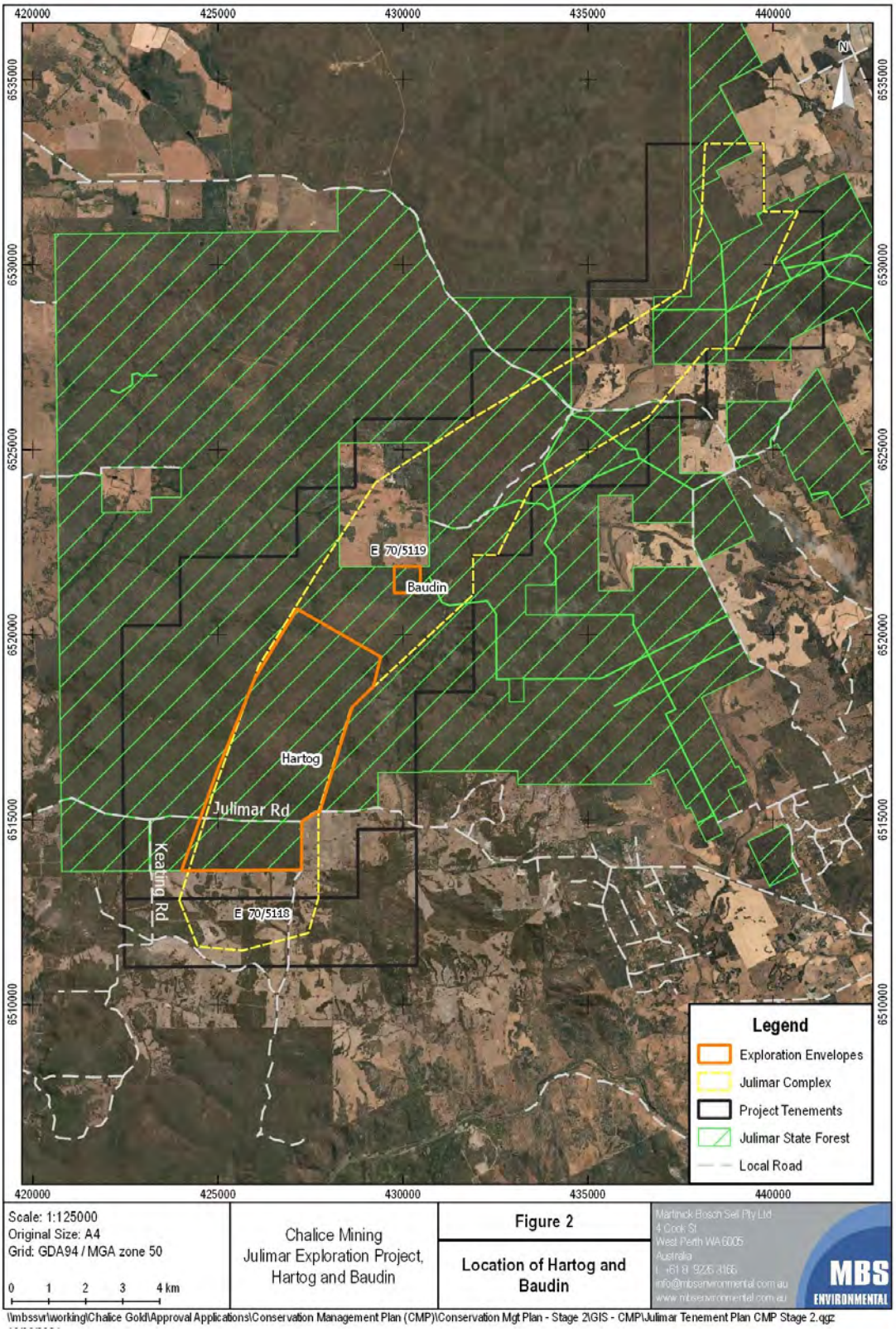


Figure 2: Location of Hartog and Baudin Targets

The purpose of a Conservation Management Plan is to provide a framework to adequately mitigate potential changes to environmental and landscape processes that could diminish the values for which lands in the conservation estate are managed. Within Julimar State Forest the key conservation values that are relevant to the proposed exploration area include:

- biodiversity conservation (e.g. threatened flora and fauna, priority flora and fauna)
- landscape conservation (drainage lines)
- research and scientific study (long-term monitoring sites)
- recreation, and
- cultural heritage.

Accordingly, this Conservation Management Plan documents these values to a degree commensurate with the nature of the activities and level of potential impacts, describes the consequences of the proposed exploration activities on those values, and commits to controls that minimise the impacts of all activities to acceptable levels. It outlines the procedures and commitments Chalice will implement to ensure potential impacts on the conservation values of the State Forest are either avoided, minimised and/or appropriately managed in relation to the proposed exploration activities.

Table 1 outlines the overall scope of the proposed exploration program and how CMP requirements have been addressed throughout this document.

Table 1: Proposed Exploration Program and CMP Scope

CMP Requirement	Detail	Section
Tenement No.	E70/5119	
Date of Grant	31 January 2018	
Holder	CGM (WA) Pty Ltd	
DBCA Tenure Affected	Julimar State Forest (State Forest 61)	
Program Type	Diamond drilling for exploration	Section 4.2
Minerals being sought	Nickel, copper, cobalt, gold and Platinum Group Elements (PGEs)	
Number of drill sites	71	Section 4.0, Figure 4.0
Land disturbance	4.4 ha	Section 4.1
Anticipated Start Date	Late Q3 2021	
Operational hours	24-hours, 2 shifts × 12 hrs per day, 7 days a week	
Estimated duration of program	6-12 months	
Workforce accommodation	Existing camps on Chalice farmland	
Access	Via Julimar, Ferguson and Keating roads and associated existing track network within Julimar State Forest	

CMP Requirement	Detail	Section
Assessment of risks to conservation values occurring in the program area.		Section 6.0
Design aspects and management practices to avoid, adequately reduce or mitigate impacts.		Section 6.0
Monitoring and reporting commitments.		Section 6.0, Section 9.0

1.2 Planning and Consultation

Consultation has been undertaken with relevant government agencies and other stakeholders as part of developing the proposed exploration program and this CMP. Table 2 summarises this engagement.

Table 2: Summary of Consultation

Date	Stakeholder	Content
23 July 2020	Toodyay Shire	« Initial introduction to Chalice Mining and Julimar Project. « CEO requested Chalice present to full Shire Council.
13 August 2020	Chittering Shire	« Initial introduction to Chalice Mining and Julimar Project.
18 September 2020	Toodyay Chamber of Commerce	« Introduction of Chalice to Toodyay CoC. « Update on activities to date, outlined the potential for non-ground disturbing exploration activities in JSF in the future. « Key discussion was the economic impact for the community.
17 November 2020	Toodyay Shire – Council Members	« Presentation delivered at Council Meeting. « Provided Project overview, current activities on private farmland and outlined the potential for non-ground disturbing exploration activities in JSF in the future. « Addressed environmental and community engagement framework.
15 February 2021	Avon and Hills Mining Awareness Group	« Introduction to Chalice Mining and Julimar Project. « Briefing on non-ground disturbing exploration activities in JSF. « Overview of Stage 1 CMP. « Key matters of discussion included future project stages and our environmental and community engagement framework. « Request for continued communication between both parties.

Date	Stakeholder	Content
29 March 2021	Dept. of Jobs, Tourism, Science and Innovation (JTSI)	« Update on Julimar Project, exploration drilling program on farmlands and progress of non-ground disturbing exploration activities in JSF. « Overview of proposed JSF drilling program and approval pathways.
13 April 2021	Dept. of Mines, Industry Regulation and Safety (DMIRS)	« Update on Julimar Project, exploration drilling program on farmlands and progress of non-ground disturbing exploration activities in JSF. « Overview of proposed JSF drilling program and approval pathways. « Discussion on a range of matters including Traditional Owner engagement and cultural heritage surveys, dieback mapping, SAPPR.
15 April 2021	Shire of Toodyay	« Update on Julimar Project, exploration drilling program on private land and progress of non-ground disturbing exploration activities in JSF. « Discussion on a range of matters relating to current and future activities, including drilling program. « Commended Chalice's execution of works to date.
15 April 2021	Avon Valley Environmental Society	« Introduction to Chalice Mining and briefing on the Julimar Project. « Discussion on a range of matters including future project stages and timeframes, and our environmental and community engagement framework. « Briefing on non-ground disturbing exploration activities in JSF.
21 April 2021	Dept. of Biodiversity, Conservation and Attractions (DBCA)	« Update on progress of non-ground disturbing exploration activities in JSF. « Briefing on proposed approach to low-impact drilling program in JSF, including scope of environmental baseline surveys. « Key matters of discussion included potential impacts to black cockatoo species, dieback management, Chuditch monitoring program, hydrocarbon management, Traditional Owner engagement and cultural heritage, and security.
4 May 2021	Office of the Minister of Environment	« Introduction to Chalice Mining and the Julimar Project. « Briefing on proposed approach to low-impact drilling program in JSF, outlining CMP process and timing.
10 May 2021	Dept of Premier and Cabinet; Office of Minister for State Development	« Introduction to Chalice Mining and the Julimar Project. « Briefing on proposed approach to low-impact drilling program in JSF, outlining CMP process and timing.
18 May 2021	South West Aboriginal Land and Sea Council (SWALSC)	« Letter to new Chair and CEO to introduce Chalice, the Julimar Project and offer project briefing.

Date	Stakeholder	Content
19 May 2021	JTSI	« Update on stakeholder engagement and approach to low-impact drilling program in JSF, including approval pathways.
1 June 2021	Shire of Toodyay	« Julimar Project Site Visit with 11 Councilors.
3 June 2021	DMIRS	« Update on stakeholder engagement and approach to low-impact drilling program in JSF, including approval pathways.
3 June 2021	Shane Love MLA	« Follow-up meeting to provide a formal briefing on Julimar Project.
11 June 2021	DBCA	« Update on scope of proposed Hartog-Baudin drilling program and outcomes of environmental surveys. « Overview of CMP submission and review process.
4 June 2021	SWALSC	« Submission of Activity Notices relating to proposed exploration program as per Heritage Agreement with the Yued Agreement Group and the Whadjuk People Agreement Group.
16 June 2021	DBCA	« Draft Conservation Management Plan submitted to DBCA for review.
29 June 2021	SWALSC	« Receipt of Activity Notice Responses outlining cultural heritage survey requirements.
6 July 2021	Mia Davies MLA and Shane Love MLA	« Julimar Project Site Visit.
22 July 2021	DMIRS	« Update on proposed Hartog-Baudin exploration program. « Overview of Native Vegetation Clearing Permit and Programme of Work application processes.
27 July 2021	JTSI	« Update on proposed Hartog-Baudin exploration drilling program. « Overview of Draft CMP.
28 July 2021	Dept of Premier and Cabinet; Office of Minister for State Development	« Update on proposed Hartog-Baudin exploration drilling program. « Overview of Draft CMP.
28 July 2021	SWALSC	« Introductory meeting with CEO. « Overview of Chalice Mining and Julimar Project. « Update on Activity Notice and cultural heritage survey process.
20 August 2021	DBCA and DMIRS	« DBCA and DMIRS provided comments on the Draft CMP.
2 September 2021	SWALSC	« Receipt of Yued and Whadjuk Aboriginal Cultural Heritage Consultant Nominations from Heritage Consultant Selection Panel
7 September 2021	DMIRS	« Julimar Project Site Visit.
8 September 2021	DBCA and DMIRS	« Review of DBCA and DMIRS comments on Draft Conservation Management Plan.

Date	Stakeholder	Content
14 September 2021	Yued Traditional Owners	« Commencement of archaeological and ethnographic Aboriginal cultural heritage surveys.
14 September 2021	DBCA	« Review of Draft Dieback Management Plan
27 September 2021	Whadjuk Traditional Owners	« Commencement of archaeological and ethnographic Aboriginal cultural heritage surveys.
29 September 2021	Hon Bill Johnston MLA	« Julimar Project Site Visit
8 October 2021	DBCA	« Discussion on Conservation Management Plan and Dieback Management Plan.
13 October 2021	DBCA	« Chalice provided an updated Conservation Management Plan with appendices to DBCA.
3 November 2021	DBCA	« DBCA provided feedback on Dieback Management Plan
5 November 2021	DBCA	« Submitted Final Conservation Management Plan to DBCA
10 November 2021	DBCA	« DBCA provided comments on Conservation Management Plan and Dieback Management Plan
11 November 2021	DBCA	« Discussion on comments on Conservation Management Plan and Dieback Management Plan.

Information gained through this consultation has been incorporated into the CMP.

2. Land Tenure, Use and Access

2.1 Land Tenure

The Julimar Project consists of two Exploration Licences (E70/5118 and E70/5119) covering approximately 15,600 ha. Tenement E70/5118 comprises solely private agricultural land and works within this tenement are not the subject of this CMP.

The majority of Tenement E70/5119 (75%) comprises land within the boundaries of the Julimar State Forest with pockets of private agricultural land also covered. A summary of tenement details is provided in Table 3.

The Hartog and Baudin targets cover an area of approximately 2,000 ha of the Julimar State Forest. The State Forest covers a total area of 28,192 ha.

Table 3: Julimar Exploration Project Tenement Details

Tenement	Area (ha)	Holder	Granted	Expiry	Portion within State Forest ha (%)
E70/5118	1,800	CGM (WA) Pty Ltd	31/01/2018	02/09/2023	0 (0%)
E70/5119	13,800	CGM (WA) Pty Ltd	31/01/2018	29/08/2024	10,316 (37%)

2.2 Land Use, Location and Access

2.2.1 Julimar State Forest

Julimar State Forest (State Forest 61) covers 28,192 ha of native bushland and was historically used for timber production. Today, Julimar State Forest is primarily used for recreation and conservation purposes. The State Forest is vested in the Conservation and Parks Commission of Western Australia and is managed by DBCA.

Under the Forest Management Plan 2014 – 2023 (CCWA 2013) Julimar State Forest is proposed to become a Forest Conservation Area as an interim proposal. These areas are managed for biodiversity values and are not available for timber harvesting, but other uses, including mining, may be permitted. Currently, the proposed final vested purpose of the reserve is as a Conservation Park.

The forest comprises predominantly Jarrah/Marri/Wandoo woodlands and provides habitat for native fauna (some of which are listed as threatened). The Julimar State Forest also provides an important site for monitoring/ trapping, baiting and fauna translocation programs initiated by DBCA, which will be avoided by the proposed drilling program. Values of the forest are discussed further in Section 5.7.

Julimar State Forest is frequently used by the public for outdoor recreational purposes such as hiking, tourism, and 4-Wheel Driving. Access to the Forest by the public is not restricted or actively controlled.

2.2.2 Nature Reserves and National Parks

There are some conservation reserves located to the east and south of the Julimar State Forest (Figure 3).

The Bindoon Spring Nature Reserve and Flat Rock Gully Nature Reserve both lie to the east of E70/5119. To the south of E70/5118, lies the Moondyne Nature Reserve and the Avon Valley National Park. The Moondyne Nature Reserve covers an area of approximately 2,000 ha and is a significant refuge for endemic flora species of the region, supporting species characteristic of northern sand heaths and woodlands (Mattiske 2019). The Avon Valley National Park covers an area of approximately 4,800 ha and contains diverse flora in Jarrah and Marri woodlands (Mattiske 2019).

The Hartog and Baudin targets do not overlap with any surrounding nature reserves or national parks (Figure 3) and this CMP does not address exploration within these areas.

2.2.3 Private Agricultural Land

Privately held land surrounding E70/5119 is predominantly used for dwellings, farming of crops such as wheat and the running of livestock including sheep and cattle. Established dams and crops provide additional food and water sources for local fauna.

Surrounding farmland properties (within E70/5118 and E70/5119) have historically been extensively cleared to allow for farming and pastoral activities, however most privately held land contains pockets of remnant native vegetation creating corridor linkages to Julimar State Forest. Site-specific flora and vegetation surveys carried out in a portion of farmland found vegetation within these remnants to be in conditions rating from 'Completely Degraded' to 'Very Good' (Biologic 2020). The main disturbances observed were associated with agriculture, historical land clearing, weeds, and grazing pressures from stock (Biologic 2020).

2.2.4 Location and Access

All areas of tenure are readily accessible via a well-connected network of roads and highways with direct access to Perth, located ~80 km to the south-west and nearby townships including Toodyay to the east (29 km), Bindoon to the north west (25 km) and Muchea to the west (31 km).

Access to the Gonneville discovery exploration program is via private property located within tenements E70/5118 and E70/5119, where the Chalice office is located, and is accessed via Keating Road which runs north to south off Julimar Road (Figure 3).

Access to proposed drill sites within Julimar State Forest will be from either:

- Ferguson Road (via Julimar Road) and network of existing tracks (sites north of Julimar Road), or
- Access track (via Keating Road) adjoining private agricultural land as shown in Figure 4.

The location of the project is highly favourable for the purposes of exploration access, proximity to logistical routes, access to local workforce and proximity to emergency facilities such as hospitals, police and fire departments.

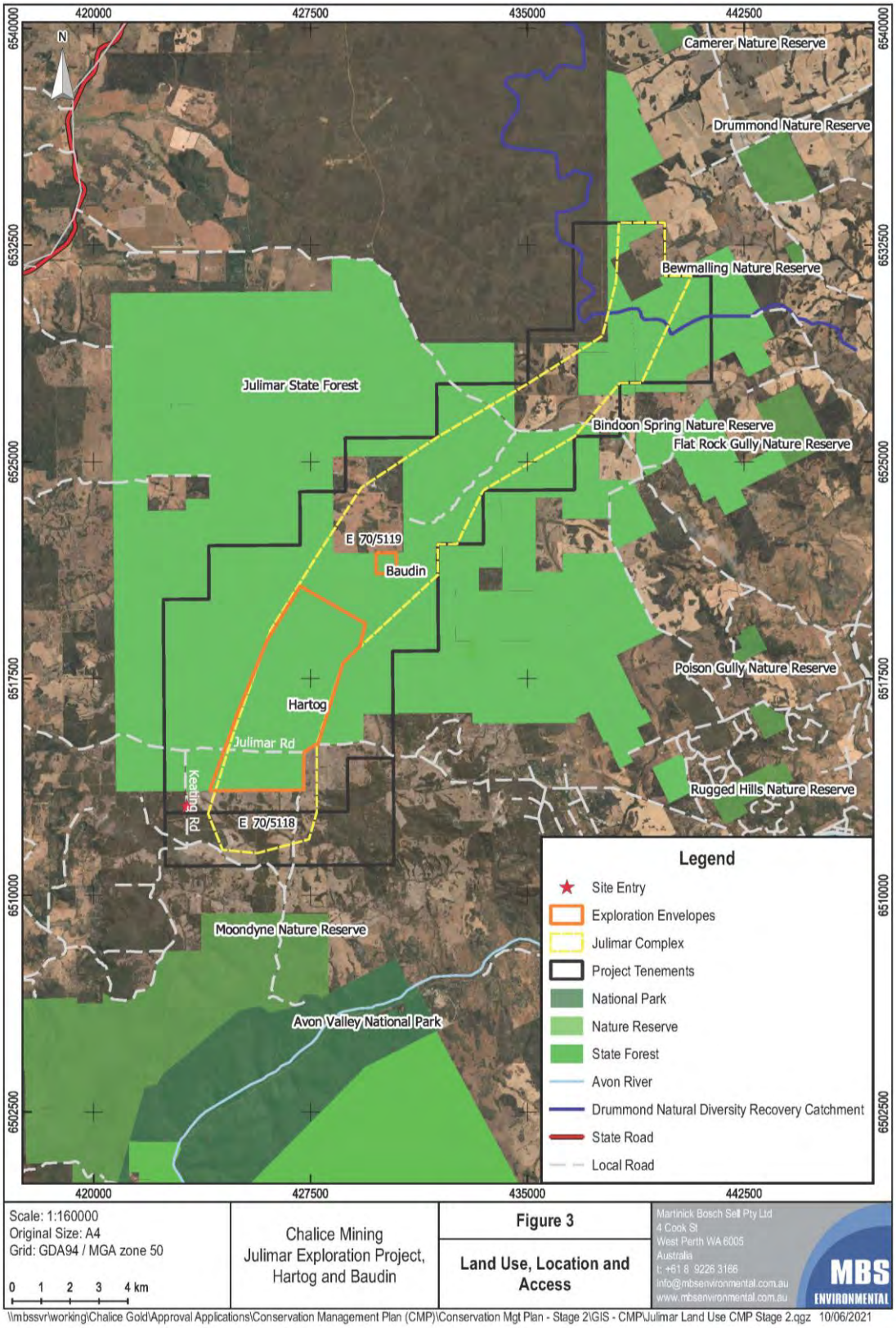


Figure 3: Land Use and Access

3. Statutory Compliance

All exploration activities are subject to the following State legislation. Chalice is aware of all approvals required under the respective legislation.

3.1 Mining Act

3.1.1 Tenement Conditions

Tenement E70/5119 was granted in January 2018 and is subject to conditions administered by the Department of Mines, Industry Regulation and Safety (DMIRS). Exploration Licences are granted subject to several standard conditions relating to rehabilitation of exploration disturbances and prescribed conditions specific to the individual tenement.

Additionally, the Minister for Mines and Petroleum must obtain concurrence from the Minister of Environment, prior to granting consent to undertake exploration activities within the Julimar State Forest. For Exploration Licences located in the south west land division of Western Australia, which is classified as a 'Dieback Vulnerable Zone' and is subject to Phytophthora Dieback infestation, a Dieback Management Plan is required to be developed, approved and implemented prior to commencement of works on the tenement.

In compliance with Condition 6 of Tenement E70/5119, a Dieback Management Plan for non-ground disturbing works in Julimar State Forest areas was developed and approved by DMIRS for Stage 1 of the CMP. The Dieback Management Plan has been updated to cover this drill program and has been included as Appendix 1.

3.1.2 Programme of Work

Under the Mining Act, where an explorer or prospector intends to undertake ground disturbing activities with mechanised equipment, a Programme of Work (PoW) is to be lodged with DMIRS for approval by the Minister of Mines and Petroleum or a prescribed official (including Environmental Officers). As the proposed exploration activities include ground disturbing works, a PoW application will be lodged.

PoWs are conditioned with the commitment to rehabilitate drill sites within six months of completion of drilling unless otherwise authorised by an approved extension. This is documented through the submission of a PoW Rehabilitation Report, which accompanies the PoW approval. The report will contain information regarding vegetation disturbance, approval details and rehabilitation activities completed.

3.2 Environmental Protection Act

Regulation No.5 of the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* lists clearing undertaken for the purpose of exploration activities as 'prescribed clearing' which, in accordance with Section 51C of the *Environmental Protection Act 1986* (EP Act), is exempt from requiring a Native Vegetation Clearing Permit unless the clearing is within an Environmentally Sensitive Area (ESA).

ESAs are declared by the Minister for Environment under section 51B of the EP Act and are described in the *Environmental Protection (Environmentally Sensitive Areas) Notice 2005.* Julimar State Forest is classified as an ESA and therefore exemptions under the EP Act do not apply.

Ground disturbance, and any impact to native vegetation, associated with the proposed exploration drilling program under this CMP will require submission and approval of a Native Vegetation Clearing Permit (NVCP) by DMIRS prior to commencement.

3.3 Biodiversity Conservation Act

Where flora has been gazetted as Threatened flora under the *Biodiversity Conservation Act 2016* (BC Act), it is an offence "to take" such flora without the written consent of the Minister for Environment. The BC Act states that "to take" flora includes to gather, pluck, cut, pull up, destroy, dig up, remove, harvest, or damage the flora by any means. The same applies to fauna that has been gazetted as Threatened under the BC Act. The BC Act states that "to take" fauna includes to kill, injure, harvest or capture fauna by any means. A licence to take fauna for biological assessment (BA27000274) and authorisation to take or disturb threatened species (TFA 2020-0080) has been obtained for all environmental surveys completed on behalf of Chalice.

Approval under regulation 4 (1) of the *Conservation and Land Management Regulations 2002* has also been obtained to collect flora for identification purposes during Chalice's baseline surveys (No. CE006334, dated 26 March 2021).

Taking or disturbing of threatened flora or fauna including undertaking ground disturbance works within 50m of a threatened species requires authorisation from the Minister for Environment under Section 40 of the BC Act. If the proposed drilling program will take or disturb threatened flora or fauna species, Chalice will request an authorisation under Section 40 of the *BC Act*. Chalice considers that this is highly unlikely to be required due to the design of the drilling program which has minimised the overall exploration footprint and aims to avoid impacting any threatened species identified during the surveys.

3.4 Aboriginal Heritage Act

The Julimar Project tenements sit within the South West Native Title area, which was recently the subject of the South West Native Title Settlement (the Settlement) between the Western Australian Government and the Noongar peoples. The Settlement resolves the Noongar native title claims in the south-west of Western Australia in exchange for a package of benefits.

The Julimar tenements (along with all other tenements located in Mineral Field 70) are the subject of an Indigenous Land Use Agreement (ILUA) between the State of Western Australia (State) and the relevant native title party. The ILUAs impose certain conditions on the State and tenement holder relating to the protection of Aboriginal cultural heritage under the *Aboriginal Heritage Act 1972* (WA).

The Whadjuk and the Yued people are the original custodians of the lands in Julimar State Forest which is subject to the Yued Indigenous Land Use Agreement and the Whadjuk People Indigenous Land Use Agreement.

Chalice entered into Aboriginal heritage agreements with the Yued Agreement Group and Whadjuk People Agreement Group in the form of two separate Noongar Standard Heritage Agreements (NSHA) in 2018. The relevant heritage agreements are as follows:

- Noongar Standard Heritage Agreement between CGM(WA) and SWALSC (on behalf of the Whadjuk People) dated 18 May 2018 in respect of both E70/5118 and E70/5119; and
- Noongar Standard Heritage Agreement between CGM(WA) and SWALSC (on behalf of the Yued People) dated 7 August 2018 in respect of E70/5119 only.

These agreements require Chalice to provide the South West Aboriginal Land and Sea Council (SWALSC) with an Activity Notice before undertaking physical works or operations on the tenements, which may trigger the requirement for a heritage survey to be conducted.

Chalice submitted Activity Notices to SWALSC on 4 June 2021 in relation to the proposed exploration drilling program in Julimar State Forest. The SWALSC have subsequently confirmed that cultural heritage surveys are required and has been advised by the SWALSC Heritage Consultant Selection Panel of the Yued and Whadjuk Aboriginal heritage survey participants. Heritage surveys will be conducted with Traditional Owners to identify any areas within the proposed drill sites and access routes that need to be avoided due to the potential presence of any Aboriginal heritage sites.

The proposed drill program will not commence until the heritage surveys and associated consultation with Yued and Whadjuk has been completed and required survey reports have been received under the terms of Chalice's agreements with the Yued and Whadjuk.

The proposed exploration program has been designed with the objective of protecting the value of the land to the culture and heritage of the Whadjuk and Yued people, to avoid heritage sites and generally have as little impact as possible. This includes by:

- Being limited to previously cleared areas (tracks) where possible and to otherwise use track mounted drill rigs so no mechanical clearing involving scraping or blading is required.
- Yued and Whadjuk representatives conducting and reporting on archaeological and ethnographic heritage surveys.
- SWALSC, in response to Chalice's request for heritage surveys and under the terms of the heritage agreements, requesting information about the work program and project and the terms under which the survey will be undertaken, including pertaining to the management of health and safety during the heritage surveys. Chalice has provided this information and will provide further information as it is required.
- Ensuring that Yued and Whadjuk Traditional Owners undertake heritage surveys independently of Chalice, with Chalice only providing information about the nature of the work program and the project, supporting survey safety and logistics and providing the resources necessary so that Yued and Whadjuk work with experienced independent archaeologists and anthropologists.
- Not commencing work until heritage surveys and the associated consultation with Yued and Whadjuk has been completed and the required survey reports have been received under the terms of Chalice's agreements with Yued and Whadjuk.
- Adopting a 'site avoidance' approach, consistent with paragraph 2.28 of the Guidelines and ensuring Chalice operates in full compliance with the *Aboriginal Heritage Act 1972* (WA).

The potential impact of proposed activities on the value of the land to the culture and heritage of the Whadjuk and Yued people, including impacts on activities such as practicing (e.g. hunting and gathering) and teaching culture, will be managed in the first instance through Yued and Whadjuk undertaking ethnographic heritage surveys. Chalice will work with Yued and Whadjuk to manage any potential impacts and ensure no material adverse effect occurs. Chalice is committed to establishing and strengthening a relationship of mutual benefit with the Whadjuk and Yued people and reporting on these matters to regulators including the DBCA through annual reporting (where appropriate).

While Chalice is unable to predict ethnographic survey results or the outcome of consultations, typically ethnographic heritage surveys will consider matters such as potential impacts to country, the associated impacts to societies and cultures and how those impacts should be avoided, mitigated and otherwise minimised. Chalice reiterates its commitment to supporting Yued and Whadjuk to undertake ethnographic surveys, their involvement in the project, and to working with and supporting Yued and Whadjuk to identify, avoid and otherwise mitigate and minimise impacts to country, culture and society.

4. Proposed Exploration Activities

The proposed exploration activities across the Hartog and Baudin targets include:

- Vegetation disturbance to access off-track drill sites (~ 70% of all drill sites).
- Diamond drilling using small track-mounted drill rigs with closed-loop drilling fluid systems.
- Support activities including water supply, drill rig refuelling and maintenance.
- Demobilisation and rehabilitation.

Land inside Julimar State Forest has experienced very little modern exploration and due to the absence of previous systematic work and available geological data, Chalice has undertaken non ground disturbing sampling and survey programs throughout the entire length of the exploration corridor (Figure 2). The purpose of this was to screen the exploration corridor, identify potential mineralisation targets and reduce the overall area of focus for ground disturbing works. This allowed for specific targets to be identified and resulted in the development of the proposed wide-spaced, low impact drill program that is the subject of this CMP.

The location and spatial extent of drilling activities has been informed by the results of previous non-disturbance soil sampling and geophysical surveys within the initial exploration corridor and ecological surveys over the Hartog and Baudin target areas. A total of 71 drill sites are proposed of which approximately 30% are located on existing access tracks. Approximately 8 km of off-track access routes to the drill sites is required (Figure 4) with a maximum width of 4 metres for new tracks comprising a total of 4.4 hectares of disturbance.

This drilling program achieves the aim of initial testing of geology for mineralisation, whilst also minimising disturbance to vegetation.

4.1 Vegetation Disturbance

No mechanised vegetation clearing involving scraping or blading is proposed under this CMP. Clearing is defined under Section 51A of the *Environmental Protection Act 1986* as:

a. the killing or destruction of; or
b. the removal of; or
c. the severing or ringbarking of trunks or stems of; or
d. the doing of any other substantial damage to,

some or all of the native vegetation in an area, and includes the draining or flooding of land, the burning of vegetation, the grazing of stock, or any other act or activity, that causes -

e. the killing or destruction of; or
f. the severing of trunks or stems of; or
g. any other substantial damage to,

some or all of the native vegetation in an area.

To minimise impacts to vegetation, small track mounted drill rigs with closed-loop drilling fluid systems will be used, negating the need to construct cleared drill pads, sumps, and access tracks. Drill rigs and drill rig support vehicles will utilise existing tracks and/or firebreaks where possible. Additionally, drill rigs and drill rig support vehicles will be configured in tandem to further reduce the overall footprint associated with set up and operation of drilling activities (Figure 5).

The use of small track-mounted drill rigs and drill rig support vehicles rather than conventional larger wheeled rigs and vehicles minimises the impact on vegetation, allowing root stock and soil profile (including seed bank) to remain intact, and vegetation to recover once the drill rig and support vehicles have passed over the area. A comparison of disturbance as a result of this method is shown in Plate 1 and Plate 2.

Vegetation disturbance proposed by the exploration activities within Julimar State Forest is restricted to minor branch pruning and rolling over vegetation only where necessary. Drill rig support vehicles with waste containment tanks, and a similar footprint to the drill rigs, will be track mounted. It is anticipated that total vegetation disturbance resulting from the works proposed under this CMP will be approximately 4.4 hectares.

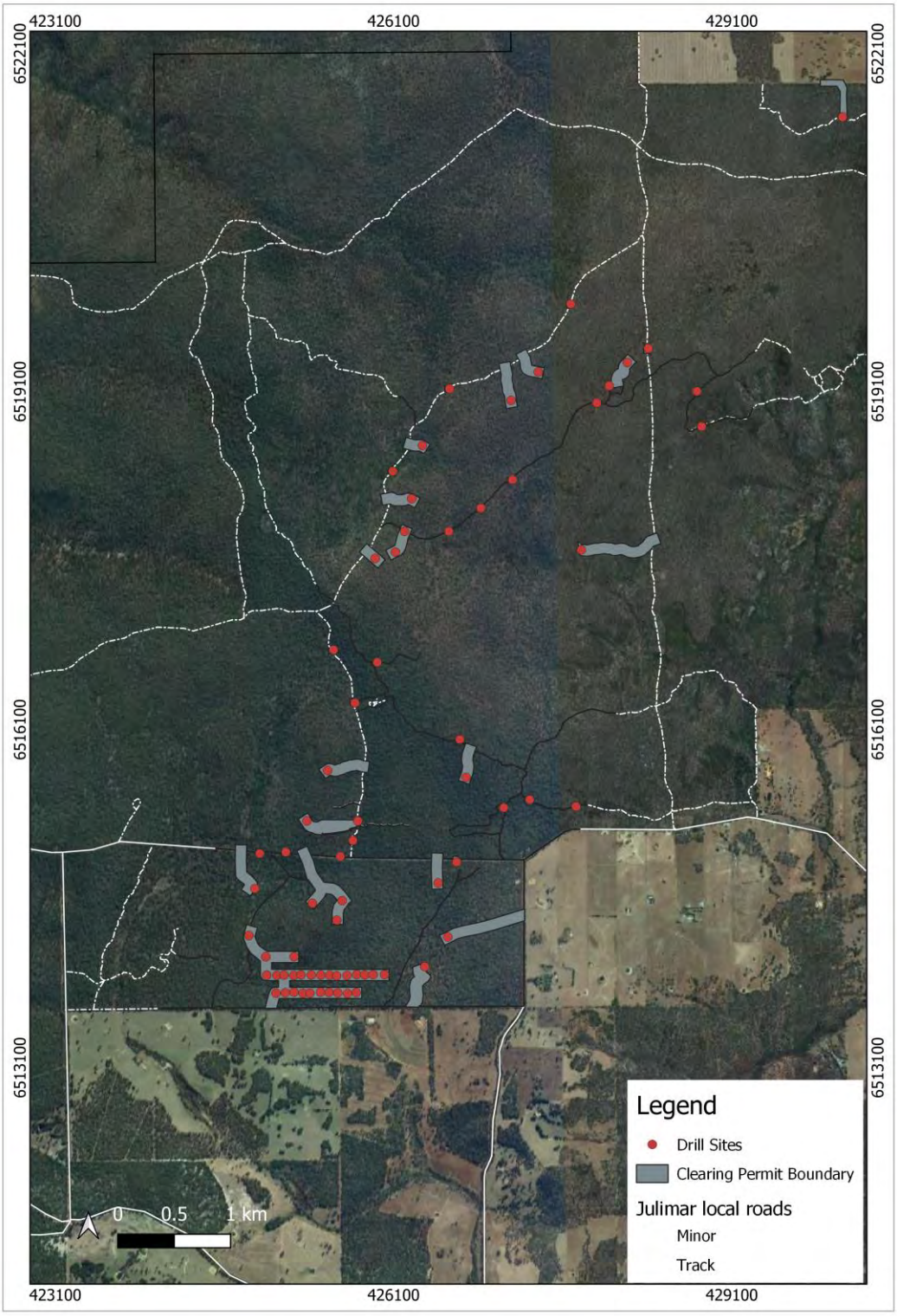


Figure 4: Hartog and Baudin Proposed Drill Program

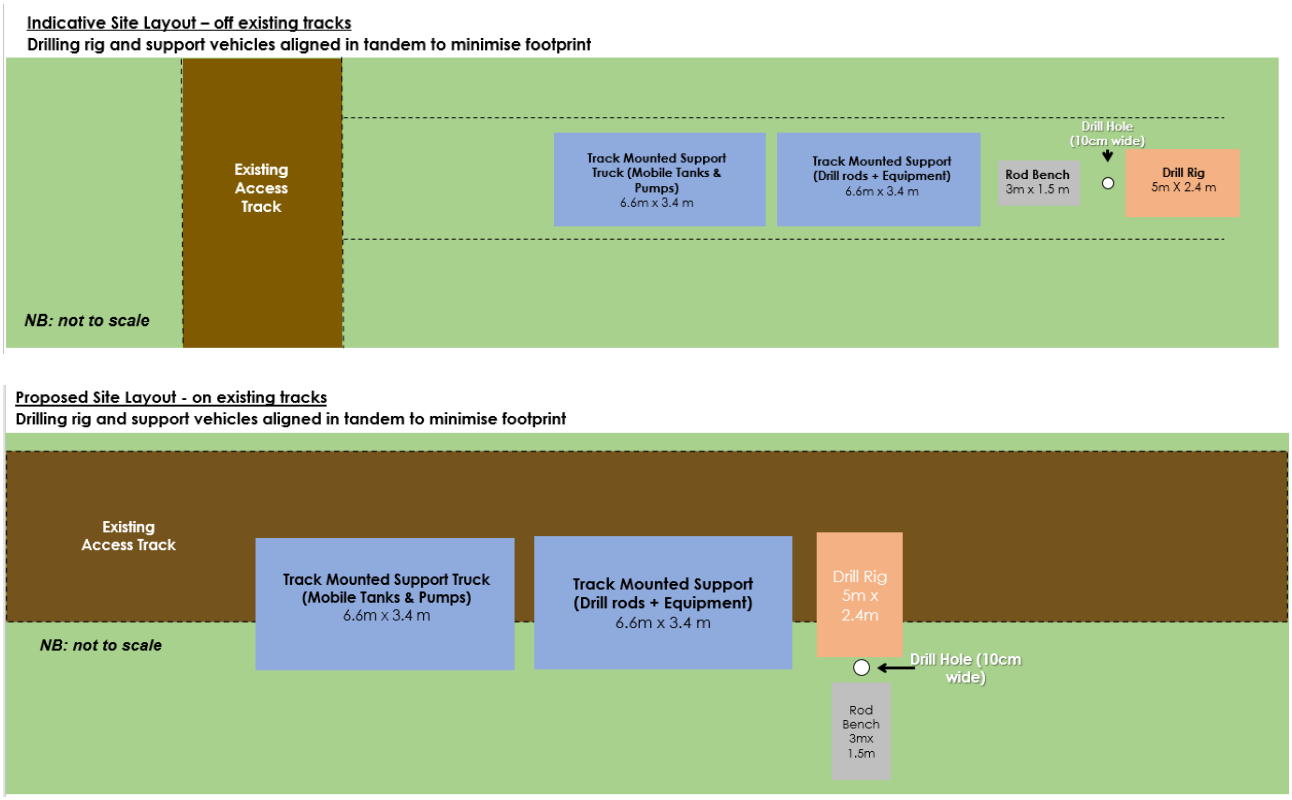


Figure 5: Proposed Drill Site and Access Route Layouts

Plate 1: Drill site pre-drilling (drilling on private farmland May 2021)

Plate 2: Drill site post drilling (drilling on private farmland May 2021)

Where possible, drill sites have been located on existing tracks or in clearings. This negates the need for additional clearing, however occasional pruning of branches may be required for safety purposes on an 'as needed' basis at each drill site. Any removed vegetative material will remain in the forest and be utilised in subsequent rehabilitation activities, in accordance with the relevant PoW and associated rehabilitation requirements.

4.2 Diamond Drilling

Diamond core drilling using small track mounted drill rigs and support vehicles will be the only drilling method employed. An example of the type of drill rig planned to be used is shown in Plate 3. Diamond drilling is the preferred technique within the Julimar State Forest because of its environmental and operational advantages in comparison to other drilling methods, including:

- Rigs and support vehicles have a small footprint.
- Rigs produce lower levels of noise compared with other drilling methods and do not produce any dust.
- Rigs generate minimal vibration.
- Equipment is track mounted, which means it can drive over vegetation without damaging the root stock.
- No clearing using scraping or blading for access tracks is required.
- Closed loop drilling fluid systems will be used allowing all waste to be removed from site (which negates the use of in-ground sumps) and drilling fluids to be contained on the support trucks.

As drilling is proposed during the night, lighting will be utilised to maintain a safe working environment. Directional lighting will be utilised to minimise light spill. It is anticipated that only a single lighting plant will be required at each drill site. An example is shown in Plate 6.

Support vehicles (Plate 4) and solids units (Plate 5) will be required to follow the drill rig and are also track mounted. The support trailer will house equipment such as rods, casings, core trays, extracted samples and hand tools and has similar dimensions to the drill rigs (i.e., 6m long by 3m wide). Drilling waste will be managed through a closed loop solids removal system and portable tanks. Portable tanks will be inspected regularly to prevent overflow, and waste will be transported off site for disposal in sumps on Chalice's private property, which will be rehabilitated at the end of the program. Core samples will be placed in core trays at the drill site and transported for storage at the core shed at the Chalice exploration office on the farmlands which is on E70/5118.

Diamond drilling requires water to be used in the drilling process. It is envisaged that tanks will be set up on existing tracks in locations central to a number of drill sites although alternative methods may be used if they result in less impact. Black poly pipe (as used for standard farming operations) will then be set up to transport the water from the tanks to the individual drill sites. Because the pipe is light weight it can be moved by hand. Where possible the pipe will run next to the drill access routes. Water will be sourced from ex-pastoral bores on surrounding Chalice owned private property and trucked to the tanks (using existing access tracks). All water sourced is fresh (less than 5,000 milligrams per litre (mg/L) Total Dissolved Solids (TDS)) as confirmed by water sampling results over the last 12-months (samples have been tested at a National Association of Testing Authorities (NATA) laboratory). There are no additives to the water being transferred in the black poly pipe.

Any general waste will be transported to the Chalice Exploration office on the farmlands which is on E70/5118 and E70/5119. Waste will be disposed of in bins for collection by an appropriately licenced waste contractor for disposal off site.

Plate 3: Track Mounted Diamond Drill Rig

Plate 4: Track Mounted Support Trailer and Core Tray

Plate 5: Track Mounted Waste Unit

Plate 6: Track Mounted Waste Unit with Lighting Plant

4.3 Support Activities

Light vehicles and trucks will provide tools and equipment required for water supply, fire suppression, drill rig refuelling and maintenance activities. These will always remain on existing tracks with only track mounted drill rigs, track mounted support vehicles and small rough-terrain vehicles (RTVs) used for transporting core and personnel to drill sites located on the access routes outlined in Figure 4.

Fuel will be transported to drill rigs via small fuel tanks (approx. 1000-2000 litres) on track mounted vehicles or RTVs. Drip trays and liners will be used during refuelling activities and spill kits will be available at all drill sites. Routine inspections on drill rigs will be undertaken to assess the integrity and monitor wear of any hoses, couplings, and fittings, to prevent accidental discharge of fuel.

4.4 Program Schedule

The proposed drilling under this CMP is a first pass assessment of the mineralisation potential of the area with a total of 71 drill sites identified. This is a maximum and it is possible that some sites may not be required if the results from neighbouring drill holes indicate that mineralisation is unlikely to be present.

In many cases, it is likely that only one hole will be required to test a target. However, drill sites have been designed so that in the event mineralisation is identified, then multiple holes can be drilled from the same site to minimise the drilling footprint rather than drilling holes on a grid pattern. The actual number of holes drilled from a single site will be regulated by the POW approval process through DMIRS, with a maximum of 12 holes per drill site.

The timing of follow up drilling will vary from immediately on completion of the initial hole, if significant visual mineralisation is identified, to up to several months later depending on the timing of the receipt of assay and geophysical results and prioritisation of targets. Regardless of the potential for follow up drilling, the access route and drill site will be rehabilitated once the drill rig leaves the drill site, even if it is likely that the rig will need to return at a later date.

Each hole is likely to take between three and ten days to complete depending on the depth of the hole, whether the rig is drilling on single or double shift and whether any difficult drilling conditions are encountered.

4.5 Public Access and Security

Many of the proposed drill sites are planned on existing public access tracks to minimise the impact on vegetation. This will necessarily impact public access. A detailed Public Access and Traffic Management Plan has been developed to ensure the safety of the drillers and the public and minimise impact to the ongoing management of Julimar State Forest (Appendix 2). The Public Access and Traffic Management Plan includes:

- Signage to be placed on relevant tracks to advise motorists that drilling activities are occurring.
- Where possible, drill holes will be located to minimise the amount of track being blocked.

- If adequate room cannot be left so that vehicles can safely pass, the drill rig will be placed partially off the track. This is expected to result in less impact to vegetation than creating a passing lane for other vehicles.
- Narrow minor access tracks may be required to be blocked off entirely for a short period of time, whilst drilling is underway at that site.

It is proposed that drilling will occur on a 24-hour basis. This will minimise the length of the overall drilling program and will also ensure that equipment is always attended. No additional security measures will therefore be required.

4.6 Rehabilitation

4.6.1 Rehabilitation Requirements

Exploration activities covered under a relevant PoW approval require rehabilitation within six months of drilling completion unless otherwise authorised by DMIRS. No mechanised clearing, involving scraping or blading, is required under this CMP and therefore rehabilitation actions such as scarifying of tracks and hardstand areas is not applicable. Chalice is committed to ensuring all rehabilitation is undertaken to a high standard and to ensure that the post disturbance environment does not have any residual rehabilitation liability.

Rehabilitation activities that will be undertaken include:

- Plugging of drill holes with a plastic hole plug buried ~400mm below the ground surface.
- Cutting of drill hole collars to 400 mm below ground level.
- Backfill of drill hole above plug and mounded over.
- Removal of drill cuttings and scarification around drill hole (1-2m^2).
- Removal of any waste including survey tape, wooden pegs, domestic rubbish.
- Logs that have been moved aside at drill sites and on access routes will be reinstated.
- If there is an area where the drilling rig tracks have noticeably disturbed the soil, the area will be lightly raked to remove signs of the tracks.
- Access will be blocked off on the access route to ensure there is no public access of the area. This will be on a case-by-case basis but may include blocking the entrance with logs.

This process will be repeated if a drill site is revisited to drill additional holes.

Because the proposed exploration activities do not require mechanised clearing, such as scraping or blading, it is anticipated that vegetation will naturally regenerate. No intervention is considered necessary because there will be minimal impact to root stock, topsoil and the seed bank.

Details surrounding disturbance and rehabilitation activities will be reported through the PoW Rehabilitation Report (Appendix 9), submitted to DMIRS within six months of drilling completion unless otherwise authorised by DMIRS.

4.6.2 Monitoring

The following process will be followed for rehabilitation monitoring:

1. Prior to disturbance, each drill site and access route will have photograph monitoring locations installed and the GPS locations recorded. A photograph will be taken prior to disturbance.
2. Following disturbance, when all equipment has been removed from site and all items outlined in Section 4.6.1 have been completed, a photograph will be taken from the photograph monitoring locations.
3. All photograph monitoring sites will be monitored quarterly. Photographs will be compared between each monitoring event to ensure:
    - No increase or introduction of weeds.
    - No observable erosion has occurred.
    - Hole capping is sufficient and has not created a hazard for animals.
    - No observable public access to site.
    - Natural regeneration of vegetation is occurring.

This process will be repeated if a drill site is revisited to drill additional holes.

All rehabilitation photograph monitoring will be undertaken for up to a year following the last disturbance at the drill site and access route (e.g. following the last drilled hole in the case of more than one visit to a drill site). Rehabilitation monitoring may cease earlier in the event that a drill site is showing adequate natural regeneration.

4.6.3 Rectification

If photograph monitoring demonstrates an issue with the rehabilitation, rectification activities will be undertaken. These may include but not be limited to:

- Installing additional barricades to stop the public accessing the area.
- Undertaking weed spraying if weeds have been introduced.
- Recapping hole.
- Fixing any erosion issues.

In the event that natural regeneration of vegetation has not occurred after a year, Chalice will consult with DBCA on the preferred method for rehabilitation. Any rectification works are likely to be specific and will be managed on a case-by-case basis.

5. Existing Environment

5.1 Climate

The Hartog and Baudin targets are situated within the Avon Wheatbelt region of WA, which experiences a Mediterranean climate characterised by cool, wet winters and hot, dry summers (DPAW 2001). A Bureau of Meteorology (BoM) weather station capturing weather and climate representative of the area is located approximately 33 km southwest of Julimar State Forest, at the Pearce RAAF Base (Site 9053) near Bullsbrook. Temperatures recorded from the station (Figure 6) indicate a mean (based on 59 years of data) maximum temperature of 25.2°C (BoM 2020) and minimum temperature of 12.2°C (BoM 2020). Average maximum temperatures (33.5°C) peak in January (BoM 2020), however average minimum temperatures (8.2°C) are experienced in August (BoM 2020).

Mean annual rainfall is 652.1 mm (BoM 2020) and peaks in July (Figure 6), with an average of 133.8 mm for the month. Annual precipitation falls predominantly in late autumn and winter (May – August).

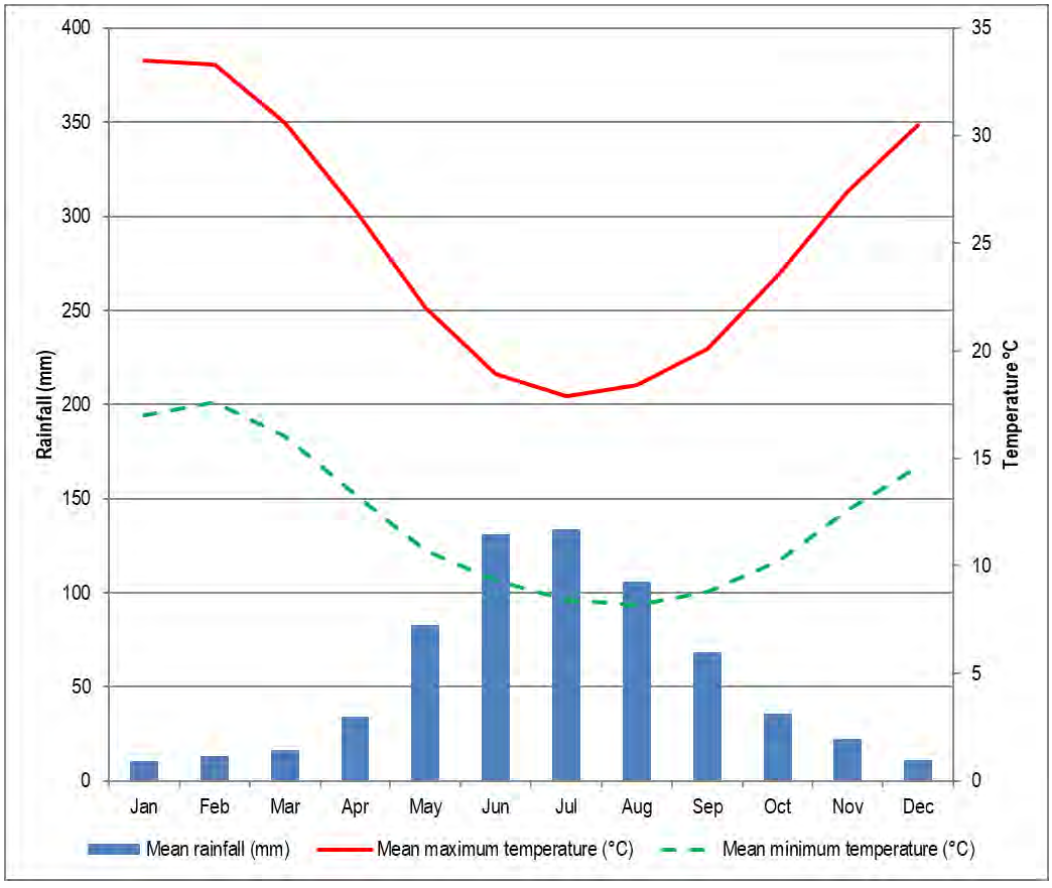


Figure 6: Climate Data for the proposed Julimar exploration area (BoM 2020)

5.2 Land Systems

Land systems are broad descriptions of landform, geology and soils. The Hartog and Baudin targets intersect two land systems as described in 5.3.2.1. The land system units link to the vegetation communities described in Section 5.3.2.1.

Table 4: Land Systems of the Hartog and Baudin Targets

Land System	Description	Total Mapped Extent (ha)
Julimar	Moderately dissected areas with gravelly slopes and ridges and minor rock outcrop on the eastern side of the Darling Plateau over weathered granite and granitic gneiss. Loamy gravel, shallow duplexes and pale deep sand common. Wandoo woodlands.	1712.19
Wundowie	Intact undulating lateritic terrain with minor rock outcrops in the north eastern Darling Range. "Buckshot" gravels, duricrust and some deep sands vegetated by Jarrah forest.	309.275

Four broad landforms were identified within the Hartog and Baudin targets which include hills, valleys, drainage lines and a wetland. Hills covered 1797 ha or 89% of the Hartog and Baudin landscape and consisted of low undulating hills, and included lower, mid and upper slopes as well as broad plateaus (Biologic 20021). Valleys covered 196 ha or 9.7% of the Hartog and Baudin landscape and comprised of depressed areas at the bottom of hillslopes and included broad floodplains on the western and northern edges and steeper valleys on the eastern edges of the exploration targets (Biologic 2021). Drainage Lines covered 15 ha or 0.7% of the landscape and consisted of defined creeklines where vegetation was observably different from the adjacent valley. The wetland, which was bare at the time of survey, accounted for 0.09 ha of the landscape (Biologic 2021).

The Hartog and Baudin targets are situated within the Northern Jarrah Forest subregion, which occupies the northern portion of the Darling Plateau to the east of the Darling Scarp (Biologic 2021). The subregion overlies Archaean granite and metamorphic rocks and the plateau is an ancient erosion surface capped by an extensive lateritic duricrust, which has been dissected by later drainage and broken by occasional granite hills (Biologic 2021). The exploration targets sit upon igneous and metamorphic rocks making up the Southwest Terrane of the Yilgarn Craton. The mineral target of the drilling program is a large interpreted mafic-ultramafic layered intrusive complex (Biologic 2021).

Typically, soils of the Northern Jarrah Forest subregion are defined as lateritic gravels consisting of up to 5 m or more of ironstone gravels in a yellow, sandy matrix. Related to these are the lateritic podzolic soils with ironstone gravels in a sandy surface horizon, overlying a mottled yellow-brown clay subsoil (Biologic 2021). According to the Atlas of Australian Soils, soils within the Hartog and Baudin targets fall within one broad soil landscape unit of the Australian Atlas of Soils, JZ2 (Biologic 2021). This unit consists of dissected plateaus having a gentle to moderately undulating relief, and with broad swampy drainage ways and basins. It is characterised by lateritic gravels and block laterite, with chief soils comprising of ironstone gravels with earthy matrices (Biologic 2021).

5.3 Flora and Vegetation

5.3.1 Previous Assessments

To further define forest values, to assist with environmental risk assessment processes, and identify potential impacts and management controls for flora and vegetation values, Chalice has commissioned the following assessments:

- Desktop Assessment of Potential Flora and Fauna Values, Julimar Project (Mattiske 2019).
- Gonneville Reconnaissance and Targeted Flora Assessment (Biologic 2020).
- Hartog and Baudin Reconnaissance Survey (Biologic 2021).

The Mattiske desktop assessment recognised the potential for 1057 vascular plant taxa, 112 introduced species, 22 Threatened and 63 Priority flora species to occur in the Julimar State Forest. Database searches identified no Threatened (TEC) or Priority Ecological Communities (PEC) occurring within the State Forest. As part of the assessment Mattiske reviewed findings from a third-party field survey over an exploration area in 2008 which recorded 94 vascular plant taxa, six introduced species, no Threatened or Priority flora species and no vegetation communities representative of any TEC or PEC. Vegetation structure was described as open woodlands of eucalyptus and marri.

The Reconnaissance and Targeted Flora survey at Gonneville covered a 65-ha area comprising remnant vegetation on private farmland. The survey recorded 73 vascular plant taxa, 15 introduced species, no Threatened or Priority flora species and no vegetation communities representative of any TEC or PEC. Vegetation structure was described as woodlands dominated by jarrah, marri and wandoo and vegetation condition was rated from 'Degraded' to 'Very Good'.

5.3.2 Hartog and Baudin Reconnaissance and Targeted Survey

In April/May 2021 Biologic Consulting (Biologic) completed a desktop assessment and Reconnaissance and Targeted field survey across the Hartog and Baudin targets covering an approximate area of 2,023 ha. The purpose of the Reconnaissance survey was to provide context and gather broad information specific to the Hartog and Baudin targets (as opposed to Julimar State Forest in general) and verify the findings of the desktop assessment (and previous assessments) by identifying the presence of Threatened and/or Priority species as well as describing broad vegetation types. The level of survey was determined based on the nature of the proposed drilling program being unlikely to have a significant impact on flora and vegetation values due to the small scale (<4.4 ha) and nature of the proposed disturbance (no mechanised clearing such as scraping or blading). Threatened (T) and Priority (P) flora species identified by the desktop assessment were actively searched for via meandering transects. The Reconnaissance and Targeted field survey was undertaken in accordance with the following EPA Guidance:

- EPA 2018. Statement of Environmental Principles, Factors and Objectives;
- EPA 2016a. Environmental Factor Guideline: Flora and Vegetation; and
- EPA 2016b. Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment.

The survey was undertaken with suitably qualified and experienced botanists. Each survey team was led by a senior botanist with a minimum of five years field survey experience as required by the EPA Technical Guidance for Flora and Vegetation Surveys (2016b). It was identified that the survey was constrained by seasonality (undertaken in Autumn not Spring) and intensity for the targeted portion with insufficient time identified to locate and record the size and extent of all conservation significant flora species.

The survey limitations indicated the requirement for a Targeted survey during the 2021 optimal season (Spring) for the Avon Wheatbelt to verify existing information obtained from the Reconnaissance survey. The Spring survey comprised targeted searching for Threatened and Priority flora within 72 proposed exploration drill sites and approximately 8 km of proposed off-track access routes (plus buffers surrounding these areas) and results are outlined in Section 5.3.2.3.

The Reconnaissance survey recorded 127 native vascular plant taxa, 3 introduced vascular plant taxa, one Threatened flora species, one Priority 2, two Priority 3 and two Priority 4 flora species. No Priority one flora species or any vegetation communities representative of TEC or PEC were recorded during the survey. The findings of the survey are described in the below sections and a report is provided in Appendix 3.

5.3.2.1 Vegetation Communities

A total of nineteen vegetation communities were mapped and described across the two exploration targets. Ten (10) vegetation types (H1, H2, H3, H4, V1, V2, V3, V4, V5 and V8) were associated with four conservation significant flora as outlined in Section 5.3.2.2 and hold importance as refuge for these species (Biologic 2021). Broadly the communities represent *Eucalyptus marginata* and *Corymbia calophylla* woodlands with *Eucalyptus wandoo* present and a wetland (Biologic 2021). Description and total mapped extent of the vegetation communities present within Hartog and Baudin is provided in Table 5 and shown in Figure 7.

The most commonly occurring vegetation community was H1, covering 1403.19 ha of the 2,023 ha surveyed area at Hartog and Baudin. Baudin comprised of only two vegetation communities (H1 and H5), both which are also present at Hartog. Exploration activities at Hartog will have the greatest impact on V6, however this is more a reflection of the limited mapped extent of this vegetation community (7.33 ha) rather than significance of proposed disturbance (0.09ha). Over 90% of vegetation in the Hartog and Baudin targets was in Excellent condition, with the main disturbances being prescribed burns and informal tracks throughout the area (Biologic 2021).

Five vegetation types (D1, D2, D3, V2 and V7) were noted as containing dry and narrow creeklines with several flora taxa known to grow in low-lying habitat with higher soil moisture levels. However, it is unlikely that this vegetation is dependent upon continuous access to surface water or groundwater (Biologic 2021) and all of these communities will not be impacted by the proposed drilling program. Due the presence of threatened flora species the proposed drill program has been redesigned and will avoid the creek communities.

No vegetation community will be impacted by more than 1.3% of its total mapped extent within the Hartog and Baudin targets. The proposed exploration program will only impact approximately 4.4 ha or 0.21% of the total mapped extent of the vegetation communities.

Table 5: Overview and Potential Impact on Vegetation Communities

ID	Description	Mapped Extent ha	Potential Impact ha (%)
D1	Mid woodland of *Eucalyptus accedens, Eucalyptus wandoo* and *Corymbia calophylla* over a tall shrubland of *Trymalium odoratissimum* subsp. *odoratissimum* and *Xanthorrhoea preissii* over a low open shrubland of *Phyllanthus calycinus*, *Hakea lissocarpha* and *Hibbertia hypericoides*	11.49	0 (0)
D2	Mid closed forest of *Corymbia calophylla* with isolated Eucalyptus wandoo trees over tall closed shrubland of *Trymalium odoratissimum* subsp. *odoratissimum* and *Xanthorrhoea preissii* over low shrubland of *Bossiaea eriocarpa, Trymalium odoratissimum* subsp. *odoratissimum* and Hibbertia *semipilosa*	2.77	0 (0)
D3	Low open woodland of Eucalyptus accedens over tall shrubland of *Acacia celastrifolia* over low open shrubland of *Hibbertia hypericoides, Xanthorrhoea gracilis* and *Hakea lissocarpha*	0.77	0 (0)
H1	Mid open forest of *Eucalyptus marginata* and *Corymbia calophylla* over mid-tall open shrubland of *Banksia squarrosa* subsp. *squarrosa, Xanthorrhoea preissii* and *Banksia sessilis* over low open shrubland of *Hibbertia hypericoides, Styphelia retrorsa* and *Banksia dallanneyi* subsp. *sylvestris*	1364.67 Hartog 38.52 Baudin	3.3984 (0.24) Hartog 0.0016 (0.004) Baudin
H2	Low open woodland of *Eucalyptus marginata* and *Corymbia calophylla* over tall open shrubland of *Banksia squarrosa* subsp. *squarrosa, Xanthorrhoea preissii* and *Macrozamia riedlei* over low open shrubland of *Hibbertia hypericoides, Phyllanthus calycinus* and *Hakea lissocarpha*	148.37	0.09(0.61)
H3	Low-mid open woodland of *Corymbia calophylla* and *Eucalyptus marginata* over tall shrubland of *Adenanthos cygnorum* and *Banksia squarrosa* subsp. *squarrosa* over low sparse shrubland of *Adenanthos cygnorum, Banksia sphaerocephala* var. *pumilio* and *Hibbertia hypericoides*	57.60	0.17 (0.29)
H4	Mid woodland of *Eucalyptus wandoo, Eucalyptus marginata* and *Corymbia calophylla* over mid-tall open shrubland of *Banksia squarrosa* subsp. *squarrosa* and *Xanthorrhoea preissii* over low open shrubland of *Hibbertia hypericoides, Styphelia retrorsa* and *Hakea lissocarpha*	157.79	0.39 (0.68)
H5	Mid woodland of *Eucalyptus wandoo* and *Eucalyptus accedens* over mid sparse shrubland of *Xanthorrhoea preissii* over low sparse shrubland of *Hibbertia hypericoides, Hakea lissocarpha* and *Banksia bipinnatifida* subsp. *bipinnatifida.*	17.64 Hartog 11.85 Baudin	0.17 (0.96) Hartog 0 Baudin
H6	Tall sparse shrubland of *Xanthorrhoea preissii* over low shrubland of *Banksia fraseri* var. *fraseri*, *Calothamnus quadrifidus* subsp. *quadrifidus* and *Hibbertia hypericoides*	1.11	0 (0)

ID	Description	Mapped Extent ha	Potential Impact ha (%)
H7	Tall open shrubland of *Allocasuarina humilis, Xanthorrhoea preissii* and *Banksia squarrosa* over low open shrubland of *Patersonia occidentalis, Hibbertia hypericoides* and *Babingtonia camphorosmae* over low open herbland of *Laxmannia squarrosa*	1.18	0 (0)
V1	Low open woodland of *Eucalyptus accedens* over tall sparse shrubland of *Xanthorrhoea preissii* and *Macrozamia riedlei* over low open shrubland of *Bossiaea eriocarpa, Hakea lissocarpha* and *Banksia bipinnatifida* subsp. *bipinnatifida*	27.36	0 (0)
V2	Mid woodland of *Eucalyptus wandoo* and *Eucalyptus accedens* over mid-tall open shrubland of *Acacia lasiocarpa* var. *sedifolia* and *Xanthorrhoea preissii* over low open shrubland of *Hibbertia hypericoides*	16.07	0 (0)
V3	Mid open woodland of *Eucalyptus marginata* and *Corymbia calophylla* with isolated *Eucalyptus wandoo* trees over tall open *Banksia sessilis* shrubland over mid shrubland of *Daviesia angulata* and *Xanthorrhoea preissii* over low shrubland of *Babingtonia camphorosmae, Melaleuca trichophylla* and *Styphelia retrorsa*	4.13	0 (0)
V4	Mid isolated *Corymbia calophylla* trees over tall scattered *Hakea undulata* and *Adenanthos cygnorum* shrubs over mid closed shrubland of *Gastrolobium calycinum* and *Leptospermum erubescens*	28.32	0 (0)
V5	Mid open woodland to isolated trees of *Eucalyptus wandoo, Corymbia calophylla* and *Eucalyptus marginata* over tall open shrubland of *Leptospermum erubescens, Banksia squarrosa* and *Adenanthos cygnorum* over low open shrubland of *Bossiaea eriocarpa, Babingtonia camphorosmae* and *Styphelia retrorsa*	71.80	0.07(0.97)
V6	Tall closed shrubland of *Banksia squarrosa* subsp. *squarrosa* and *Banksia sessilis* over low open shrubland of *Hibbertia hypericoides*, Calytrix sp. indet 2, and *Calothamnus quadrifidus* subsp. *quadrifidus*	7.33	0.09(1.23)
V7	Mid open forest of *Eucalyptus wandoo* over mid-tall open shrubland of *Trymalium odoratissimum* subsp. *odoratissimum* and *Xanthorrhoea preissii* over low open shrubland of *Gastrolobium calycinum* and *Bossiaea eriocarpa*	39.95	0 (0)
V8	Tall closed shrubland of *Banksia squarrosa* subsp. *squarrosa, Leptospermum erubescens* and *Allocasuarina huegeliana* over low open shrubland of *Banksia sphaerocarpa* var. *pumilio*	1.17	0 (0)
W1	Wetland	0.09	0 (0)
Cl	Cleared	12.84	0.02 (0.156)
Total		2022.82	4.4 (0.21)

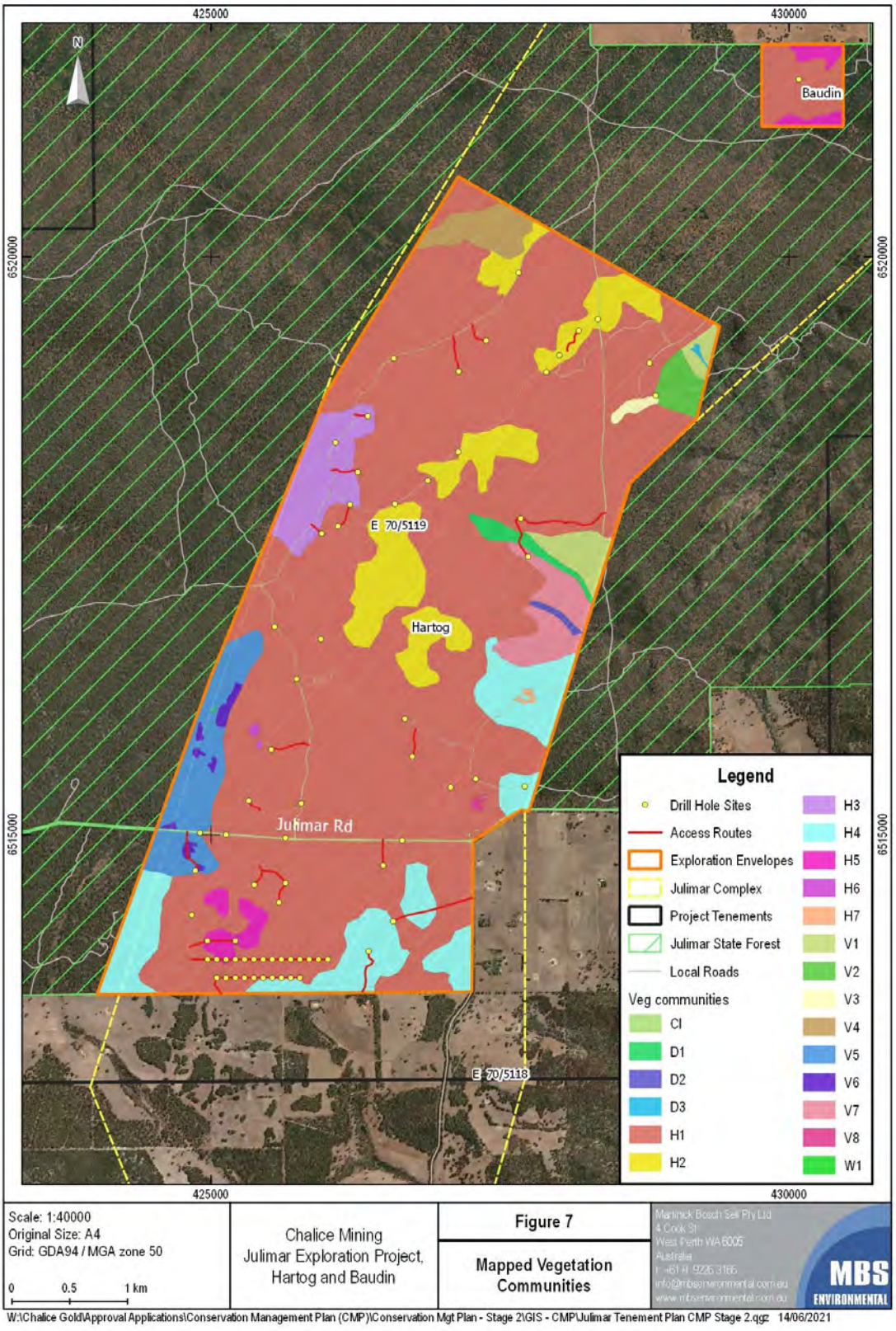


Figure 7: Vegetation Communities Mapped Within the Hartog and Baudin Targets

5.3.2.2 Threatened and Priority Ecological Communities

No TEC or PECs were identified within the Hartog and Baudin targets and no vegetation communities recorded within the targets were determined to be representative of any TEC or PECs listed under the EPBC Act or BC Act. As the proposed drilling program will not impact TEC or PEC, no further discussion on these aspects is presented in this CMP.

5.3.2.3 Conservation Significant Flora

Database searches of the area surrounding Hartog and Baudin targets were undertaken as part of the desktop assessment and identified 15 Threatened federal and state listed flora species and seven Priority 1, 19 Priority 2, 16 Priority 3 and 21 Priority 4 listed species as likely to occur.

Of the conservation significant species potentially occurring in proximity to the Hartog and Baudin targets the following were recorded during the Reconnaissance survey:

- *Conospermum densiflorum subsp. unicephalatum* (T)
- *Drosera sewelliae* (P2)
- *Beaufortia eriocephala* (P3)
- *Lasiopetalum caroliae* (P3)

All locations of recorded Threatened and Priority flora from the reconnaissance survey are outside the proposed drilling program footprint.

Existing DBCA database records for *Drosera sewelliae* (P2), *Persoonia sulcata* (P4) and *Synaphea grandis* (P4) were visited during the reconnaissance field survey to further assess known populations. *Persoonia sulcata* and *Synaphea grandis* are present within the Hartog and Baudin targets but no additional locations were recorded during the reconnaissance survey (Biologic 2021).

Due to specimens lacking fruit/flower and size of the survey area, additional presence of Threatened and Priority species was considered possible. A further targeted survey of conservation significant species was undertaken across specific drill sites and access routes in Spring 2021. The targeted flora survey was undertaken in accordance with all relevant Environmental Protection Authority (EPA) guidance including the following:

- EPA 2018. Statement of Environmental Principles, Factors and Objectives;
- EPA 2016a. Environmental Factor Guideline: Flora and Vegetation; and
- EPA 2016b. Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment.

As required by the EPA guidance, the targeted flora survey was undertaken in Spring, with suitably qualified and experienced botanists. Each survey team is led by a senior botanist with a minimum of five years field survey experience as required by the EPA Technical Guidance for flora and vegetation surveys. The targeted flora survey was designed to identify individuals and the extent of any conservation significant flora populations relevant to the vegetation units. Where conservation significant flora taxa were located in the field, a GPS coordinate of the individual was taken, or, if the taxon existed within a small population, a central coordinate with an approximate 20 m radius was

used. Generalised information was collected for each occurrence, including an estimate of the number of individuals, photographs, reproductive status, condition and vegetation description.

Previously recorded locations of conservation significant flora were re-visited to confirm the results of the initial Reconnaissance survey.

The Targeted Flora Survey report is included as Appendix 4. The following Threatened and Priority flora species were found during the targeted survey (Biologic 2021):

- *Conospermum densiflorum subsp. unicephalatum* (T)
- *Drosera sewelliae* (P2)
- *Cyanicula ixioides* subsp. *candida* (P2)
- *Acacia drummondii* subsp. *affinis* (P3), and
- *Cyanicula ixioides* subsp. *ixioides* (P4).

Table 6 outlines all potentially occurring and recorded conservation significant flora including a likelihood rating on presence within the Proposed Drill Program (Biologic 2021a). All recorded conservation significant flora are shown in Figure 8.

Table 6: Potentially Occurring and Recorded Conservation Significant Flora within Proposed Exploration Drilling Program Area

Species	Status		Likelihood of Occurrence	Justification of Likelihood
	EPBC Act (BC Act)	DBCA Listed		
Acacia browniana var. glaucescens.	-	P2	Highly Unlikely	Taxon is a perennial shrub which would have been observed if present. Previously recorded within 2-20 km of Hartog and Baudin.
Acacia drummondii subsp. affinis	-	P3	Confirmed	Not applicable.
Acacia pulchella var. reflexa acuminate bracteole variant		P3	Highly Unlikely	Taxon is a perennial shrub which would have been observed if present. Previously recorded within 2-20 km of Hartog and Baudin.
Adenanthos cygnorum subsp. chamaephyton		P3	Highly Unlikely	Taxon is a perennial shrub which would have been observed if present. Previously recorded within 2 - 20 km of Hartog and Baudin.
Androcalva fragifolia		P1	Unlikely	Taxon is a perennial shrub which would have been observed if present. Previously recorded within 2 - 20 km of Hartog and Baudin.
Beaufortia eriocephala		P3	Unlikely	Taxon is a perennial shrub which would have been flowering at the time of the survey. Known from approximately 10 individuals recorded from one location in the broader area during the reconnaissance survey.
Calothamnus pachystachyus		P4	Highly Unlikely	Taxon is a perennial shrub which would have been flowering at the time of survey. Previously recorded within 2 -20 km of Hartog and Baudin.
Chorizema ulotropis		P4	Unlikely	Taxon is a perennial shrub which would have been flowering at the time of survey. Previously recorded within 2 -20 km of Hartog and Baudin.
Conospermum densiflorum subsp. unicephalatum (T)	EN (EN)	-	Confirmed	Not applicable. Occurred at drill site location that has been removed from the proposed drilling program to avoid impact to this species.

Species	Status		Likelihood of Occurrence	Justification of Likelihood
	EPBC Act (BC Act)	DBCA Listed		
Conostylis caricina subsp. elachys	-	P1	Unlikely	Taxon does not flower in September, however there was no suitable habitat present. Previously recorded within 2- 20km of Hartog and Baudin.
Cyanicula ixioides subsp. candida		P2	Confirmed	Not Applicable
Cyanicula ixioides subsp. ixioides		P4	Confirmed	Not Applicable
Drosera sewelliae	-	P2	Confirmed	Not Applicable
Eleocharis keigheryi,	VU(VU)	T	Highly Unlikely	No surface water present. Previously recorded within 2 -20 km of Hartog and Baudin.
Gastrolobium crispatum,		P1	Highly Unlikely	Taxon is a perennial shrub which would have been flowering at the time of survey, marginal habitat. Previously recorded within 2 -20 km of Hartog and Baudin.
Gastrolobium nudum		P2	Highly Unlikely	Taxon is a perennial shrub which would have been observed if present. Previously recorded within 2 -20 km of Hartog and Baudin.
Grevillea bracteosa subsp. Bracteos	EN (-)	-	Highly Unlikely	Taxon is a perennial shrub which would have been flowering at the time of survey. Previously recorded within 2 -20 km of Hartog and Baudin.
Grevillea corrugata	VU (EN)	-	Highly Unlikely	Taxon is a perennial shrub which would have been flowering at the time of survey. Previously recorded within 2 -20 km of Hartog and Baudin.
Grevillea curviloba	CR (EN)	-	Highly Unlikely	No suitable habitat present. Prefers winter-wet heath. Previously recorded within 2-20 km of Hartog and Baudin targets.

Species	Status		Likelihood of Occurrence	Justification of Likelihood
	EPBC Act (BC Act)	DBCA Listed		
Hemigenia platyphylla		P4	Highly Unlikely	Taxon is a perennial shrub which would have been flowering at the time of survey. Previously recorded within 2 -20 km of Hartog and Baudin.
Hibbertia miniata		P4	Highly Unlikely	Taxon is a perennial shrub which would have been flowering at the time of survey. Previously recorded within 2 -20 km of Hartog and Baudin.
Hydrocotyle lemnoides		P4	Highly Unlikely	No surface water present. Previously recorded within 2 -20 km of Hartog and Baudin.
Johnsonia inconspicua	-	P3	Highly Unlikely	No suitable habitat. Previously recorded within 2 - 20 km of Hartog and Baudin.
Lasiopetalum caroliae	-	P3	Unlikely	Taxon is a perennial shrub which would have been flowering at the time of survey. Known from two individuals recorded at two locations during the reconnaissance survey in the broader area. Previously recorded within 2 - 20 km of Hartog and Baudin.
Lechenaultia magnifica	-	P1	Unlikely	Medium shrub. Suitable habitat present. Previously recorded within 2 - 20 km of Hartog and Baudin.
Millotia tenuifolia var. laevis		P2	Possible	?Millotia sp. was present but flowers were too immature for identification. Suitable habitat present. Previously recorded within 2 -20 km of Hartog and Baudin.
Oxymyrrhine coronata	-	P4	Unlikely	Taxon is a large perennial shrub which would have been observed if present. Previously recorded within 2 km of Hartog and Baudin.
Persoonia sulcate	-	P4	Unlikely	Taxon is a perennial shrub which would have been flowering at the time of survey. Existing records within Julimar State Forest confirmed, but no further locations recorded during the survey.

Species	Status		Likelihood of Occurrence	Justification of Likelihood
	EPBC Act (BC Act)	DBCA Listed		
Schoenus natans	-	P4	Highly Unlikely	No suitable habitat. Previously recorded within 2 km of Hartog and Baudin.
Schoenus capillifolius		P3	Highly Unlikely	No suitable habitat. Previously recorded within 2 - 20 km of Hartog and Baudin.
Stylidium longitubum		P4	Highly Unlikely	No suitable habitat. Previously recorded within 2 - 20 km of Hartog and Baudin.
Stylidium vinosum		P1	Unlikely	Taxon flowers in September, however none of the flowering Stylidium were considered analogous to this taxon. Previously recorded within 2 - 20 km of Hartog and Baudin.
Synaphea grandis	-	P4	Unlikely	This taxon does not flower in September so would have been less observable. None of the Synaphea observed during the field survey matched the description or herbarium specimen for this taxon. Existing records within Hartog and Baudin targets confirmed in the broader area, but no further locations recorded during the survey.
Synaphea rangiferops		P2	Unlikely	Taxon is a perennial shrub which would have been observed if present. Previously recorded within 2 -20 km of Hartog and Baudin.
Tetratheca pilifera		P3	Unlikely	Taxon is a perennial shrub which would have been flowering at the time of survey. Previously recorded within 2 -20 km of Hartog and Baudin.
Thelymitra stellata	EN (EN)	T	Unlikely	This taxon does not flower during September however most records are further west in different bioregions.

Species	Status		Likelihood of Occurrence	Justification of Likelihood
	EPBC Act (BC Act)	DBCA Listed		
Verticordia citrella		P2	Possible	This taxon does not flower in September so would have been less observable. However, no Verticordia were observed within the Study Area. Previously recorded within 2 -20 km of Hartog and Baudin.
Verticordia huegelii var. tridens		P3	Highly Unlikely	Taxon is a perennial shrub which would have been flowering at the time of survey, marginal habitat. Previously recorded within 2 -20 km of Hartog and Baudin.
Verticordia serrata var. linearis		P3	Highly Unlikely	Taxon is a perennial shrub which would have been flowering at the time of survey. Previously recorded within 2 -20 km of Hartog and Baudin.

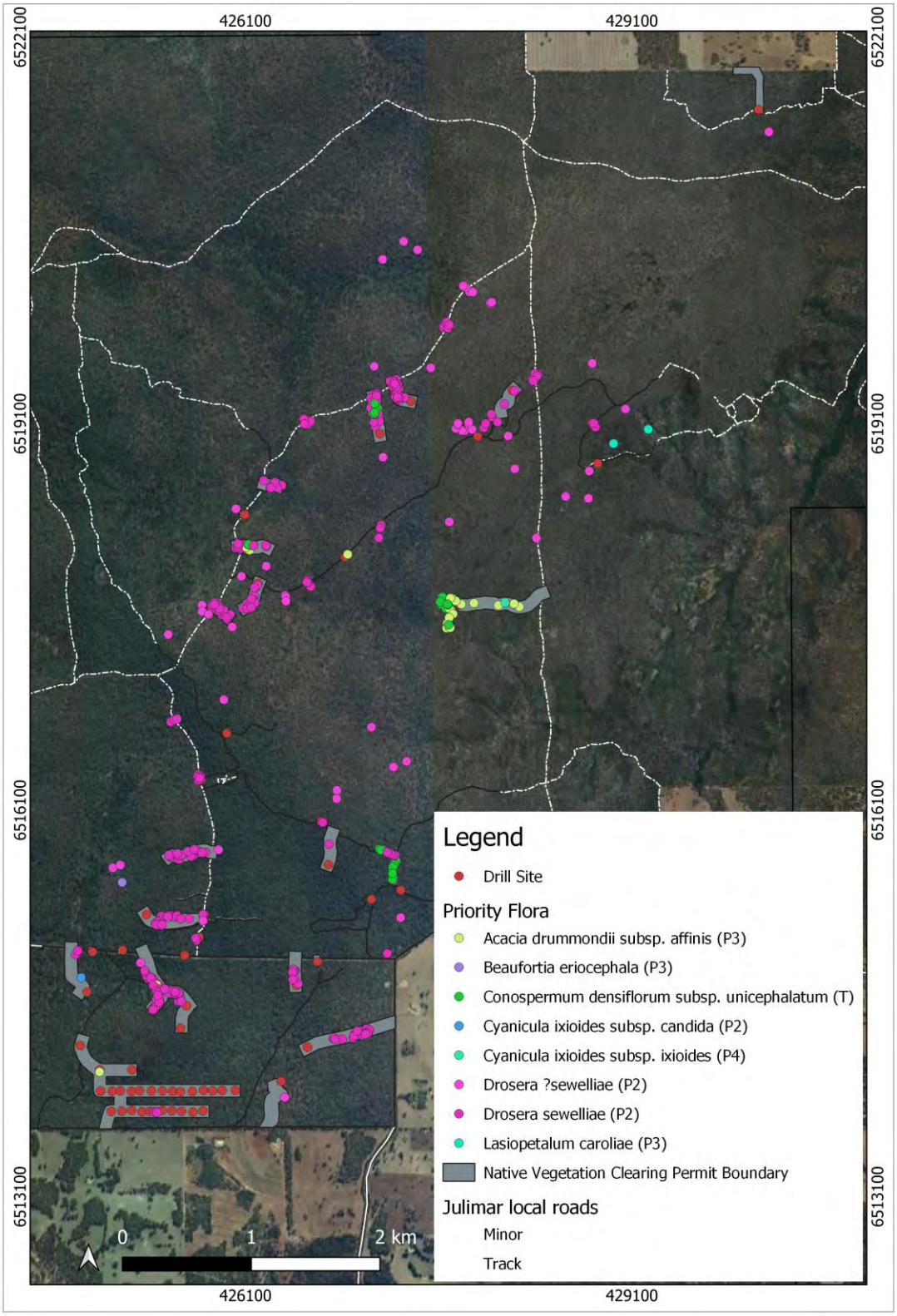


Figure 8: Conservation Significant Flora Recorded Within the Hartog and Baudin Targets

An assessment of the potential impact from the proposed drilling program on conservation significant flora has been undertaken and is included as Table 7. There will be no impact to Threatened flora species as a result of the proposed drilling program.

Table 7: Potential Impact on Conservation Significant Flora (Biologic 2021)

Significant taxon	Number of regional records (outside of 10 km)^	Number of local records (within 10 km)*	Number of individuals found by Biologic#	Total number of individuals	Maximum number to be impacted by Proposed Drill Program	Potential Percentage Impact
Conospermum densiflorum subsp. *unicephalatum* (T)	16	0	1,359	2,540	0	0.00%
Drosera sewelliae (P2)	8	3	6,704	6,896	600	8.70%
Cyanicula ixioides subsp. *candida* (P2)	7	0	1	315	1	0.32%
Acacia drummondii subsp. *affinis* (P3)	34	3	116	197	15	7.61%
Cyanicula ixioides subsp. *ixioides* (P4)	26	2	1	267	1	0.37%

^Includes WAH records more than 10 km away from Hartog and Baudin targets (excluding the number of local records).

*Includes WAH records provided by DBCA database searches within the 10 km search radius. # This includes both inside and outside of the current Study Area.

5.3.2.4 Introduced Flora

Database searches identified 86 introduced plant taxa as potentially occurring in the Hartog and Baudin target areas. Of these, 33 are listed as Weeds of National Significance (WoNS), 50 as declared pests (DPs) and 16 as Priority Alert Weeds. The following three introduced taxa were recorded during the Reconnaissance survey, none of which are listed as WoNS, DPs or Priority Weeds:

- *Aira caryophyllaceus.*
- *Ursinia anthemoides.*
- *Solanum nigrum.*

These species are known from five (5) locations across the Hartog and Baudin targets, all of which fall completely outside of the proposed drilling program and do not intercept any drill site locations or access routes.

5.3.3 Phytophthora Dieback

5.3.3.1 Previous Assessments

Chalice commissioned Glevan Consulting to undertake a Dieback assessment of the Gonneville target on private farmland adjacent to the southern boundary of the Julimar Forest in June 2020. All Dieback detection, diagnosis, mapping and testing was performed to standards and procedures defined in FEM047 Phytophthora Dieback Interpreter's Manual for lands managed by the Department (DPAW 2015). These procedures are grounded on the presence of indicator species in the vegetation, and the observance of deaths in these plants. All field work was led by a Registered Phytophthora Dieback Interpreter.

No Dieback infestations were observed over the 132-ha assessment area. Most of the survey area (109 ha or 80%) was excluded from assessment due to being degraded or void of vegetation. Of the eligible survey area (23.1 ha), 13.8 ha was assessed as Dieback uninfested and protectable, and 9.3 ha was assessed as uninterpretable due to the lack of reliable indicator species. A desktop review of previous indicator species recoveries from the Julimar area indicate that Dieback has not been previously recorded in or near the Gonneville target.

The Mattiske Desktop Assessment (2019) also concluded that although the vegetation in the Julimar area is thought to have a medium susceptibility to *Phytophthora* Dieback, there were no known disease positive sample points recorded (to 30 June 2018) for the Julimar State Forest.

5.3.3.2 Hartog and Baudin Linear Dieback Assessment

In June 2021, Chalice commissioned Glevan Consulting to undertake a linear dieback assessment of the Hartog and Baudin targets. This assessment covered an area of 620 ha comprising 72 proposed exploration drill sites, off-track access routes and existing forest tracks. The area north of Julimar Road has been assessed as uninterpretable due to the lack of indicator species (Glevan 2021). The area south of Julimar Road has been interpreted as uninfested (Glevan 2021).

Further detail of the dieback assessment can be found in Glevan's (2021) report in the attached Dieback Management Plan in Appendix 1.

5.4 Fauna and Habitat

5.4.1 Previous Assessments

To further define forest values, assist with environmental risk assessment processes, and identify potential impacts and management controls on vertebrate fauna and habitat values, Chalice has commissioned the following assessments:

« Desktop Assessment of Potential Flora and Fauna Values of the Julimar Project (Mattiske 2019).

- Gonneville Basic Vertebrate Fauna, Targeted Chuditch Survey and Black Cockatoo Habitat Assessment (Western Wildlife 2020).
- Hartog and Baudin Basic Vertebrate Fauna and Targeted Mammal Survey (Western Wildlife 2021).
- Hartog and Baudin Targeted Cockatoo Habitat Tree Survey (Western Wildlife 2021a).

From database searches the Mattiske desktop assessment recognised the potential for 688 fauna species to occur in the Julimar State Forest, comprising of 15 amphibian, 162 bird, 5 fish, 37 mammal, 67 reptile and 358 invertebrate taxa. Of these, 13 were recognised as Threatened and nine as Specially Protected under the BC Act, and eight listed as priority by the DBCA. From the 30 species listed at state level, 20 were also listed under the EPBC Act. The assessment concluded the Threatened Carnaby's Black Cockatoo (*Calyptorhynchus latirostris),* Chuditch (*Dasyurus geoffroii*), Quenda (*Isoodon obesulus fusciventer*), and Western Brush Wallaby (*Notamacropus irma)* were highly likely to be present within the Julimar State Forest.

The fauna assessments undertaken at the Gonneville target aimed to confirm the presence of conservation significant fauna identified in farmland adjacent to Julimar State Forest. Remnant vegetation patches present at Gonneville provide corridor linkages for fauna and it is assumed fauna species present in these areas are visitors and occupy the State Forest most of the time. Survey results confirmed the presence of Carnaby's Black Cockatoo, Chuditch and Quenda in the remnant patches. The survey also identified the presence of the Threatened species Forest Red-tailed Black-cockatoo (*Calyptorhynchus latirostris banksii*) which had medium likelihood of occurrence ranking in the Mattiske assessment. Three broad fauna habitats, creek, jarrah-marri woodland and wandoo woodland were identified, aligning with description of vegetation structures in the Gonneville Reconnaissance and Targeted Flora Assessment (Biologic 2020).

5.4.2 Hartog and Baudin Basic Vertebrate and Targeted Mammal Survey

In April/May 2021 Western Wildlife (WW) completed a Basic vertebrate fauna survey and Targeted conservation significant mammal survey across the Hartog and Baudin targets covering an approximate area of 2,023 ha. The survey consisted of fauna habitat identification and mapping, deployment of camera traps at 20 locations to identify conservation significant mammals, and opportunistic recordings of all vertebrate fauna observed during the field survey.

This survey was conducted in accordance with the following guidance:

- Technical guidance: terrestrial vertebrate fauna surveys for environmental impact assessment (EPA 2020).
- Referral Guidelines for Three Threatened Black-Cockatoo Species (DSEWPaC 2012).
- Survey Guidelines for Australia's Threatened Mammals (DSEWPaC 2011).

As required by the EPA guidance, the survey was undertaken by a suitably qualified and experienced zoologist. There were only minor limitations of the April-May 2021 survey, primarily related to seasonal constraints for assessing black cockatoo habitat. An additional black cockatoo survey has therefore since been undertaken as outlined in Section 5.4.2.2.

The purpose of the survey was to provide context to the desktop assessment as well as identify habitats and inventory likely fauna assemblages. The purpose of the Targeted survey was to provide additional data on Threatened and Priority mammal species known to occur in Julimar State Forest. The level of survey was determined based on the nature of the proposed drilling program being unlikely to have a significant impact on fauna and habitat values due to the small scale (<4.4 ha) and nature of the proposed disturbance (no mechanised clearing such as scraping or blading).

The Basic Vertebrate and Targeted Mammal survey recorded the presence of one frog, three reptiles, 39 birds and 12 mammal fauna species within the Hartog and Baudin targets. The findings of the survey are described in the below sections and a technical report provided in Appendix 5.

5.4.2.1 Habitat Assessment

The survey identified three fauna habitats as described in Table 8 and shown in Figure 9. The jarrah-marri woodlands account for most of the habitat throughout the two exploration areas (i.e. Hartog and Baudin). The wandoo woodlands generally surround the creek habitats in areas of lower topography.

The jarrah-marri woodland habitat will be impacted the most (3.6039 ha) by the proposed drilling program, however this accounts for only 0.21% of the total mapped extent for this habitat during the survey. No habitat is impacted more than 0.24% of its total mapped extent.

The habitats are common in the Northern Jarrah Forest (NJF) IBRA subregion and are therefore not locally restricted. However, the habitats are of importance because large, intact remnant vegetation areas such as Julimar State Forest are less vulnerable to the impacts of habitat fragmentation as seen through the NJF subregion and increase the likelihood of faunal populations persisting long term. The habitats are common throughout Julimar State Forest and reflect the habitat types recorded during the 2020 Gonneville survey. Less common habitat types, such as wetlands and granite outcrops, were not present.

Table 8: Overview and Proposed Impact on Fauna Habitats

Habitat	Description and Key Elements	Mapped Extent ha	Proposed Impact ha (%)
Jarrah-Marri woodland	Description: Occurs on higher ground on lateritic sandy gravels with occasional surface rock outcropping. Canopy is mostly Marri and Jarrah with occasional wandoo and bull banksia in the mid story. Understory is a mixture of low mixed shrubs dominated by *Hibbertia hypericoides.* Thickets of *Banksia sessilis* (Parrot Bush) and/or *Banksia squarrosa* (Pingle) are also present. Key Elements: « Hollow trees and crevices provide shelter and breeding habitat. « Fallen logs, scattered surface rocks and small outcrop provide shelter habitat for ground-dwelling reptiles. « Thickets of Parrot bush and Pingle provide shelter and foraging habitat for nectar-feeding species. « Native understory provides habitat for terrestrial fauna. Conservation Significant Species Supported: « Carnaby's Black Cockatoo « Forest-Red-tailed Black-cockatoo « Chuditch « Quenda « Brush-tailed Phascogale	1642.1	3.6039 (0.21) Hartog 0.0061 (0.0004) Baudin
Wandoo woodland	Description: Occurs mainly on lower slopes and valleys on pale clay-loams. Canopy is mostly wandoo with scattered Marri and Jarrah. Powderbark wandoo present on lateritic rises. Often sparse understorey consisting of mixed shrubs and grasstrees. Large hollow trees present. Key Elements: « Trees with hollows and crevices provide shelter and breeding habitat « Fallen logs, scattered surface rocks and small outcrops provide shelter habitat for ground-dwelling reptiles « Native understory provides habitat for terrestrial fauna. Conservation Significant Species Supported: « Carnaby's Black Cockatoo « Forest-Red-tailed Black-cockatoo « Chuditch « Quenda	323.3	0.77 (0.24)

Habitat	Description and Key Elements	Mapped Extent ha	Proposed Impact ha (%)
Creek	Description: Consists of small seasonal or ephemeral channels, with understory which is either open and sparse, shrubby or dense patches. Key Elements « Shelter and breeding habitat for native frogs. « Emergent trees with hollows and crevices provide shelter and breeding habitat for fauna. « Dense stands of *Kunzea* sp. provide habitat for nesting birds. « Large tree hollows for nesting and roosting fauna. « Creek channels and adjacent wet areas provide damp habitats for native frogs. Conservation Significant Species Supported: « Quenda « Carnaby's Black Cockatoo « Forest-Red-tailed Black-cockatoo « Chuditch	43.2	0 (0)
Cleared	Description « Tracks and roads with limited fauna value	12.8	0.02 (0.16)
Total		2021.4	4.4 (0.21)

Black cockatoo roosting and nesting sites are known to occur within 15 km of the Hartog and Baudin targets. Chalice engaged Western Wildlife to complete a Black Cockatoo habitat survey in Spring 2021 that comprised targeted searching for suitable nesting trees within areas designated for the proposed drill program (plus a 50 m buffer surrounding access routes and drill sites). The Black Cockatoo survey was designed to identify any potential cockatoo habitat trees and record the GPS coordinate, diameter at breast height, tree species, tree status, presence of hollows, indication of any activity by cockatoos and the presence of feral bees.

The Black Cockatoo survey was undertaken in accordance with the following relevant State and Commonwealth guidance:

« EPA 2020. Technical Guidance – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment; and
« DSEWPAC 2012. Referral Guidelines for Three Threatened Black-Cockatoo Species.

As required by the EPA guidance, the survey was undertaken by a suitably qualified and experienced zoologist. A comprehensive effort was made to survey all potential habitat trees in the survey area.

The Black Cockatoo Habitat survey report is included as Appendix 6 and identified the following:

« No trees were found that were being utilised by breeding cockatoos.

- Four trees were located that contain hollow/s potentially suitable for cockatoos and showed evidence of previous use by cockatoos.
- 470 trees were found that contained hollow/s potentially suitable for cockatoos that did not show evidence of previous Black Cockatoo use.

Locations of potential habitat trees are shown in Appendix 6.

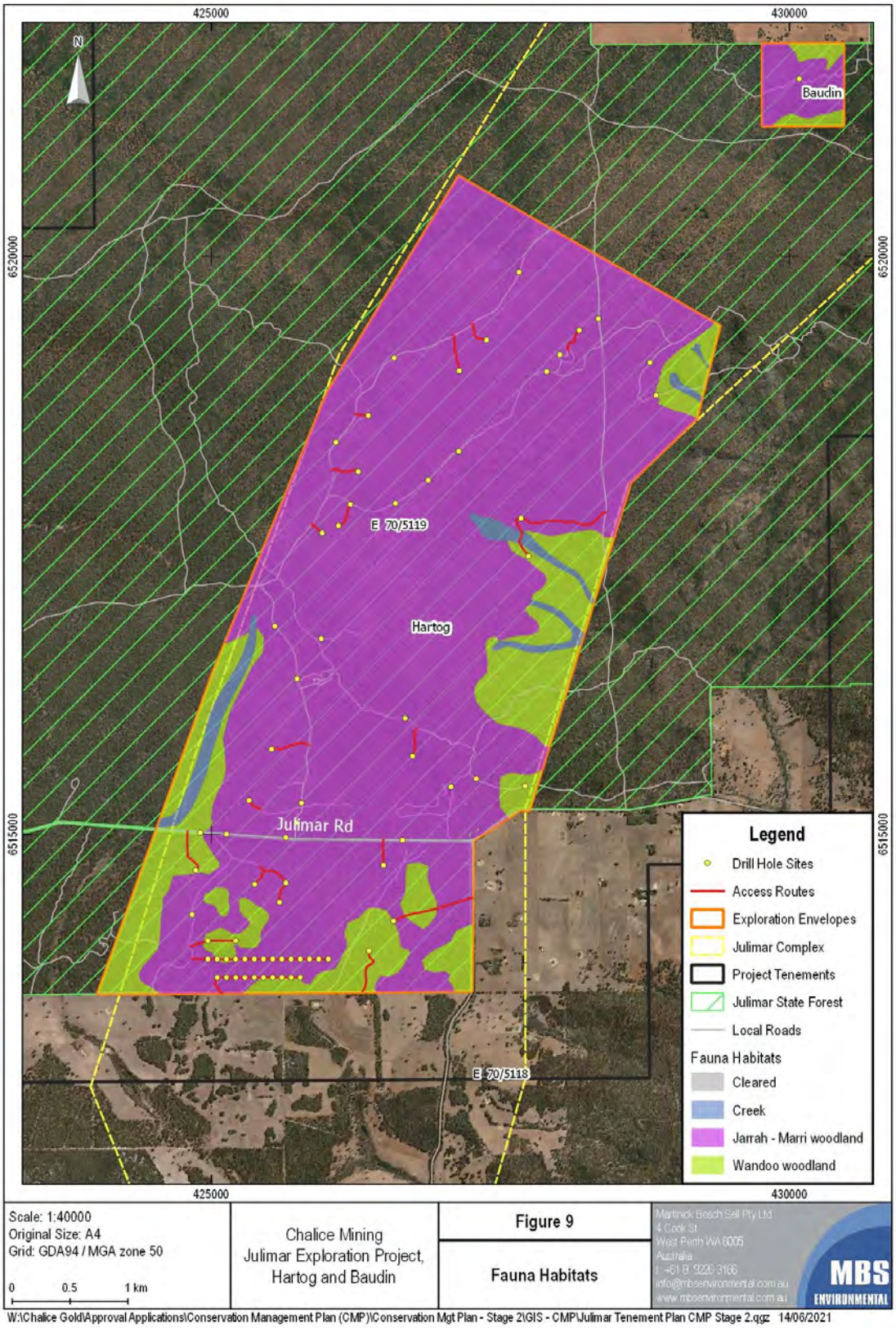


Figure 9: Fauna Habitats Mapped Within the Hartog and Baudin Targets

5.4.2.2 Conservation Significant Fauna

Database searches of a 40 km area surrounding Hartog and Baudin targets were undertaken as part of the desktop assessment. Fifteen conservation significant species have the potential to occur within the proposed exploration targets. This includes six Threatened, one Priority 3 (P3) and three Priority 4 (P4) listed fauna, as well as one Migratory species, two Specially Protected species and one Locally Significant Species. No Priority 1 or Priority 2 fauna listed by DBCA have the potential to occur. Of the conservation significant species potentially occurring in proximity to the Hartog and Baudin targets, 40% were recorded during the Basic and Targeted Mammal survey.

The conservation significant flora species potentially occurring in the Hartog and Baudin targets and their likelihood of occurrence is provided in Table 9 and shown in Figure 10.

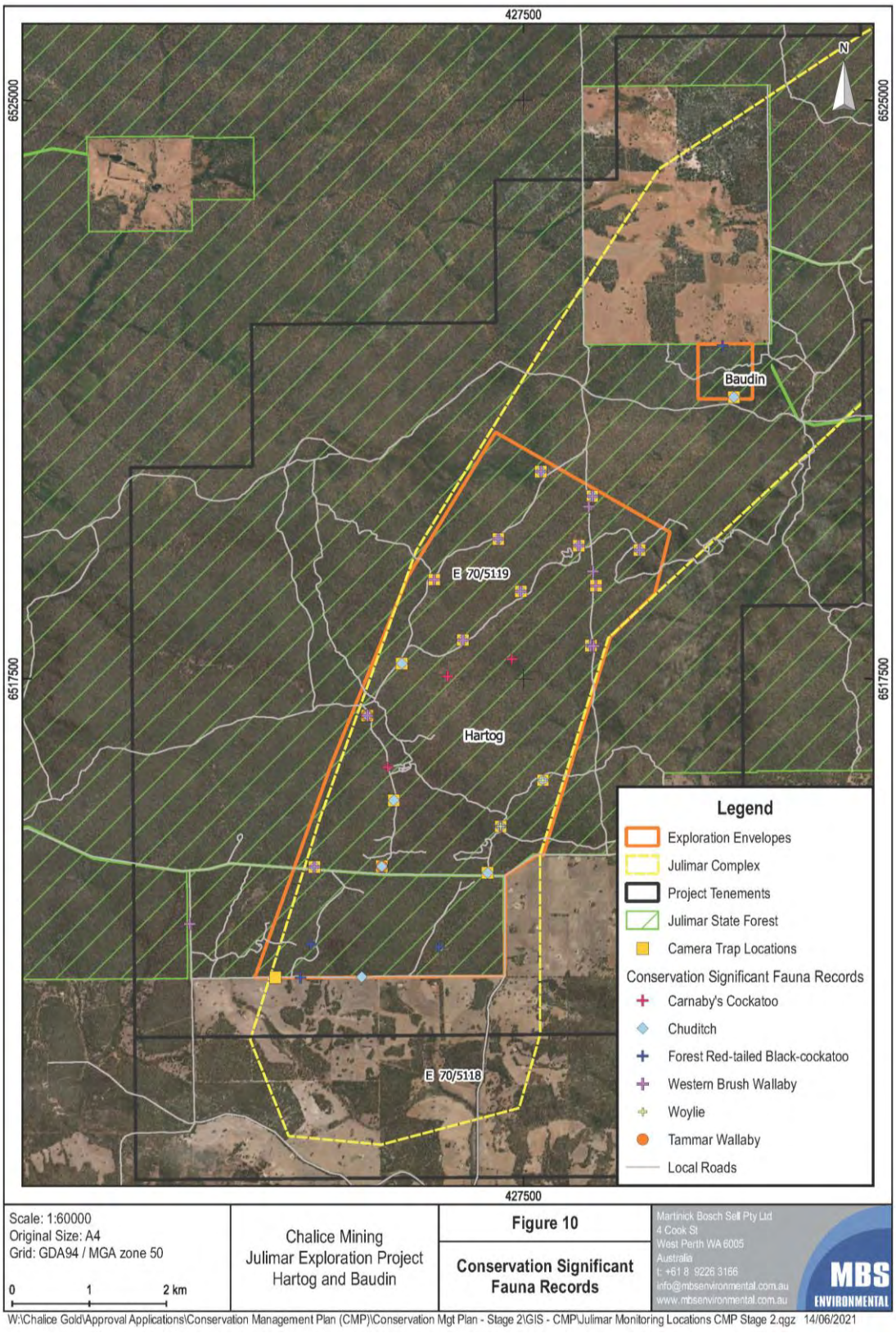


Figure 10: Conservation Significant Fauna Records

Table 9: Potentially Occurring and Recorded Conservation Significant Fauna of the Hartog and Baudin Targets

Species	Status		Likelihood of Occurrence	Justification of Likelihood
	EPBC Act (BC Act)	DBCA Listed		
Barking Owl, southern *(Ninox connivens connivens)*		P3	Moderate	Known from records within Julimar and surrounding national park. Possible breeding resident, breeding in large tree hollows. The study area would be part of a much larger home-range for a single pair.
Baudins Cockatoo (*Calyptorhynchus baudinii)*	EN (EN)	-	Low	Known from records within Julimar and surrounds. An uncommon winter visitor, foraging in Jarrah – Marri woodland. The exploration targets lie on the northern limit of its range.
Black-flanked Rock Wallaby *(Petrogale lateralis)*	EN (EN)	-	Very Low	Known from translocation records and surrounding national parks/sanctuary. This species may disperse throughout the Hartog and Baudin targets, however, is unlikely to use any of the habitats present.
Brush-tailed Phascogale *(Phascogale tapoatafa*)	- (CD)	-	High	Conservation Dependent Species. Likely to be a breeding resident occurring in all mapped habitats.
Carnaby's Black Cockatoo *(Calyptorhynchus latirostris)*	EN (EN)	-	Recorded	Recorded from evidence of foraging. A seasonal visitor, foraging in Jarrah – Marri woodland, Banksia thickets and possibly breeding in tree hollows in Jarrah, Marri or Wandoo.
Carpet Python (*Morelia spilota imbricata*).	-	-	High	Locally significant species. May occur in woodland habitats, sheltering in tree hollows, rock piles and hollow logs.
Chuditch (*Dasyurus geoffroii*)	VU (VU)	-	Recorded	Recorded on several camera traps. Likely to be a breeding resident occurring in all habitats, denning in hollow logs, rock piles and possibly tree hollows.
Dell's Ctenotus (*Ctenotus delli*)		P4	High	Known from records within Julimar. Likely to be a breeding of Jarrah-Marri woodland. Known from 5 other records including Julimar.

Species	Status		Likelihood of Occurrence	Justification of Likelihood
	EPBC Act (BC Act)	DBCA Listed		
Forest Red-tailed Black Cockatoo *(Calyptorhynchus banksii naso)*	VU(VU)	-	Recorded	Recorded from evidence of foraging and bird calls. A resident or seasonal visitor, foraging in Jarrah – Marri woodland and possibly breeding in tree hollows in Jarrah, Marri or Wandoo. .
Fork-tailed Swift (*Apus pacificus*)	Mi (Mi)		Moderate	No known records within 20km. Migratory species that is thought to be almost entirely aerial when visiting Australia. The species is unlikely to use any of the habitat mapped within the Hartog and Baudin targets.
Peregrine Falcon *(Falco peregrinus)*	-	(OS)	Moderate	Other Specially Protected species. Known from records within Julimar. Possible foraging visitor over pasture, that may breed in tall trees in woodlands. Habitats within the exploration targets are unlikely to be important for the species as its population is large and secure, and favoured breeding habitats are absent. The mapped habitats would be part of a much larger home range for a single pair of the species.
Quenda *(Isoodon fusciventer)*		P4	High	Known from records within Julimar. Likely to be a breeding resident occurring in all habitats but favouring creek and woodlands with a dense understory.
Tamar Wallaby *(Notamacropus eugenii derbianus)*	-	P4	Recorded	Recorded on camera traps. Likely to be a breeding resident occurring in all mapped habitats.
Western Brush Wallaby *(Notamacropus irma)*		P4	Recorded	Recorded on camera traps. Likely to be a breeding resident occurring in all mapped habitats.
Woylie (*Bettongia penicilata ogilbyi*)	EN (CR)		Recorded	Recorded on camera traps. Likely to be a breeding resident occurring in all habitats.

5.4.2.3 Introduced Fauna

Four introduced fauna species were observed within the site, including the House Mouse (*Mus musculus)*, Rabbit *(Oryctolagus cuniculus)*, Red Fox *(Vulpes vulpes)* and Cat *(Felis cattis).*

A total of eight fauna species identified as potentially occurring in the survey area are introduced species. These consist of six mammal and two bird taxa (Table 10). Five of the introduced taxa were recorded during the Basic survey, also shown in Table 10.

Table 10: Potential Introduced Species and Declared Pest Organisms

Group	Introduced Species	Common Name	Recorded During Basic Survey
Birds	*Dacelo novaeguineae*	Laughing Kookaburra	✓
	Streptopelia senegalensis	Laughing Turtledove	
Mammals	*Felis cattis*	Cat (feral)	✓
	Mus musculus	House Mouse	
	Oryctolagus cuniculus	Rabbit (feral)	✓
	Rattus rattus	Back Rat	
	Sus scrofa	Pig (feral)	✓
	Vulpes vulpes	Red Fox	✓

5.4.2.4 Invertebrate Fauna

Four invertebrates of conservation significance were identified on DBCA's Threatened and Priority Database (Western Wildlife, 2021) as outlined in Table 11.

Table 11: Invertebrate Fauna of Conservation Significance

Species	Status		Likelihood of Occurrence	Justification of Likelihood
	EPBC Act (BC Act)	DBCA Listed		
Carter's Freshwater Mussel – *Westralunio carteri*	VU (VU)	-	Very low	The creek habitat will not hold water for a sufficient length of time to support this species.
Inornate Trapdoor Spider – *Euoplos inornatus*	-	Priority 3	Moderate	Nearest single record is within 20 km of the study area and this species may occur in Jarrah- Marri woodland. The Inornate Trapdoor Spider (*Euoplos inornatus*) has been found on Chittering Road near Bullsbrook and also near the Dwellingup State Forest representing a range of approximately 130km at least.

Species	Status		Likelihood of Occurrence	Justification of Likelihood
	EPBC Act (BC Act)	DBCA Listed		
Julimar Shield-backed Trapdoor Spider – *Idiosoma mcclementsorum*	-	Priority 2	Moderate	Julimar Shield-backed trapdoor spider has been found between Chittering Lakes and Gillingara representing a range of approximately 60km at least. Although there are no records within the study area, this species is known from within the Julimar State Forest.
Mortlock River Shield-backed Trapdoor Spider - *Idiosoma schoknechtorum*	-	Priority 3	Very low	Although there are records of this species about 15km south, the range of this species is not currently thought to extend as far north as the proposed drilling area.

5.5 Hydrology

Rivers are the only wetlands of subregional significance in the Northern Jarrah Forest (Biologic 2021). The water courses of the subregion are dominated by the creation of water storage structures (dams and reservoirs) within the forested catchment primarily to provide potable water to the Perth metropolitan area and irrigation horticulture and agriculture (Biologic 2021). The Hartog and Baudin targets are in the Brockman River sub catchment within the Swan-Avon Main-Avon Catchment of the Swan Coastal Basin.

There are two un-named minor watercourses, which form tributaries to Julimar Brook. One intersects the mid-eastern side of Hartog, the other is in the south-eastern corner (Figure 11). These minor watercourses, originating from Julimar State Forest in the north, flow northwest to southeast through the exploration targets entering Julimar Brook approximately 3.2 km to the east. Julimar Brook then feeds into the Avon River 5.6 km south of this confluence. There is also a third un-named watercourse in the northern portion which flows into the Brockman River via the Spice Brook and ends in the Chittering-Needonga lakes.

Limited groundwater data is available for the proposed exploration targets. Groundwater is likely to occur in low yielding, fractured rock aquifers. Water for drilling activities will be sourced from ex-pastoral bores on surrounding farmland on E70/5118 and E70/5119. Water required for exploration programs will depend on the characteristics of the drill hole and will be transported to drill sites within the State Forest using a light vehicle and trailer mounted tank.

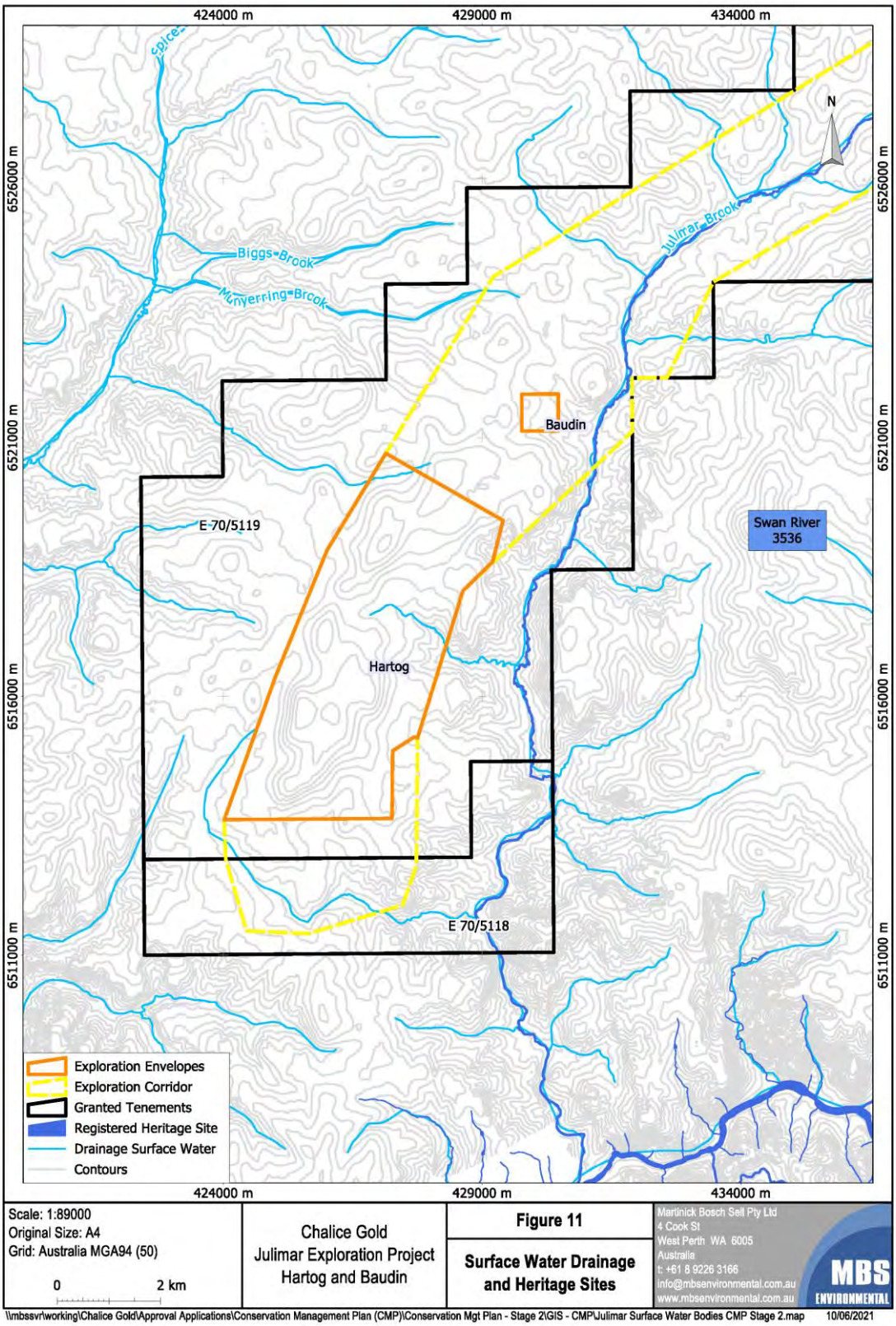


Figure 11: Surface Water Drainage and Heritage Sites within the Hartog and Baudin Targets

5.6 Aboriginal and Cultural Heritage

Chalice entered into Aboriginal heritage agreements with the Yued Agreement Group and Whadjuk People Agreement Group in the form of two separate Noongar Standard Heritage Agreements (NSHA) in 2018.

Chalice submitted Activity Notices to SWALSC on 4 June 2021 in relation to the proposed exploration drilling program in Julimar State Forest. Heritage surveys will be conducted with Traditional Owners to identify any areas within the proposed drill sites and access routes that need to be avoided due to the presence of a potential Aboriginal heritage site. The proposed drill program will not commence until the heritage surveys and associated consultation with Yued and Whadjuk has been completed and survey reports have been received under the terms of Chalice's agreements with Yued and Whadjuk. Cultural heritage surveys will be undertaken with Traditional Owners using the Site Avoidance Model which is consistent with paragraph 2.28 of the Aboriginal Heritage Due Diligence Guidelines (DPLH, 2013).

A search of the Heritage Inquiry System (DLPH 2020) indicates Julimar Brook as the nearest Aboriginal heritage site which passes through the project tenements and feeds into the Avon River in the south (Figure 11). All proposed access routes and drill sites are located outside of the Julimar Brook registered site.

5.7 Values of Julimar State Forest

5.7.1 Conservation Values

5.7.1.1 Western Shield Fauna Recovery Program

Commencing in 1996, the Western Shield Fauna Recovery Program, managed by DBCA, aims to reduce the threat of predation by introduced species European Red Fox (*Vulpes vulpes*) and Feral Cat (*Felis catus)* on WA's native fauna species. The program targets the protection of four main species including the Woylie (Brush-tailed Bettong), Chuditch (Quoll), Quenda (Southern Brown Bandicoot), and the Brushtail Possum, which are monitored (trapped) and assessed annually to determine rate of recovery. There are 36 monitoring sites within WA, one of which is the Julimar State Forest.

Western Shield is one of the largest threat abatement programs, which involves the distribution of sausage-like baits loaded with 1080 poison, across 3.9 million hectares of State Forest and reserves (DBCA 2017). Baiting is carried out four times a year for foxes and once a year for cats. The use of specially modified aircraft allows baiting to occur over the great distances required and allows accurate dropping of baits. Where the aircraft cannot be used baits are delivered by vehicles. DBCA drop more than 900,000 baits each year—600,000 fox baits and 300,000 feral cat baits (DBCA 2017). Over the years the program has been so successful the Woylie has been removed from the Threatened species list (DBCA 2020) and the Julimar State Forest is renowned for being home to one of the healthiest known Chuditch populations in WA (DBCA 2017). In addition to baiting, automated wildlife cameras are in use within the Northern Jarrah forest to provide insight into native fauna behaviour.

5.7.1.2 Chuditch Translocation Program

Over a three-year period Chuditch were bred at Perth Zoo with the aim of reintroducing the species into Julimar State Forest where it had not been observed since 1973 (DEC 2012). Following evidence from DBCA (then CALM) that predator control and species management programs had been working well, in 1992, 22 of the 42 individuals bred in captivity at Perth Zoo were released into the Forest. Ongoing monitoring at Julimar State Forest has shown that Chuditch populations have continued at trap success rates of 2-4%, higher than before fox control was implemented (DEC 2012). The health of this Chuditch population allows individuals to be used for other translocation projects around Australia.

5.7.2 Tourism, Recreation and Aesthetics

The Forest caters for a wide variety of activities, including picnicking, bushwalking and cycling. There are two gazetted off-road vehicle areas within pine plantations north of Perth and many 4WD clubs utilise the area and organise activities such as car rallies and adventure racing. The spring flowering season brings wildflower (and orchid) enthusiasts to the forest to walk the trails within the State Forest.

The Camino Salvador Pilgrim Walk Trail is a 185 km walking trail from Subiaco to New Norcia, managed by the non-profit organisation the Pilgrim Trail Foundation (Camino Salvador 2014). A 22 km length of the trail runs through the Julimar State Forest, entering from Julimar Rd and heading generally north following the route of Ferguson, Mortimer, Cooke, Munyerring Springs Roads and exiting the forest boundary 4.5km from Dewars Pool.

6. Risk Assessment and Management

To identify environmental issues and management requirements associated with the proposed exploration drilling program, a risk assessment has been completed considering the following key elements:

- Types of exploration activities likely to occur.
- Potential impacts from exploration activities.
- Known conservation values of the Julimar State Forest.

The risk assessment was undertaken using the tools consistent with the Australian Standard for Risk Management (AS/NZS ISO 31000:2018) (Appendix 7). Appropriate levels were assigned to risks using a risk matrix that comprises the defined categories of likelihood, or probability, and defined categories of environmental consequence (Appendix 7). Inherent risks were assessed, preventative and management measures documented, and residual risks subsequently assessed based on application of management controls.

In assessing risk levels and appropriate controls priority has been given to higher order controls and management measures within the hierarchy of controls i.e. avoidance and substitution (Figure 12). The higher up the hierarchy of control the greater protection management measures or controls provide and increased effectiveness they have in reducing residual risk.

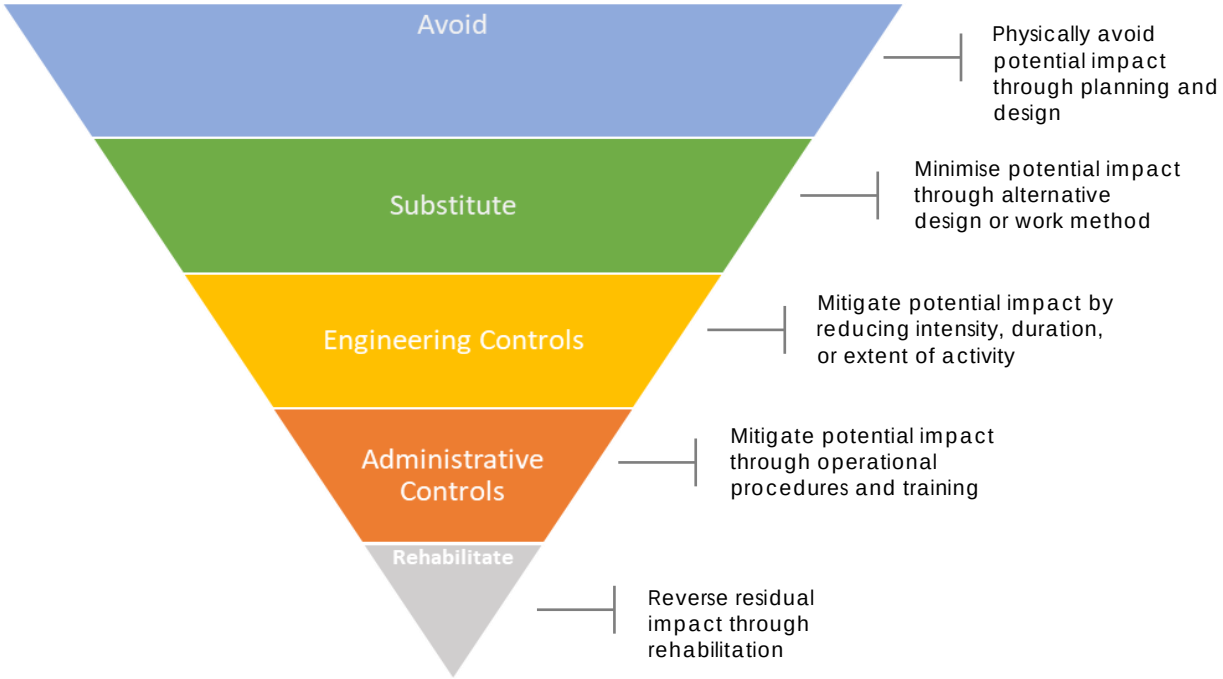


Figure 12: Hierarchy of Controls

In total one 'high', one 'moderate-high', 10 'moderate' and 5 'low' inherent (i.e. uncontrolled) risks were identified. Fourteen of the 17 risks were assessed as having a 'low' residual risk following the application of management controls. Two 'moderate' residual risks relate to the spread or introduction of dieback or weeds from the proposed drilling program. One 'moderate-high' residual risk relates to minor direct impact to four Priority flora species. All these species have broad distributions outside of Julimar State Forest with 0.32% to 8.7% of the total records of any species potentially impacted. There will be no impact to Threatened flora species as a result of the proposed drilling program.

Table 12 details the environmental management measures and commitments Chalice will implement to prevent or adequately minimise potential environmental impacts associated with the proposed exploration drilling program. Where specific management procedures are required, these are referenced and included as appendices to this CMP.

Table 12: Risk Assessment and Management Commitments

			Inherent Risk				Residual Risk		
Conservation Value	Activity	Risk and Potential Impact	L	C	Risk	Management Measures	L	C	Risk
Flora and vegetation	• Drill rig and support vehicle movement on access routes as outlined in Figure 4. • Siting and operation of drill rigs and equipment in vegetated areas. • Movement of support vehicles and personnel.	Direct disturbance to threatened or priority ecological communities and/or threatened flora.	Possible	Moderate	M	Avoid: • Flora and vegetation surveys (including Spring surveys) conducted over 2000 ha envelope to identify presence and distribution of TEC/PECs and threatened and priority flora. • Drill program has been redesigned to avoid recorded Threatened flora species. All ground disturbing works will remain greater than 50m away from any threatened flora species records. • No TEC/PECs were identified within the proposed exploration program footprint during surveys. • Drill sites and access routes located in areas of sparse vegetation where practicable. • Drill sites have been located on existing tracks where possible (approx. 30%). Substitute: • Track-mounted diamond drill rigs and support vehicles will be used to limit the footprint and negate need for mechanical clearing of access routes and drill sites. • Track mounted drill rigs and support vehicles will limit disturbance to above topsoil and minimises the impact to root stock and seedbank. • Multiple holes drilled from single drill site, rather than grid	Unlikely	Minor	L

			Inherent Risk				Residual Risk		
Conservation Value	Activity	Risk and Potential Impact	L	C	Risk	Management Measures	L	C	Risk
						configuration, to minimise footprint. Engineering control: • Drill rigs and support vehicles will be configured in tandem off existing access routes to reduce disturbance footprint. • Access routes will be clearly pegged, and movement of equipment and personnel restricted to designated areas. • Establishment of clearly delineated buffer zones of 50m around any Threatened flora in the vicinity of exploration activities. • Any threatened flora occurring within the drilling program access routes (as outlined in Figure 4) will be clearly demarcated in the field to ensure avoidance. • Rough Terrain Vehicles (RTVs) will be used to transport personnel and equipment to off-track drill sites instead of light vehicles. Number of movements per day will be limited. Administrative controls: • All personnel will be required to undertake an induction, which will include details on the importance of vegetation and flora protection. Rehabilitate: • Rehabilitation activities will be undertaken in accordance with tenement condition using the PoW Rehabilitation Report Checklist.			

			Inherent Risk				Residual Risk		
Conservation Value	Activity	Risk and Potential Impact	L	C	Risk	Management Measures	L	C	Risk
						• Submission of PoW Rehabilitation Completion Report to DMIRS.			
Flora and vegetation	• Drill rig and support vehicle movement on access routes as outlined in Figure 4. • Siting and operation of drill rigs and equipment in vegetated areas. • Movement of support vehicles and personnel.	Direct disturbance to Priority flora.	Almost Certain	Minor	H	Avoid: • Flora and vegetation surveys (including spring surveys) conducted over 2000 ha envelope to identify presence and distribution of TEC/PECs and threatened and priority flora. • The proposed drill program will not impact on more than 10% of the known population of any Priority species. • Drill sites and access routes located in areas of sparse vegetation where practicable. • Drill sites have been located on existing tracks where possible (approx. 30%). Substitute: • Track-mounted diamond drill rigs and support vehicles will be used to limit the footprint and negate need for mechanical clearing of access routes and drill sites. • Track mounted drill rigs and support vehicles will limit disturbance to above topsoil and minimises the impact to root stock and seedbank. • Multiple holes drilled from single drill site, rather than grid configuration, to minimise footprint. Engineering control:	Almost Certain	Minor	M-H

			Inherent Risk				Residual Risk		
Conservation Value	Activity	Risk and Potential Impact	L	C	Risk	Management Measures	L	C	Risk
						• Drill rigs and support vehicles will be configured in tandem off existing access routes to reduce disturbance footprint. • Access routes will be clearly pegged, and movement of equipment and personnel restricted to designated areas. • Rough Terrain Vehicles (RTVs) will be used to transport personnel and equipment to off-track drill sites instead of light vehicles. Number of movements per day will be limited. Administrative controls: • All personnel will be required to undertake an induction, which will include details on the importance of vegetation and flora protection. Rehabilitate: • Rehabilitation activities will be undertaken in accordance with tenement condition using the PoW Rehabilitation Report Checklist. • Submission of PoW Rehabilitation Completion Report to DMIRS.			
Flora and vegetation	• Drill rig and support vehicle movement on access routes as outlined in Figure 4. • Siting and operation of drill rigs and equipment in vegetated areas. • Refuelling of drill rigs.	Ignition of fire and loss of significant areas of vegetation and flora.	Unlikely	Moderate	M	Avoid: • No open fires will be permitted. • All personnel accommodated at existing camps outside of the Julimar State Forest. • Bulk fuel supplies will be stored offsite and not within State Forest boundaries. Engineering control:	Rare	Moderate	L

			Inherent Risk				Residual Risk		
Conservation Value	Activity	Risk and Potential Impact	L	C	Risk	Management Measures	L	C	Risk
	• Movement of support vehicles and personnel.					• A fire suppression system is present on the drill rig. • All support vehicles, light vehicles, RTVs will be equipped with fire extinguishers. • Drill rigs and support vehicles use diesel rather than petrol reducing risk of fire. Administrative control: • Daily checks on weather conditions and fire bans. • Exploration personnel will be trained in the use of fire extinguishers and fire prevention measures. • All exploration activities will be conducted in accordance with the Chalice Bushfire Response Plan.			
Flora and vegetation	• Drill rig and support vehicle movement on access routes. • Siting and operation of drill rigs and equipment in vegetated areas. • Waste management. • Refuelling of drill rigs. • Movement of support vehicles and personnel.	Hydrocarbon soil contamination impacts to TEC/PECs and/or threatened or priority flora.	Possible	Minor	M	Avoid: • Spring surveys were conducted prior to commencement of work to verify that proposed access routes and drill sites do not directly impact TEC/PECs or Threatened flora. • Drill program has been redesigned to avoid recorded Threatened flora species. • No TEC/PECs were identified within the proposed exploration program footprint during surveys. • The proposed drill program will not impact on more than 10% of the known population of any Priority species.	Unlikely	Minor	L

			Inherent Risk				Residual Risk		
Conservation Value	Activity	Risk and Potential Impact	L	C	Risk	Management Measures	L	C	Risk
						• Drill sites have been located on existing tracks where possible (approx. 30%). • Bulk fuel supplies will be stored offsite and not within State Forest boundaries. Engineering controls: • Maximum hydrocarbon inventory on drill rig is less than 1000 litres. • All vehicles will be subject to pre-start checks. • Drip trays, liners and/or bunding will be utilised during refuelling activities to minimise hydrocarbon spillage. • Establishment of clearly delineated buffer zones of 50m around any Threatened flora in the vicinity of exploration activities. Administrative control: • Spill response training will be provided as part of the site induction for all exploration personnel on the containment and remediation of hydrocarbon spills. • Material Safety Data Sheets will be available onsite in easily accessible locations. • Spillages will be reported using the incident report system. Rehabilitate: • Spill kits will be available at all drill sites. • Spills will be cleaned up immediately to avoid contamination.			

			Inherent Risk				Residual Risk		
Conservation Value	Activity	Risk and Potential Impact	L	C	Risk	Management Measures	L	C	Risk
Flora and vegetation	• Drill rig and equipment movement on access routes. • Siting and operation of drill rigs and equipment in vegetated areas. • Movement of support vehicles and personnel.	Localised compaction of soils.	Likely	Minor	M	Avoid: • Drill sites have been located on existing tracks where possible (approx. 30%). Substitute: • Track-mounted diamond drill rigs and support vehicles will be used to limit footprint and impact to soils (generally < 4PSI). • Multiple holes drilled from single drill site, rather than grid configuration, to minimise footprint. • Rough Terrain Vehicles (RTVs) will be used to transport personnel and equipment to off-track drill sites instead of light vehicles and number of movements per day will be limited.	Possible	Insignificant	L
Flora and vegetation	• Drill rig and equipment movement and operation on access routes. • Movement of support vehicles and personnel.	Spread or introduction of dieback from personnel, track mounted drill rigs and/or support vehicles.	Possible	Major	M-H	Avoid • Drilling activities will not take place during wet soil conditions in the northern uninterpretable area with the exception of movement of light vehicles and personnel for demobilization and security purposes. Substitute: • Dieback surveys have been conducted to identify required dieback control methods and protocols. Engineering controls:	Unlikely	Major	M

			Inherent Risk				Residual Risk		
Conservation Value	Activity	Risk and Potential Impact	L	C	Risk	Management Measures	L	C	Risk
						• All vehicles and equipment mobilising to the site will first be cleaned down off-site. • Designated vehicles will be allocated for use in State Forest areas. • All vehicles and equipment will be washed down in accordance with the Dieback Management Plan (Appendix 1) • Vehicles equipped with Dieback hygiene kits. Administrative controls: • Field and digital mapping of infested and uninterpretable areas for avoidance and management. • Dieback Management Plan implemented (Appendix 1). • Exploration drilling personnel training and induction (including greencard training).			
Flora and vegetation	• Drill rig and equipment movement on access routes. • Siting and operation of drill rigs and equipment in vegetated areas. • Movement of support vehicles and personnel.	Spread or introduction of weeds from personnel, track mounted drill rigs and/or support vehicles.	Possible	Minor	M	Engineering control: • All vehicles and track mounted drill rigs and equipment mobilising to the site will first be cleaned down off-site prior to entering the State Forest. • Baseline surveys conducted to determine presence and locations of weeds along access routes and at drill sites. Administrative control: • Exploration personnel training and induction covering weed management procedures. Rehabilitation:	Possible	Minor	M

			Inherent Risk				Residual Risk		
Conservation Value	Activity	Risk and Potential Impact	L	C	Risk	Management Measures	L	C	Risk
						• Off-track access routes and drill sites will be monitored following completion of exploration activities to identify any new infestations or spread of weeds and assess control requirements.			
Flora and vegetation	• Drill rig and equipment movement on access routes. • Siting and operation of drill rigs and equipment in vegetated areas. • Waste management.	Soil contamination from waste management impacts significant vegetation and flora.	Possible	Insignificant	L	Avoid: • Use of specialised track mounted diamond drill rigs and support vehicles avoids need to construct open sumps associated with conventional drilling. Substitute: • A closed-circuit drilling method will be used and all cuttings that come from the drill holes and other waste materials will be stored on support vehicles in portable tanks and sealed containers and taken off site for disposal. • All personnel will be accommodated outside of the State Forest at existing camps. Engineering controls: • All waste including rubbish, survey tape, wooden pegs, spare parts etc. will be removed from site and appropriately disposed of. Administrative controls: • Regular inspection and change out of portable tanks to prevent overflow.	Unlikely	Insignificant	L
Fauna	• Drill rig and equipment movement on	Loss of significant fauna habitat including removal	Possible	Moderate	M	Avoid:	Unlikely	Insignificant	L

			Inherent Risk				Residual Risk		
Conservation Value	Activity	Risk and Potential Impact	L	C	Risk	Management Measures	L	C	Risk
	access routes as outlined in Figure 4. • Siting and operation of drill rigs and equipment in vegetated areas.	of breeding, nesting, and foraging habitats.				• Targeted fauna surveys were conducted over 2000-hectare envelope to identify presence and distribution of threatened and priority fauna and habitat. • Creek habitats avoided. • Drill sites and access routes will be in areas of sparse vegetation where practicable. • Drill sites have been located on existing tracks where possible (approx. 30%). • No clearing of trees or grass trees (*Xanthorrhoea preissii*) is required, and vegetation disturbance will be limited to understorey vegetation. • A suitably qualified and experienced fauna specialist will check potential habitat logs within access routes and drill sites a maximum of seven days prior to mobilisation and establishment of the drill site using appropriate methods. • Habitat logs will only be moved during drill site set up upon confirmation from a suitably qualified and experienced fauna specialist there is no conservation significant fauna utilising it. • Potential Black Cockatoo nesting trees with hollows will be checked by a suitably qualified and experienced fauna specialist a maximum of seven days prior to establishment of a drill site using appropriate methods. In the event nesting black cockatoos are found, a 50m buffer will be established or timing of drilling adjusted to avoid direct disturbance.			

			Inherent Risk				Residual Risk		
Conservation Value	Activity	Risk and Potential Impact	L	C	Risk	Management Measures	L	C	Risk
						Substitute: • Track-mounted diamond drill rigs and support equipment will be used to limit footprint and negate need for mechanical clearing of access routes and drill sites. • Multiple holes drilled from single drill site, rather than grid configuration, to minimise footprint. Engineering controls: • Potential fauna habitat logs moved to the side of access routes and reinstated following drilling. • Drill rigs and support vehicles will be configured in tandem off existing access tracks to reduce disturbance footprint. • Access routes will be clearly marked, and movement of equipment and personnel restricted to designated areas. Administrative controls: • All personnel will be required to undertake an induction, which will include details on the importance of fauna protection. Rehabilitate: • Habitat logs will be reinstated following drilling. • Rehabilitation activities will be undertaken in accordance with tenement conditions and using the PoW Rehabilitation Report Checklist.			

			Inherent Risk				Residual Risk		
Conservation Value	Activity	Risk and Potential Impact	L	C	Risk	Management Measures	L	C	Risk
						• Submission of PoW Rehabilitation Completion Report to DMIRS.			
Fauna	• Drill rig and equipment movement on access routes as outlined in Figure 4. • Siting and operation of drill rigs and equipment in vegetated areas. • Movement of support vehicles and personnel.	Fauna mortality and injury from vehicle strike or entrapment in drill hole.	Possible	Insignificant	L	Avoid: • Drill sites have been located on existing tracks where possible (approx. 30%). • A suitably qualified and experienced fauna specialist will check access routes and drill sites for conservation significant fauna a maximum of seven days prior to a drill site being established using appropriate methods. • New drill sites off existing tracks will only be established during daylight hours. Engineering controls: • Access routes will be clearly pegged, and movement of equipment and personnel restricted to designated areas. • Exploration personnel to drive to conditions. • Movements restricted to low speeds. • Rough Terrain Vehicles (RTVs) will be used to transport personnel and equipment to off-track drill sites instead of light vehicles and number of movements per day will be limited. Administrative controls: • All personnel will be required to undertake an induction, which will include details on the importance of fauna protection.	Possible	Insignificant	L

			Inherent Risk				Residual Risk		
Conservation Value	Activity	Risk and Potential Impact	L	C	Risk	Management Measures	L	C	Risk
						Rehabilitate: • Drill holes will be plugged ~400mm below surface and backfilled in accordance with the PoW Rehabilitation Report Checklist to prevent fauna entrapment.			
Fauna	• Drill rig and equipment movement on access routes as outlined in Figure 4. • Siting and operation of drill rigs and equipment in vegetated areas. • Movement of support vehicles and personnel.	Mortality of invertebrate due to impact to habitat (such as a destruction of a burrow).	Possible	Insignificant	L	Avoid: • Drill sites have been located on existing tracks where possible (approx. 30%). • A suitably qualified and experienced fauna specialist will check access routes and drill sites for trapdoor spider burrows a maximum of seven days prior to establishment of a drill site using appropriate methods. Any recorded burrows of conservation significant trapdoor spiders will be avoided as far as practicable and recorded and reported to DBCA. Administrative controls: • All personnel will be required to undertake an induction, which will include details on the importance of fauna protection.	Possible	Insignificant	L
Fauna	• Drill rig and equipment movement on access routes as outlined in Figure 4. • Siting and operation of drill rigs and equipment in vegetated areas. • Movement of support vehicles and personnel.	Short-term disturbance/ displacement of species from noise, light and vibration.	Possible	Insignificant	L	Avoid: • Creek habitats avoided. • Black cockatoo surveys have been conducted in the vicinity of drill sites and access routes to identify nesting trees. • Potential Black Cockatoo nesting trees with hollows will be checked by a suitably qualified and experienced fauna specialist a maximum of seven days prior to establishment of a drill site using appropriate methods. In the event	Possible	Insignificant	L

			Inherent Risk				Residual Risk		
Conservation Value	Activity	Risk and Potential Impact	L	C	Risk	Management Measures	L	C	Risk
						nesting black cockatoos are found a 50m buffer will be established or timing of drilling adjusted to avoid direct disturbance. • New drill sites off existing tracks will only be established during daylight hours. Substitution: • Use of track mounted diamond drill rigs which generate low levels of noise, vibration, and dust rather than conventional RC drill rigs. Engineering: • Use directional lighting to reduce light spill whilst maintaining a safe working environment. Administrative controls: • All personnel will be required to undertake an induction, which will include details on the importance of reducing noise and light spill to minimise indirect impacts on fauna. • Light checks will be undertaken each night to ensure any light spill is minimised.			
Fauna	• Waste management.	Waste management and scavenging.	Possible	Insignificant	L	Substitute: • All personnel will be accommodated outside of the State Forest at existing camps. Engineering controls: • All waste including rubbish, survey tape, wooden pegs, spare parts etc. will be removed from site and appropriately disposed of.	Possible	Insignificant	L

			Inherent Risk				Residual Risk		
Conservation Value	Activity	Risk and Potential Impact	L	C	Risk	Management Measures	L	C	Risk
Fauna	• Drill rig and equipment movement on access routes as outlined in Figure 4. • Siting and operation of drill rigs and equipment in vegetated areas. • Hydrocarbon refuelling. • Movement of support vehicles and personnel.	Ignition of fire and loss of significant areas of habitat and/or fauna mortality.	Unlikely	Moderate	M	Avoid: • No open fires will be permitted. • All personnel accommodated at existing camps outside of the Julimar State Forest. • Bulk fuel supplies will be stored offsite and not within State Forest boundaries. Engineering control: • A fire suppression system is present on the drill rig. • All support vehicles, light vehicles, RTVs will be equipped with fire extinguishers. • Drill rigs and support vehicles use diesel rather than petrol reducing risk of fire Administrative control: • Daily checks on weather conditions and fire bans. • Exploration personnel will be trained in the use of fire extinguishers and fire prevention measures. • All exploration activities will be conducted in accordance with the Chalice Bushfire Response Plan.	Rare	Moderate	L
Research and scientific study	• Drill rig and equipment movement on access routes as outlined in Figure 4. • Siting and operation of drill rigs and equipment in vegetated areas.	Interference of baiting/trapping/monitoring/translocation programs that compromise third party environmental programs.	Unlikely	Moderate	M	Avoid: • Drill targets will be designed to avoid DBCA long-term fauna trapping and camera trapping monitoring sites. Administrative controls:	Rare	Minor	L

			Inherent Risk				Residual Risk		
Conservation Value	Activity	Risk and Potential Impact	L	C	Risk	Management Measures	L	C	Risk
	• Movement of support vehicles and personnel.					• Exploration personnel will be provided with information about these sites and the importance of avoidance as part of the induction. • 'Notification of Commencement' to DBCA			
Cultural heritage	• Drill rig and equipment movement on access routes as outlined in Figure 4. • Siting and operation of drill rigs and equipment in vegetated areas. • Movement of support vehicles and personnel.	Disturbance causing impacts to Aboriginal heritage sites and/or values.	Possible	Moderate	M	Avoid: • Cultural heritage surveys will be undertaken with Traditional Owners in accordance with the Heritage Management Agreements. • Adopting a Site Avoidance Model consistent with paragraph 2.28 of the Aboriginal Heritage Due Diligence Guidelines (DHLP, 2013). • No exploration activities will be undertaken in, near or within the buffer zone of a heritage site. • Use of existing access tracks where possible (approx. 30%). • Crossing of Julimar Brook to be avoided except at existing crossing points. All access route and drill sites are located outside of Julimar Brook registered site. Administrative controls: • Heritage sites will be clearly demarcated on maps to prevent inadvertent access or disturbance. • If a suspected heritage site is discovered during exploration activities, operations within the vicinity of the site will cease immediately and GM – Development will be notified of the discovery.	Rare	Moderate	L

			Inherent Risk				Residual Risk		
Conservation Value	Activity	Risk and Potential Impact	L	C	Risk	Management Measures	L	C	Risk
						• Noongar Standard Heritage Agreement requirements will be adhered to. • Exploration personnel training and induction.			
Recreation	• Siting and operation of drill rig and equipment on or near existing access tracks. • Movement of support vehicles and personnel.	Public interaction with track mounted drill rig, equipment or support vehicles and personnel. Reduced/disrupted used of the forest by the public such as 4WD activities, hikers/campers, wildflower enthusiasts.	Possible	Moderate	M	Administrative controls: • Appropriate signage erected on relevant access tracks for public awareness. • Notification to and consultation with relevant recreation user groups. • Driving to conditions. • Public Access and Traffic management Plan.	Unlikely	Minor	L

7. Roles and Responsibilities

Chalice will ensure adequate resourcing to effectively implement the controls outlined in this CMP throughout the proposed drilling program. Specific roles and responsibilities are defined below.

7.1 GM Environment and Community

- Coordinate preparation and finalisation of the CMP, in consultation with relevant government agencies, and ensure adequate systems and procedures are in place to facilitate compliance with CMP requirements through the exploration program.
- Manage all pre-construction environmental surveys and post-implementation monitoring.
- Coordinate engagement with key stakeholders including relevant recreational user groups.
- Overall responsibility for ensuring that all supervisory and management personnel are aware of, and understand, their responsibilities under this CMP.
- Conduct visits and inspections to ensure all work complies with commitments and management measures outlined in this CMP.
- Provide advice and assistance to exploration employees and contractors to ensure compliance with this CMP.
- Oversee the implementation of any corrective and remedial actions arising from audits and incident investigations.

7.2 GM Development

- Chalice's GM Development has overall responsibility for ensuring that all environmental activities undertaken for the Julimar Exploration Project are consistent with this CMP
- Ensure measures contained in this CMP and associated documents are implemented throughout the drilling program.
- Coordinate all exploration activities and operations, ensuring applicable policies, procedures, legislative requirements and management plans are complied with.
- Ensure employees are provided with the training and awareness required to fulfil their obligations under this CMP (e.g. inductions, noticeboards, bulletins, procedure reviews, toolbox meetings, greencard training).
- Provide advice and assistance to exploration employees to ensure compliance with this CMP.
- Undertake incident cause analysis method investigations where required.
- Manage the implementation of corrective and remedial actions arising from audits and incident investigations.

7.3 Exploration Project Geologist

- Ensure measures contained in this CMP are implemented and maintained on site.
- Ensure the Environmental Checklist (Appendix 8) is completed for each planned exploration activity allowed by the CMP prior to commencement.

- Ensure all vehicles and equipment are washed down and free of weed and soil materials prior to entering and exiting Julimar State Forest.
- Reporting incidents and any audit outcomes to the GM Development.
- Conduct task specific inductions with relevant personnel.

7.4 All Employees and Contractors

- Understand the employee responsibilities as defined by this CMP.
- Follow correct exploration drilling and vehicle movement procedures.
- Dispose of all waste material appropriately as outlined in this CMP.
- Keep to existing tracks and demarcated access routes at all times.
- Aid in implementing and maintaining impact minimisation programs when requested by the Project Geologist.
- Report incidents and any non-compliance with this CMP to the Project Geologist.

8. Inductions and Training

The GM Development will be responsible for ensuring that all personnel complete an exploration and environmental induction and are appropriately trained (greencard, spills, fire), and familiar with environmental procedures.

All site personnel will undergo a comprehensive environmental induction that will cover all the components of the onsite environmental management program with specific procedures to follow for matters such as Dieback clean-down points, exclusion zones, flora and fauna management, heritage management and interactions with the public.

Chalice will ensure that exploration personnel are aware of their responsibilities in relation to this CMP. Regular training and awareness programs will be implemented to ensure training is maintained and kept current with the requirements of this CMP.

9. Reporting and Communications

9.1 Internal Communication

To ensure a strategic approach to activities within the Forest, Chalice will undertake a daily pre-start meeting to:

- Assess weather conditions and any potential fire bans.
- Assess the occurrence of any public events held within Julimar State Forest boundaries.
- Ensure field personnel are aware of planned access and activities.
- Discuss any matter of issue or incident.

9.2 External Communication

Prior to the commencement of works with Julimar State Forest, Chalice will notify stakeholders of exploration activities through:

- Chalice Community Newsletter.
- Direct communications with key stakeholders (phone, email, letters).
- Updates on the Chalice company website.

The Exploration Project Geologist will ensure compliance with the following notification conditions as stipulated by DBCA:

- Notification to the Swan Regional Manager at the time when the CMP is approved for the proposed exploration works to be conducted on land within Julimar State Forest.
- At least five working days prior to accessing Julimar State Forest, provision of an itinerary and program of the locations of operations on E70/5119 to the DBCA Swan Regional Manager.
- Informing the DBCA Swan Regional Manager of any changes to the itinerary at least five days in advance (where possible).

9.3 Internal Reporting

9.3.1 Incidents

All exploration staff and contractors are responsible for ensuring that environmental incidents and community complaints are reported to the Project Geologist immediately. The Project Geologist will ensure that appropriate response actions are undertaken and will seek further environmental advice on the best course of action as need be.

The Project Geologist is responsible for ensuring that an Incident Report Form (Appendix 10) is filled in and supplied to the General Manager Development and General Manager Environment and Community for all environmental incidents. Environmental incidents will be investigated to determine their cause and measures will be put in place to prevent or minimise the reoccurrence of such an incident.

9.3.2 Fauna Sightings

All exploration staff and contractors will record fauna sightings (such as mammals, snakes and large lizards) in the onsite fauna sighting logbook. Information such as date, location, time of day, type and description of animal, photographs (if possible) and any other details will be recorded.

9.4 External Reporting

9.4.1 General

The GM Development will ensure compliance with the following reporting conditions as stipulated by DBCA:

« The tenement holder submitting to the Executive Director, Resource and Environmental Compliance, DMIRS and Swan Regional Manager, DBCA annually within a month of the anniversary of grant (of this CMP) in each year, a brief report outlining the operations and rehabilitation undertaken in the previous 12 months and proposed operations, environmental management plans and rehabilitation programs planned for the next 12 months. The report must include maps showing location of all disturbance and rehabilitation activities which occurred during the reporting period.

Notifications and annual updates and general reporting will be forwarded to the Regional Manager and the DBCA Environmental Management Branch, Principal Environmental Officer. Details of key contacts are shown in Table 13.

Table 13: Key Contact Details

Role	Contact Details
Chalice Mining Limited	
Corporate Office	08 9322 3960
DBCA	
Swan Regional Manager	swanregion@dbca.wa.gov.au
Perth Hills District Manager	shawn.debono@dbca.wa.gov.au
District Natural Conservation Program Coordinator	robert.huston@dbca.wa.gov.au
Principal Environmental Officer	embadmin@dbca.wa.gov.au
Perth Hills District Duty Officer (fire)	perthhills_ddo_dl@dbca.wa.gov.au ph 9290 6100
Native fauna injury/mortality	fauna@dbca.wa.gov.au
Death of quenda, chuditch, possum or woylie	Karen Jackson – 0477 701 157
Bushfire Emergency	000

9.4.2 Incident Reporting

In the event of an emergency (such as a bushfire), the Project Geologist or delegate will call 000 immediately and comply with any requirements from emergency services.

The following incidents will be reported to DBCA;

- Any public complaint received by Chalice related to Chalice's activities;
- Any uncontrolled release of hazardous materials (such as a hydrocarbon spill) regardless of size;
- Injury or mortality of any native fauna; and
- Clearing of any threatened flora species.

All incidents will be reported to DBCA within seven days of the incident being identified except for fauna injury or death which will be reported within 48 hours.

Any fauna injury or death will be reported using the fauna report form. Any deceased quenda, chuditch possum or woylie will also be reported (using the contact details in Table 13) to provide the opportunity for the animal to be checked to confirm if it was microchipped as part of the ongoing fauna monitoring program.

9.4.3 Fauna Sightings

All fauna sightings in the logbook will be collated and supplied to DBCA via the Fauna Report Form monthly.

9.4.4 Reporting to DMIRS

As required by PoW approval, Chalice will submit a PoW Rehabilitation Report within six months of drilling completion unless otherwise authorised in writing by DMIRS. An extension of time to complete rehabilitation will be requested if an area if required to remain open for future drilling and access.

10. References

Biologic 2021. Julimar Exploration Project - Reconnaissance and Targeted Flora Survey. Report prepared for Chalice Gold Mines Limited.

Biologic 2021a. Hartog and Baudin targets – Chalice Julimar Project - Targeted Flora Survey Report prepared for Chalice Gold Mines Limited.

Bryant, G. 2019. *Quenda - Our Ecosystem Engineers Nature Conservation Information Sheet.* Report prepared for Nature Conservation Margaret River Region.

Bureau of Meteorology (BoM). 2020. http://www.bom.gov.au/climate/averages/tables/cw_009053.shtml Accessed June 2020

Camino Salvado. 2014. The Camino Salvado. A Pilgrimage from Subiaco to New Norcia. Available at http://pilgrimtrail.com.au/the_trail/. Accessed June 2020.

Chalice Gold Mines Limited. 2020. Julimar Exploration Program Dieback Management Plan. June 2020

Churchward, H.M., and McArthur, W.M. 1980, Landforms and Soils of the Darling system, Western Australia. In:
Department of Conservation and Environment, Atlas of Natural Resources - Darling System, Western Australia – Explanatory Memoir, 1980, Department of Conservation and Environment, Perth, WA.

Conservation and Parks Commission of Western Australia. 2013. *Forest Management Plan 2014-2023.* Perth: DPaW.

Department of Biodiversity, Conservation and Attractions. 2017a. *Fauna profiles - Chuditch Dasyurus geoffroii.* Available at http://www.dbca.wa.gov.au/. Accessed March 2021.

Department of Biodiversity, Conservation and Attractions. 2017b. *Managing the threats*. Available at https://www.dbca.wa.gov.au/parks-and-wildlife-service. Accessed June 2020.

Department of Biodiversity, Conservation and Attractions. 2017c. *Fauna Notes - Living with Quenda.* Available at https://www.dbca.wa.gov.au/parks-and-wildlife-service. Accessed March 2021.

Department of Biodiversity, Conservation and Attractions. 2018. *Quenda.*
Available at https://www.dbca.wa.gov.au/parks-and-wildlife-service. Accessed March 2021

Department of Biodiversity, Conservation and Attractions. 2019. *Fire Management Strategy.* Perth: DBCA.

Department of Defence. 2017. *Bindoon Training Area, Western Australia*. Commonwealth of Australia.

Department of Environment and Conservation. 2012. Chuditch (*Dasyurus geoffroii*) Recovery Plan. Perth: DEC.

Department of Planning, Lands and Heritage. 2013. Aboriginal Due Diligence Guidelines. Perth: DPLH.

DSEWPAC 2012. Referral Guidelines for Three Threatened Black-Cockatoo Species

Environmental Protection Authority 2016a. Environmental Factor Guideline: Flora and Vegetation.

Environmental Protection Authority 2016b. Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment.

Environmental Protection Authority 2018. Statement of Environmental Principles, Factors and Objectives.

Environmental Protection Authority 2020. Technical Guidance – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment

Glevan Consulting 2020. *Phytophthora Dieback Occurrence Assessment for Julimar Exploration Project*. Report prepared for Chalice Gold Mines Limited.

Mattiske Consulting Pty Ltd (Mattiske). 2019. *Assessment of Potential Flora, Vegetation and Fauna Values - Julimar Project, Bindoon, WA*. Report prepared for Chalice Gold Mines Limited.

Project Dieback 2014, Dieback Public Map. Available from: http://www.dieback.net.au/about/dieback-map.html, Accessed May 2019.

Western Wildlife 2021. Julimar Nickel-Copper PGE Project. Basic Vertebrate Fauna Survey, Targeted Chuditch Survey and Cockatoo Habitat Survey. Report prepared for Chalice Gold Mines Limited.

Western Wildlife 2021. Julimar Nickel-Copper PGE Project. Hartog and Baudin Targeted Cockatoo Habitat Tree Survey (Western Wildlife, 2021a). Report prepared for Chalice Gold Mines Limited.

Appendices

Appendix 1 Dieback Management Plan

Chalice Mining Limited

Chalice Mining Limited

Hartog-Baudin Low-Impact Exploration Program

Dieback Management Plan - Julimar State Forest Areas

November 2021

Version: Final | Submission Date: 12/11/2021 | Manager: Soolim Carney

Level 2, 1292 Hay Street
West Perth, Western Australia
GPO Box 2890, Perth WA 6001

T: +61 8 9322 3960
F: +61 8 9322 5800

info@chalicemining.com
www.chalicemining.com

@chalicemining
chalice-mining

CONTENTS

1. DEFINITION OF TERMS 4

2. SCOPE AND OBJECTIVE 5

3. LEGISLATION 6

4. PHYTOPHTHORA DIEBACK 7

5. PROPOSED EXPLORATION ACTIVITIES 9

5.1 Vegetation Disturbance 9

5.2 Diamond Drilling 14

5.3 Support Activities 16

5.4 Program Schedule 16

5.5 Public Access and Security 17

6. PROJECT DIEBACK STATUS 18

6.1 Farmland 23

6.2 Julimar State Forest 23

7. RISK ASSESSMENT 25

8. DIEBACK MANAGEMENT PRINCIPLES AND STRATEGIES 29

8.1 Entry, Exit and Movement Within Julimar State Forest 30

8.2 General Management Measures 33

8.3 Clean Down Procedure 33

8.4 Training 35

8.5 Monitoring and Reporting 35

9. COMMUNICATION 35

10. ACCOUNTABILITY 36

TABLES

Table 1: Definition of Terms 4

Table 2: Relevant Legislation 6

Table 3: Soil Sampling Results 19

Table 4: Dieback Risk Assessment in Uninfested Area in Wet Soil Conditions 25

Table 5: Dieback Risk Assessment for Drilling in the Uninterpretable Area (only in dry and moist soil conditions) 26

Table 6: Dieback Management Strategies (DWG 2021) 29

Table 7: Julimar State Forest Dieback Management Measures 30

Table 8: Communications Program 36

Table 9: Roles and Responsibilities 36

FIGURES

Figure 1: Dieback in south-west of Western Australia 7
Figure 2: Examples of Dieback Free and Dieback Infested Vegetation 8
Figure 3: Hartog and Baudin Proposed Drill Program 11
Figure 4: Proposed Drill Site and Access Route Layout 12
Figure 5: Julimar Survey Status 20
Figure 6: Project Dieback Status and Sample Locations – Northern Section 21
Figure 7: Project Dieback Status and Sample Locations – Southern Section 22
Figure 8: Dieback Status and Clean Down Locations 32
Figure 9: Chalice Washdown Bay 34

APPENDICIES

Appendix 1 Phytophthora Dieback occurrence assessment (Glevan 2021) 40
Appendix 2 Phytophthora Dieback Risk Assessment and Management Plan Form 41

1. Definition of Terms

Table 1: Definition of Terms

Term	Definition
Chalice	Chalice Mining Limited and/or subsidiary entities.
CMP	Conservation Management Plan
CoE	Clean on Entry is the requirement and practice of ensuring a carrier is clean before passing the designated point.
DBCA	Department of Biodiversity Conservation and Attractions
Dieback Vulnerable Zone	The area of the south-west of Western Australia where dieback occurs when Phytophthora is present. The zone includes all areas of the south-west land division, west and south of the 400mm rainfall isohyet.
DMIRS	Department of Mines, Industry Regulation and Safety
DMP	Dieback Management Plan
Dry Soil Conditions	Soil conditions where dust forms when exposed soil is disturbed.
Infested Area	A dieback occurrence category for an area that an Interpreter has determined is infested with *Phytophthora cinnamomi* through a systematic assessment.
Moist Soil Conditions	Soil conditions where soil is damp but does not stick to carriers.
Pathogen	Any disease-producing agent, especially a virus, bacterium, or other microorganism.
Phytophthora Dieback (dieback)	The common name for the disease in native ecosystems caused by plant pathogens from the water mould genus Phytophthora.
PoW	Programme of Works
Precautionary Principle	Proactive hygiene practices that are implemented to manage dieback risk when dieback status of an area is uncertain.
Uninfested Area	An area that an Interpreter has determined to be free of plant disease symptoms that indicate the presence of *Phytophthora cinnamomi.*
Uninterpretable Area	Uninterpretable is collective name for the following dieback occurrence categories: Permanently uninterpretable; Temporarily uninterpretable; Not Yet Resolved; Excluded. In all cases the dieback status is unknown because there are insufficient signs and symptoms of disease to enable an Interpreter to determine if the area is uninfested or infested.
Unknown Area	The disease status of a site where the disease status is not known because either: i) there is no dieback occurrence information, or ii) the site has been assessed as uninterpretable by an Interpreter.
Wet Soil Conditions	Soil conditions where soil and moisture combine so that soil sticks to tyres, equipment and/or footwear.

2. SCOPE and OBJECTIVE

This Dieback Management Plan (DMP) applies to exploration activities undertaken in the Julimar State Forest within tenement E70/5119 in relation to the Hartog-Baudin low-impact exploration drilling program. The proposed exploration drill program will be undertaken in accordance with the Conservation Management Plan (CMP) Hartog and Baudin Low Impact Exploration Drilling Program – Julimar State Forest (Chalice 2021).

The dieback management strategies outlined within this DMP apply to all workers on Chalice controlled work sites within the State Forest.

The objectives of this DMP are to:

- Minimise the potential introduction and/or spread of dieback because of exploration activities.
- Prescribe the management actions to avoid, mitigate and manage the potential introduction or spread of Dieback due to exploration activities within Julimar State Forest.

This DMP has been developed in accordance with the Phytophthora *Dieback Management Manual* (DBCA 2020) and *Management of Dieback Disease in Mineral Exploration* (DMP 2006) and outlines the dieback management actions for Chalice's proposed Hartog-Baudin low-impact exploration drilling program.

3. LEGISLATION

Applicable legislation shall be followed for all activities and forms the minimum standard for all procedures. This includes the Acts and Regulations described in Table 2.

Table 2: Relevant Legislation

Jurisdiction	Legislation	Year
Australia	*Environment Protection and Biodiversity Conservation Act*	1999
Western Australia	*Agriculture and Related Resources Protection (European House Borer) Regulations*	2006
	Agriculture and Related Resources Protection (Spraying Restrictions) Regulations	1979
	Agriculture and Related Resources Protection Regulations	2011
	Environmental Protection Act	1986
	Environmental Protection Regulations	1987
	Biodiversity Conservation Act	2016
	Biosecurity and Agricultural Management Act	2007
	Conservation and Land Management Act	1984
	Mining Act	1978
	Mining Regulations	1981

4. PHYTOPHTHORA DIEBACK

4.1 Background

The 'dieback vulnerable zone' is a geographic region in Western Australia (WA), where conditions enable dieback to occur and persist (DBCA 2020). This zone includes all areas of the south-west land division, west and south of the 400mm rainfall isohyet (DBCA 2020). Planned disturbance activities on lands managed by the DBCA within the 'dieback vulnerable zone' which have a moderate to high risk of introducing or spreading the disease require development and implementation of a DMP.

Dieback is a water mould that produces an infection and can cause a decline in vegetation health. The water mould lives in susceptible plant tissue and soil, and migrates and reproduces in warm, moist conditions. Infected roots cannot provide the water and nutrients needed to maintain life, and the plants die from dehydration. As well as infecting native plants and causing damage to forests, it also results in removal of habitats for small mammals. Significant parts of the southwestern portion of Western Australia are Dieback infested (Figure 1). Dieback is also known to occur in other Australian states and territories. The Dieback plant pathogen is one of the world's most invasive species and is present in over 70 countries around the world.

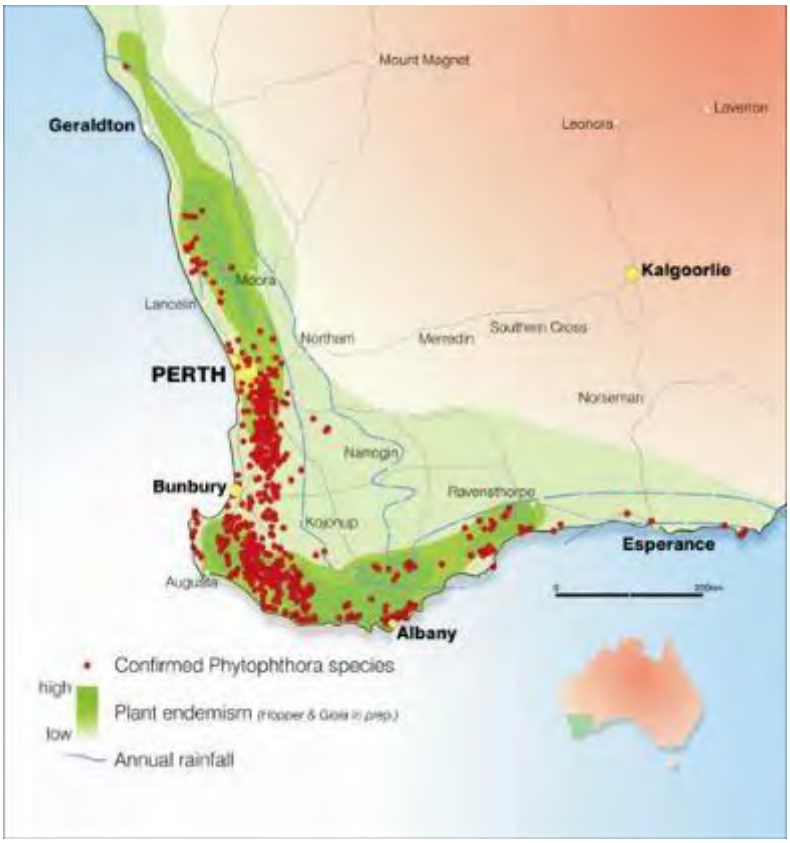


Figure 1: Dieback in south-west of Western Australia

The Dieback water mould spreads naturally both by moving within open water, and through the movement of water within soils. People spread the disease primarily by the transport of infected soil and roots; the most likely movers of soil and root material are machinery and vehicles. It is therefore important to:

- Prevent soil and root material from being picked up.
- If picked up, remove soil and root material immediately.
- Not spread soil and root material from site to site.

Early symptoms of infection include wilting, yellowing and retention of dried foliage and darkening of root colour (Figure 2). Infection often leads to death of the plant, especially in dry summer conditions when plants may be water stressed.

In some cases, specific Dieback regulations and management plans may already exist for certain areas or may need to be generated for planned exploration work. Such plans, and associated permits and authorisations, may be part of existing tenure conditions, subsequent conditions imposed by various government authorities or other agencies, and/or part of general good environmental practice.

Figure 2: Examples of Dieback Free and Dieback Infested Vegetation

5. PROPOSED EXPLORATION ACTIVITIES

The proposed exploration activities across the Hartog and Baudin targets include:

- Vegetation disturbance to access 47 off-track drill sites (~ 70% of all drill sites with a maximum 4.4 ha disturbance footprint).
- Diamond drilling using small track-mounted drill rigs with closed-loop drilling fluid systems.
- Support activities including water supply, drill rig refuelling and maintenance.
- Demobilisation and rehabilitation.

This drilling program achieves the aim of initial testing of geology for mineralisation, whilst also minimising disturbance to vegetation.

5.1 Vegetation Disturbance

No mechanised vegetation clearing involving scraping or blading is proposed under this CMP. Clearing is defined under Section 51A of the *Environmental Protection Act 1986* as:

a. the killing or destruction of; or
b. the removal of; or
c. the severing or ringbarking of trunks or stems of; or
d. the doing of any other substantial damage to,

some or all of the native vegetation in an area, and includes the draining or flooding of land, the burning of vegetation, the grazing of stock, or any other act or activity, that causes -

e. the killing or destruction of; or
f. the severing of trunks or stems of; or
g. any other substantial damage to,

some or all of the native vegetation in an area.

To minimise impacts to vegetation, small track mounted drill rigs with closed-loop drilling fluid systems will be used, negating the need to construct cleared drill pads, sumps, and access tracks. Drill rigs and drill rig support vehicles will utilise existing tracks and/or firebreaks where possible. Additionally, drill rigs and drill rig support vehicles will be configured in tandem to further reduce the overall footprint associated with set up and operation of drilling activities (Figure 4).

The use of small track-mounted drill rigs and drill rig support vehicles rather than conventional larger wheeled rigs and vehicles minimizes impact on vegetation, allowing root stock and soil profile (including seed bank) to remain intact, and vegetation to recover once the drill rig and support vehicles have passed over the area. A comparison of disturbance resulting from this approach to drilling is shown in Plate 1 and Plate 2.

Vegetation disturbance by the proposed exploration activities within Julimar State Forest is restricted to minor branch pruning and rolling over vegetation. Drill rig support vehicles with waste containment

tanks, and a similar footprint to the drill rigs, will be track mounted. It is anticipated that total vegetation disturbance resulting from the works proposed will be 4.4 hectares or less.

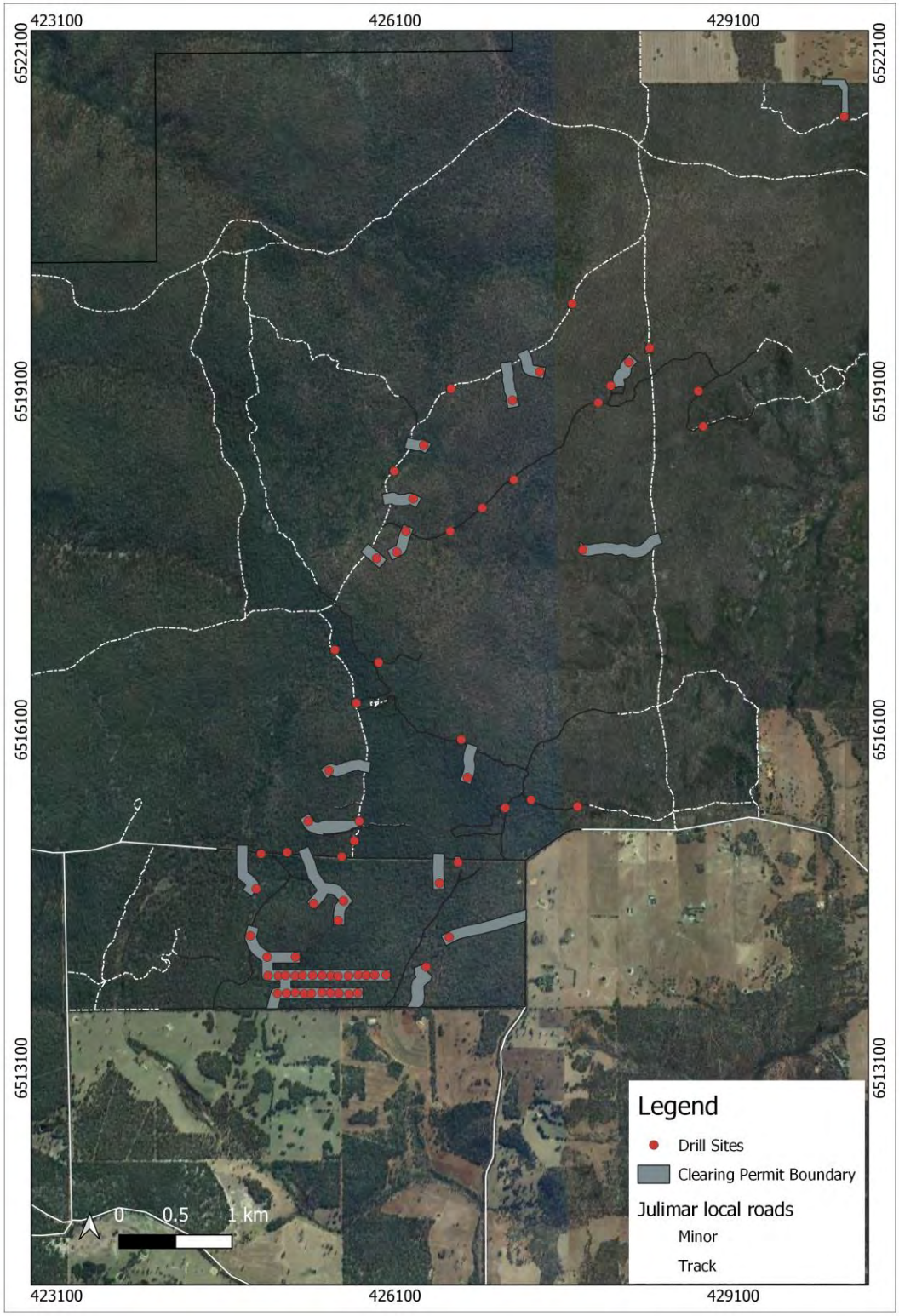


Figure 3: Hartog and Baudin Proposed Drill Program

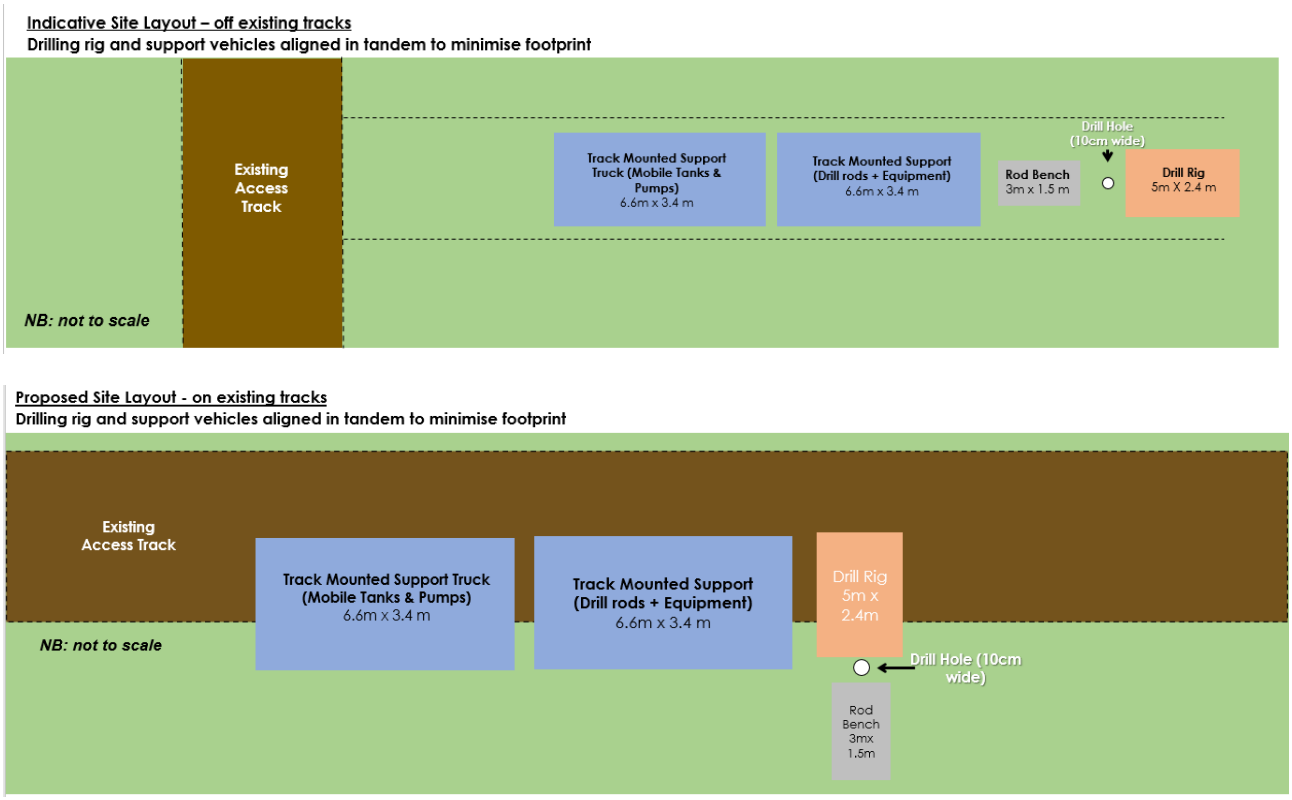


Figure 4: Proposed Drill Site and Access Route Layout

Plate 1: Drill site pre-drilling (drilling on private farmland May 2021)

Plate 2: Drill site post drilling (drilling on private farmland May 2021)

Where possible, drill sites have been located on existing tracks or in clearings. Any disturbed vegetation (i.e. impacted by drill rig and support vehicle access or minor branch clearing) will remain in the forest and be utilised in subsequent rehabilitation activities, in accordance with the relevant PoW and associated rehabilitation requirements.

5.2 Diamond Drilling

Diamond core drilling using small track mounted drill rigs and support vehicles will be the only drilling method employed. An example of the type of drill rig planned to be used is shown in Plate 3.

Support vehicles (Plate 4) and solids units (Plate 5) will be required to follow the drill rig and are also track mounted. The support trailer will house equipment such as rods, casings, core trays, extracted samples and hand tools and has similar dimensions to the drill rigs (i.e., 6m long by 3m wide). Drilling waste will be managed through a closed loop solids removal system and portable tanks. Portable tanks will be inspected regularly to prevent overflow, and waste will be transported off site for disposal in sumps on Chalice's private property, which will be rehabilitated at the end of the program. Core samples will be placed in core trays at the drill site and transported for storage at the core shed at the Chalice exploration office on the farmlands on E70/5118 and E70/5119.

Diamond drilling requires water to be used in the drilling process. It is envisaged that tanks will be set up on existing tracks in locations central to a number of drill sites although alternative methods may be used if they result in less impact. Black poly pipe (as used for standard farming operations) will then be set up to transport the water from the tanks to the individual drill sites. Because the pipe is light weight it can be moved by hand. The pipe will run next to or near the drill access routes when possible. Water will be sourced from ex-pastoral bores on surrounding Chalice owned private property where groundwater is greater than 15 metres below ground level and trucked to the tanks (using existing access tracks). All water sourced is fresh (less than 5,000 milligrams per litre (mg/L) Total Dissolved Solids (TDS)) as confirmed by water sampling results over the last 12-months (samples have been tested at a National Association of Testing Authorities (NATA) laboratory). There are no additives to the water being transferred in the black poly pipe.

Any general waste will be transported to the Chalice exploration office on the farmlands which is on E70/5118 and E70/5119. Waste will be disposed of in bins for collection by an appropriately licensed waste contractor for disposal off site.

Plate 3: Track Mounted Diamond Drill Rig

Plate 4: Track Mounted Support Trailer and Core Tray

Plate 5: Track Mounted Waste Unit

5.3 Support Activities

Light vehicles and trucks will provide tools and equipment required for water supply, fire suppression, drill rig refuelling and maintenance activities. These will always remain on existing tracks with only track mounted drill rigs, track mounted support vehicles and small rough-terrain vehicles (RTVs) used for transporting core and personnel to drill sites located on the access routes outlined in Figure 3.

Fuel will be transported to drill rigs via small fuel tanks (approx. 1000-2000 litres) on track mounted vehicles or RTVs. Drip trays and liners will be used during refuelling activities and spill kits will be available at all drill sites. Routine inspections on drill rigs will be undertaken to assess the integrity and monitor wear of any hoses, couplings, and fittings, to prevent accidental discharge of fuel.

5.4 Program Schedule

The proposed drilling under this CMP is a first pass assessment of the mineralisation potential of the area with a total of 71 drill sites identified. This is a maximum and it is possible that some sites may not be required if the results from neighbouring drill holes in an area indicate that mineralisation is unlikely to be present.

In many cases, it is likely that only one hole will be required to test a target. However, drill sites have been designed so that in the event mineralisation is identified, then multiple holes can be drilled from the same site to minimise the drilling footprint rather than drilling holes on a grid pattern. The actual number of holes drilled from a single site will be regulated by the POW approval process through DMIRS, with a maximum of 12 holes per drill site.

The timing of follow up drilling will vary from immediately on completion of the initial hole, if significant visual mineralisation is identified, to up to several months later depending on the timing of the receipt

of assay and geophysical results and prioritisation of targets. Regardless of the potential for follow up drilling, the access route and drill site will be rehabilitated once the drill rig leaves the drill site, even if it is likely that the rig will need to return at a later date.

Each hole is likely to take between three and ten days to complete depending on the depth of the hole, whether the rig is drilling on single or double shift and whether any difficult drilling conditions are encountered.

5.5 Public Access and Security

Many of the proposed drill sites are planned on existing public access tracks to minimise the impact on vegetation. This will necessarily have some impact on public access. A Public Access and Traffic Management Plan has been developed that outlines the controls and procedures necessary to safely manage public access on tracks during drilling.

It is proposed that drilling will occur on a 24-hour basis. This will minimise the length of the overall drilling program and will also ensure that equipment is always attended. No additional security measures will therefore be required.

6. PROJECT DIEBACK STATUS

The proposed Hartog-Baudin exploration drilling area, comprising all drill sites, access routes and existing tracks to be used, has been surveyed for dieback as outlined on Figure 5. The survey area shown in Figure 5 covers the entire area of operations associated with the proposed drilling program. Specific sampling locations within the survey area are shown in Figure 6 and Figure 7.

All dieback detection, diagnosis, mapping and testing was performed to standards and procedures defined in FEM047 Phytophthora Dieback Interpreter's Manual for lands managed by the Department (DPAW 2015). These procedures are guided by the presence of indicator species in the vegetation, and the observance of deaths in these plants (Glevan 2021). An indicator species is a plant species that is reliably susceptible to *Phytophthora cinnamomi*. Indicator Species Deaths (ISDs) alone do not necessarily indicate disease presence and it is necessary to consider all environmental and ecological factors that may be present (Glevan 2021). These other factors (as listed in FEM047) include:

- chronology of deaths;
- pattern of deaths;
- topographical position;
- vectoring – causal agencies, and
- biomass and biological diversity reduction.

Other causes of plant deaths need to be considered when determining the presence of Phytophthora Dieback, including (from FEM047):

- Armillaria Root Disease;
- various cankers;
- insects;
- drought, wind scorch and frost;
- salinity and waterlogging;
- fire and lightning;
- senescence and competition;
- physical damage, and
- herbicides and chemical spills.

For most of the assessment, the assessment type used was the comprehensive type (featuring transect lines) using standards defined by Chapter 8, FEM047. Prior to assessment, all information relevant to the project was assembled to assist the interpretation process (as defined in Chapter 7, FEM047). This information included previous assessments of the area, history of burning and possible other disturbances (Glevan 2021).

Soil and tissue samples taken during the assessment were to standards and prescriptions defined in Chapter 11 of FEM047. All samples were analysed in the Vegetation Health Services (DBCA) laboratory using best-practice techniques (Glevan 2021). Soil sample results are outlined in Table 3.

Table 3: Soil Sampling Results

Sample no	Plant Sampled	Easting	Northing	Result
01	*Banksia squarrosa*	425419	6517067	Negative
02	*Banksia grandis*	428238	6520451	Negative
03	*Banksia grandis*	428317	6520879	Negative
04	*Xanthorrhoea preissii*	428339	6521806	Negative
05	*Banksia grandis*	425126	6514712	Negative
06	*Banksia grandis*	426671	6514712	Negative
07	*Banksia grandis*	426823	6514273	Negative
08	*Banksia squarrosa*	427256	6513860	Negative
09	*Banksia squarrosa*	425187	6513701	Negative
10	*Xanthorrhoea preissii*	426500	6513631	Negative
11	*Xanthorrhoea preissii*	426277	6513732	Negative
12	*Xanthorrhoea preissii*	427272	6514502	Negative
13	*Xanthorrhoea preissii*	426143	6512855	Positive
14	*Eucalyptus marginata*	426961	6512776	Negative
15	*Adenanthos cygnorum*	426124	6512640	Positive
16	*Banksia squarrosa*	425948	6513255	Negative
17	*Xanthorrhoea preissii*	425891	6513250	Negative

All field work was led by a Registered Phytophthora Dieback Interpreter (Glevan 2021).

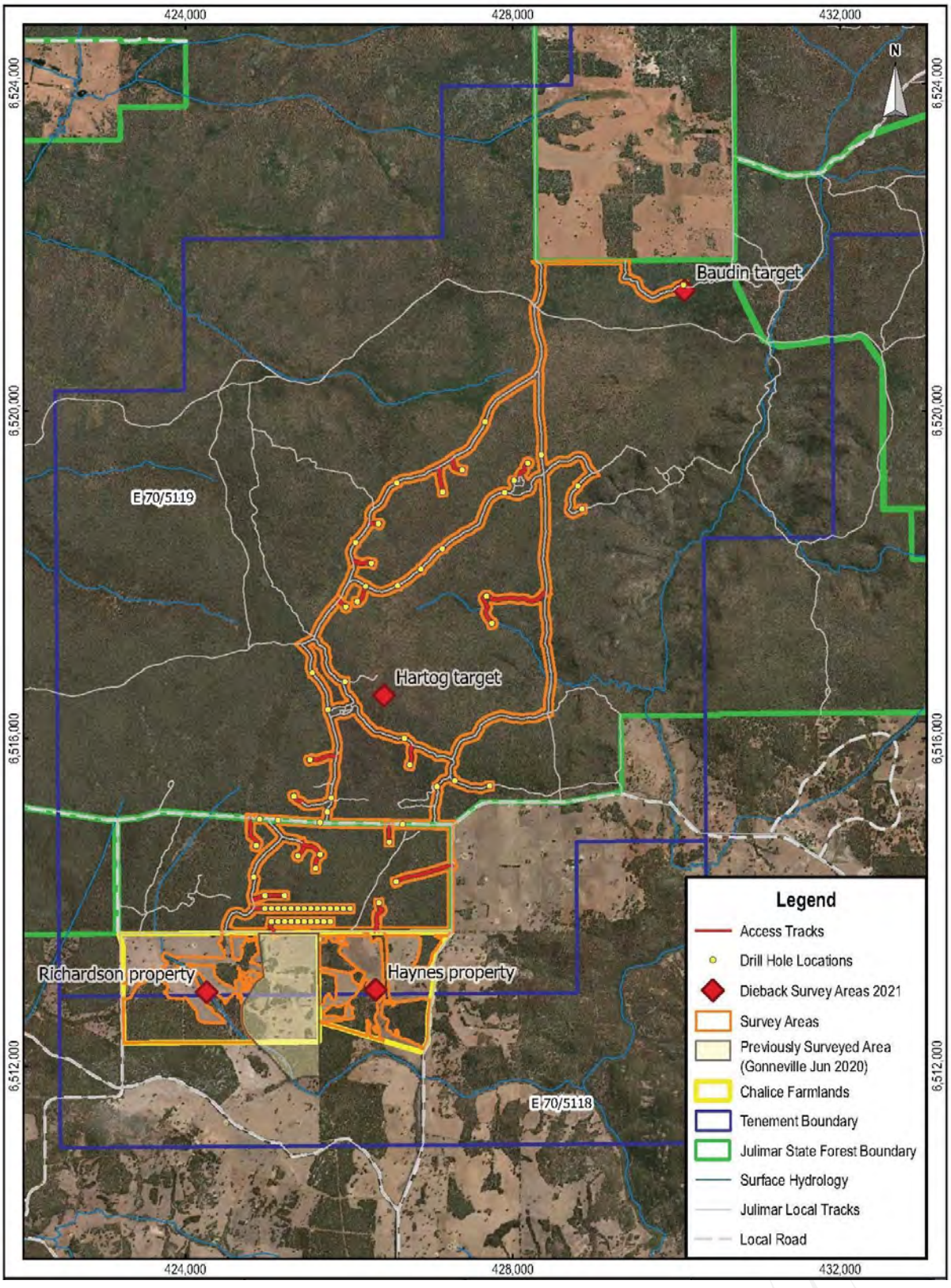


Figure 5: Julimar Survey Status

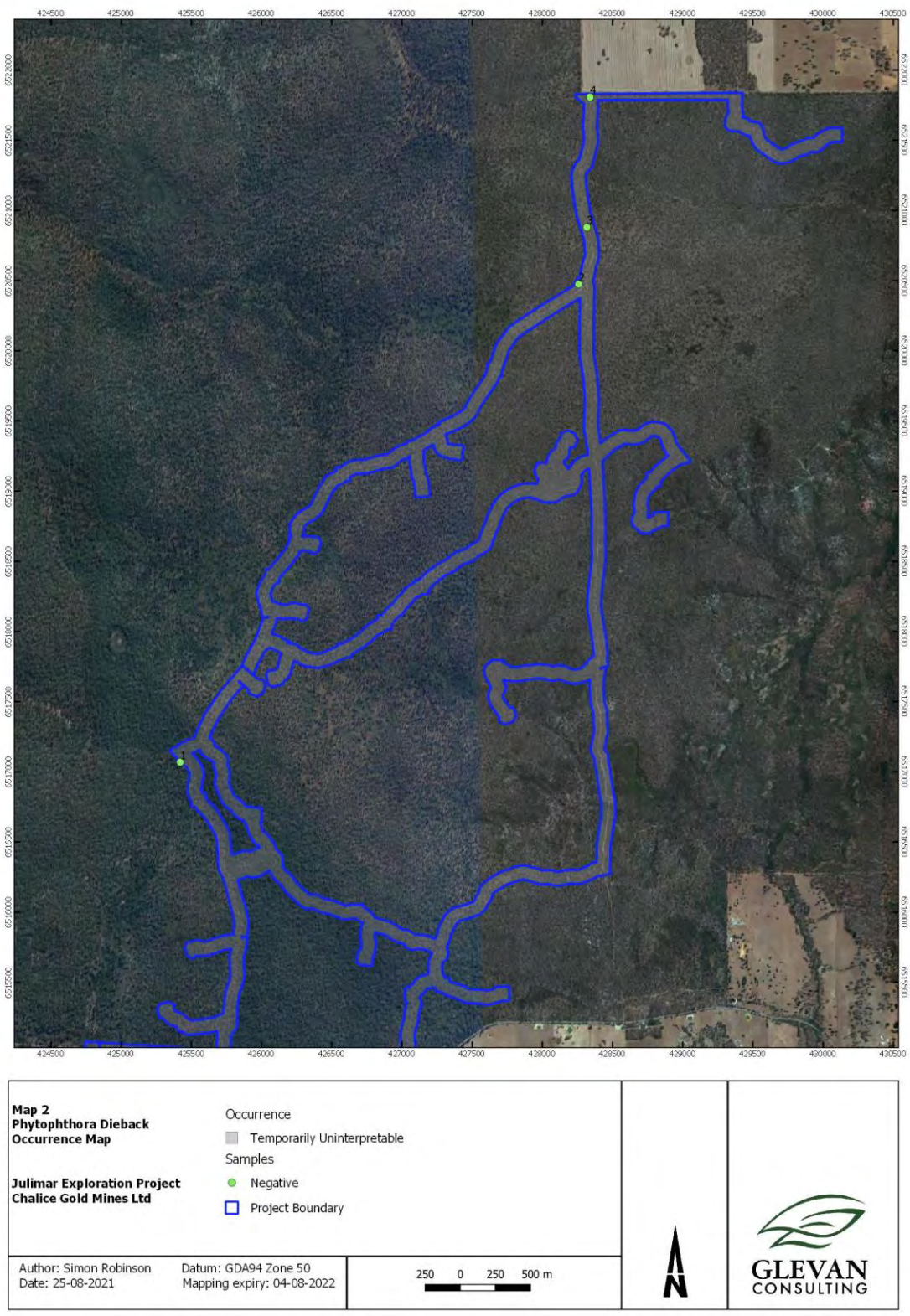


Figure 6: Project Dieback Status and Sample Locations – Northern Section

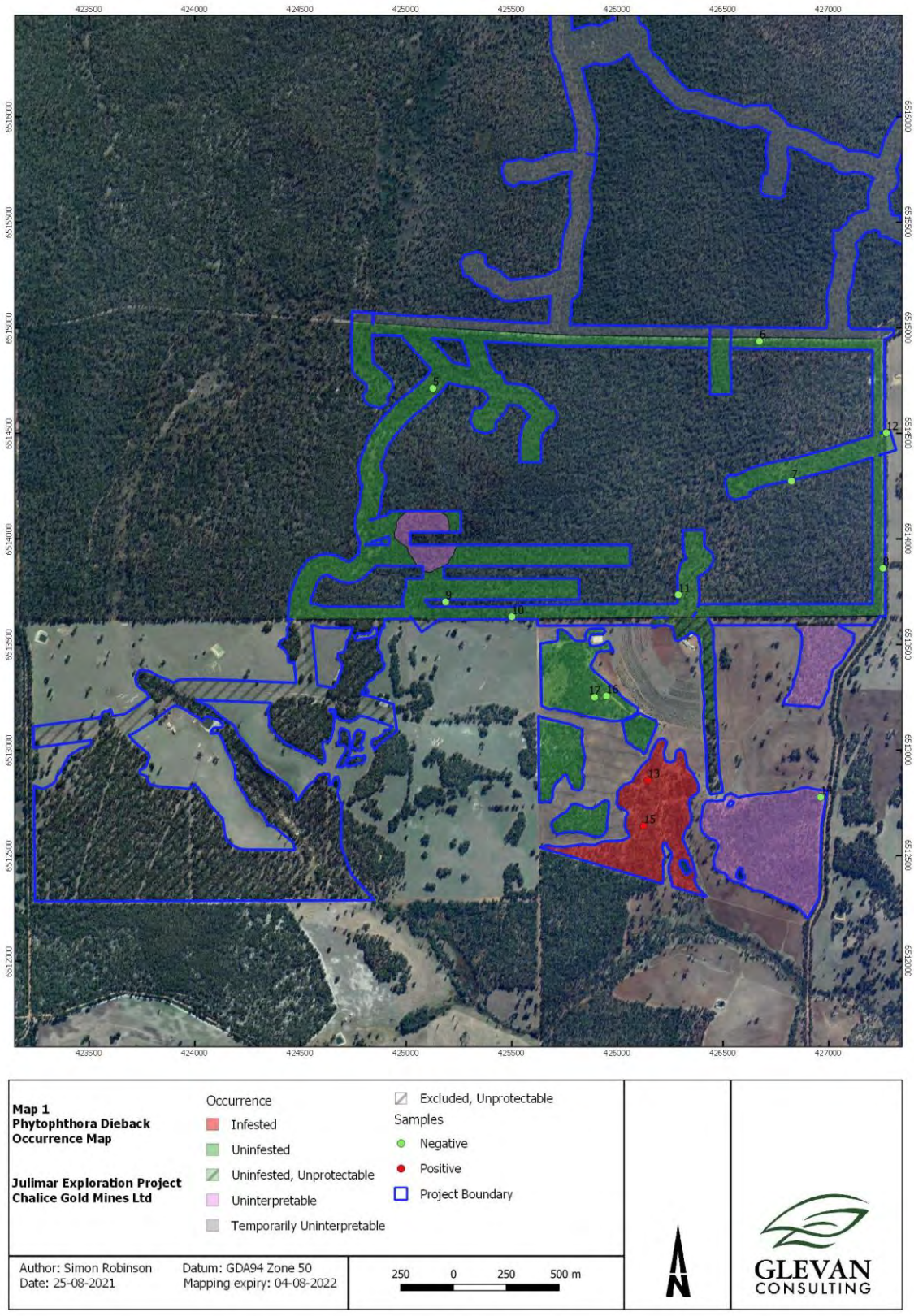


Figure 7: Project Dieback Status and Sample Locations – Southern Section

6.1 Farmland

In June 2020, Chalice commissioned a Dieback Assessment for portions of remnant vegetation (65 ha) on private farmland on E70/5118 and E70/5119 located immediately south of the Julimar State Forest (Glevan 2020). Six soil and tissue samples were taken, all of which tested negative for the presence of *Phytophthora*. These six samples are additional to the 17 samples taken during the 2021 Dieback Assessment. The assessment by Glevan Consulting (2020) found that:

- 13.8 ha was observed to be uninfested and protectable.
- 9.3 ha was observed to be uninterpretable due to a lack of reliable indicator species. This tended to be areas subject to grazing and agricultural activities where the vegetation understorey had been removed.
- The remaining 109 ha of the project area was excluded from the assessment due to being degraded (actively being used for agricultural activities) or void of vegetation.

In July and August 2021, Glevan completed a Dieback Assessment over additional portions of remnant vegetation on the private farmland. The assessment by Glevan Consulting (2021) which is included as Appendix 1 found that:

- 127.5 ha was observed to be uninfested and protectable.
- 9.3ha was observed to be uninterpretable due to a lack of reliable indicator species. These areas were associated with Wandoo.
- 21 ha was confirmed as dieback infested (no exploration activities have occurred in this area).
- The remaining 132 ha of the project area was excluded from the assessment due to being completely degraded and void of understorey vegetation due to cropping and grazing. These areas are not likely to recover in the near future.

Management of dieback on the farmlands is managed through the Julimar Project – Farmlands Exploration Program – Dieback Management Plan (Chalice 2021a) which is applied as a tenement condition. Chalice has not undertaken any operations within the dieback infested area to date. If Chalice undertakes works in the infested area in the future, no drill rig that has been used in the infested area will be utilised in the Julimar State Forest.

6.2 Julimar State Forest

The Julimar State Forest is predominantly composed of Jarrah/Marri/Wandoo woodlands and supports an array of significant flora and fauna, including Threatened species. The forest is separated from surrounding agriculture by fencing which controls grazing and degradation by stock.

In June 2021, Chalice commissioned Glevan Consulting to undertake a linear dieback assessment of the Hartog and Baudin targets. This assessment covered an area of 620 ha comprising 72 proposed exploration drill sites, off-track access routes and existing forest tracks and is included as Appendix 1. The area north of Julimar Road has been assessed as temporarily uninterpretable due to fire disturbance as outlined on Figure 6 and Figure 7 (Glevan 2021). Glevan (2021) notes that it is likely to be at least another 18 months before the vegetation recovers sufficiently to be able to be assessed for *Phytophora* dieback presence. The area south of Julimar Road has been interpreted as uninfested with a small section mapped as uninterpretable (Glevan 2021) as outlined on Figure 7. The uninterpretable section is associated with Wandoo woodland which did not contain sufficient

numbers of reliable indicator species for dieback status to be determined (Glevan 2021). Glevan (2021) notes that given all the surrounding vegetation is uninfested and that no obvious vectors were observed within the uninterpretable area, it is highly likely that the uninterpretable area is also dieback free.

For the purposes of this DMP, the Julimar State Forest has been broken down into two dieback zones: north of Julimar Road (uninterpretable); and south of Julimar Road (uninfested). Julimar Road is a bitumen road that traverses between these two zones within the Julimar State Forest.

The Julimar State Forest is subject to recreational activities including four-wheel driving in both wet and dry conditions. Recreational activities are a significant potential vector of *Phytophthora* introduction and spread through the deposition of Dieback infested soil or vegetation. Driving where dieback management is not undertaken poses a particular risk as the activity itself involves interaction with soils and vegetation and movement over large areas.

An assessment has been undertaken to determine if areas within the Julimar State Forest are protectable or not protectable in accordance with DBCA's Phytophthora Dieback Management Manual (DBCA, 2020) and Corporate Policy Statement No 3. Management of Phytophthora Disease (DPaW 2015).

The Phytophthora Dieback Management Manual (DBCA 2020) and Corporate Policy Statement No 3. Management of Phytophthora Disease (DPaW, 2015) define a protectable area as:

- *situated in zones receiving greater than 600 mm per annum average rainfall, or is water gaining (e.g. granite outcrops, impeded drainage or engineering works which aggregate rainfall) and occurring below 600 mm per annum average rainfall; and,*
- *determined to be free of Phytophthora disease by a registered Disease Interpreter; and,*
- *positioned in the landscape and of sufficient size (e.g. greater than 4 hectares with axis greater than 100 metres) such that a registered Disease Interpreter judges that Phytophthora disease will not autonomously infest it, in the short term (a period of up to several decades); and,*
- *where human vectors are controllable (e.g. not an open road or private property).*

In accordance with the Phytophthora Dieback Management Manual (DBCA 2020) an unprotectable area is defined as areas that are generally infested, or uninterpretable and uninfested but are likely to be engulfed by autonomous spread of the pathogen in the short term.

Using the above definitions, the section of Julimar State Forest located south of Julimar Road (primarily uninfested) meets the definition of a protectable area whilst the area north of the Julimar Road (temporarily uninterpretable) remains uninterpretable. Protectable areas are outlined on Figure 8.

7. RISK ASSESSMENT

Risk assessments to assess the risk of the spread of dieback from the proposed drilling program have been undertaken using the tools outlined in the Phytophora Dieback Management Manual (DBCA 2020).

A risk assessment for the uninfested area in the area south of Julimar Road in wet soil conditions is outlined in Table 4.

A risk assessment for drilling in the area north of Julimar Road (uninterpretable) is outlined in Table 5 for moist soil conditions. Drilling activities will not take place during wet soil conditions in the northern uninterpretable area with the exception of movement of light vehicles and personnel for demobilization and security purposes.

Table 4: Dieback Risk Assessment in Uninfested Area in Wet Soil Conditions

Activity	Likelihood	Consequence	Inherent Risk	Controls
Movement of Tracked Drill Rigs	Very Likely	Significant	High*	Drill rigs will be entering previously undisturbed areas however all tracked drill rigs will be thoroughly washed down at the Chalice washdown bay and will also be cleaned down at the COE locations outlined on Figure 8. Drill rigs will be designated to one of the dieback zones (i.e. separate drill rigs to operate in the northern (uninterpretable) and southern (dieback free) zones and would only be moved between zones after thorough washdown at the Chalice washdown bay.
Movement of personnel via RTVs	Unlikely	Significant	High*	RTVs will be entering previously undisturbed areas however all RTVs will be thoroughly washed down prior to entering any part of the State Forest and will also be cleaned down at the COE locations outlined on Figure 8. If an RTV needs to move between the northern (uninterpretable) and southern (uninfested) dieback zones a dry clean down using a dry hygiene kit will be undertaken at the COE locations outlined on Figure 8. Movement of RTVs between the two zones will be minimized as far as practicable.
Movement of Personnel via light vehicles	Unlikely	Significant	High*	Light vehicles will remain on existing tracks. Light vehicles will be thoroughly cleaned when entering and exiting the Julimar State Forest at the Chalice washdown bay and will also be cleaned down at the COE locations outlined on Figure 8. Movement of light vehicles between dieback zones will be minimized as far as practicable. If a light vehicle needs to move between the northern (uninterpretable) and southern (uninfested) dieback zones a dry clean down using a dry hygiene kit will be undertaken at the COE locations outlined on Figure 8.
Refuelling and refilling of water tanks	Unlikely	Significant	High*	All equipment that is used for refuelling and refilling of water tanks will be washed down in accordance with this DMP. Equipment used for refuelling and refilling of water tanks (which includes rubber tyred support trucks, light

Activity	Likelihood	Consequence	Inherent Risk	Controls
				vehicles or RTVs) will be thoroughly cleaned when entering and exiting the Julimar State Forest at the Chalice washdown bay and will also be cleaned down at the COE locations outlined on Figure 8. Most refuelling and water equipment will remain on existing tracks. Only RTVs will move off track for refuelling and water stocking purposes. If a vehicle used for refuelling or refilling of water tanks needs to move between the areas north and south of Julimar Road, a dry clean down using a dry hygiene kit will be undertaken at the COE locations outlined on Figure 8. All crossings between the zones will be minimized as far as practical.
Movement of personnel on foot	Very Unlikely	Significant	Moderate	Personnel will be working in a localised area. Footwear will be washed down in accordance with this DMP. All footwear will be washed prior to entering the Julimar State Forest and will also be cleaned down at the COE locations outlined on Figure 8. All footwear will be, where necessary, cleaned of soil and vegetative material before and after entry and exist of each site using the mobile dry hygiene kit (i.e. hand brush and phytoclean spray).
Extraction of groundwater and transport of water using poly pipe	Very Unlikely	Significant	Moderate	Water used in drilling will be the groundwater extracted at the Chalice private properties at depth (greater than 15 m below ground level). Water will be transferred from storage tanks on existing tracks to drill rigs at drill sites over land using poly pipe.
Movement of drilling muds or water used in drilling	Very Unlikely	Significant	Moderate	Drilling muds and water used in drilling will be captured in tanks on the support vehicles and taken out of the Julimar State Forest for disposal.

*High risk rating reflects inherent risk in the proposed drilling program and does not account for application of controls that reduce the likelihood of the risk.

Table 5: Dieback Risk Assessment for Drilling in the Uninterpretable Area (only in dry and moist soil conditions)

Activity	Likelihood	Consequence	Inherent Risk	Controls
Movement of Tracked Drill Rigs and Support Vehicles	Very Likely	Significant	High*	Drilling activities will not take place during wet soil conditions in the northern uninterpretable area with the exception of movement of light vehicles and personnel for demobilization and security purposes. All tracked drill rigs and large tracked support vehicles will be thoroughly washed down at the Chalice wash down bay prior to entering any part of the State Forest and will also be cleaned down at the COE locations outlined on Figure 8.

Activity	Likelihood	Consequence	Inherent Risk	Controls
				Drill rigs will be designated to one of the dieback zones (i.e. separate drill rigs to operate in the northern (uninterpretable) and southern (die back free) zones and would only be moved between zones after thorough washdown at the Chalice washdown bay.
Movement of personnel via RTVs	Unlikely	Significant	Moderate	RTVs will not operate off existing access tracks in the uninterpretable area in wet soil conditions except to demobilize personnel. All RTVs will be thoroughly washed down prior to entering any part of the State Forest and will also be cleaned down at the COE locations outlined on Figure 8. If an RTV needs to move between the northern (uninterpretable) and southern (uninfested) dieback zones a dry clean down using a dry hygiene kit will be undertaken at the COE locations outlined on Figure 8. Movement of RTVs between the two zones will be minimized as far as practicable.
Movement of Personnel via light vehicles	Unlikely	Significant	Moderate	Light vehicles will remain on existing tracks and will not operate off existing access tracks. Light vehicles will be thoroughly cleaned when entering and exiting the Julimar State Forest at the Chalice washdown bay and will also be cleaned down at the COE locations outlined on Figure 8. Movement of light vehicles between dieback zones will be minimized as far as practicable. If a light vehicle needs to move between the northern (uninterpretable) and southern (uninfested) dieback zones a dry clean down using a dry hygiene kit will be undertaken at the COE locations outlined on Figure 8.
Refuelling and refilling of water tanks	Unlikely	Significant	Moderate	Refuelling and refilling water tanks will not occur off existing access tracks in the uninterpretable area in wet soil conditions. All equipment that is utilized for refuelling and refilling of water tanks will be cleaned down at the COE locations outlined on Figure 8 in accordance with this DMP. Equipment used for refuelling and refilling of water tanks (which includes rubber tyred support trucks, light vehicles or RTVs) will be thoroughly cleaned when entering and exiting the Julimar State Forest at the Chalice washdown bay. Most refuelling and water equipment will remain on existing tracks. Only RTVs will move off track for refuelling and water stocking purposes. If a vehicle used for refuelling or restock of water tanks needs to move between the areas north and south of Julimar Road, a dry clean down using a dry hygiene kit will be undertaken at the COE locations outlined on Figure 8. All crossings between the zones will be minimized as far as practical.
Movement of personnel on foot	Very Unlikely	Significant	Moderate	Personnel will be working in a localised area. Footwear will be washed down in accordance with this DMP.

Activity	Likelihood	Consequence	Inherent Risk	Controls
				All footwear will be washed prior to entering the Julimar State Forest and will also be cleaned down at the COE locations outlined on Figure 8. All footwear will be cleaned of soil and vegetative material before and after entry and exit of each site using the mobile dry hygiene kit (i.e. hand brush and phytoclean spray).
Extraction of groundwater and transport of water using poly pipe	Very Unlikely	Significant	Moderate	Water used in drilling will be the groundwater extracted at the Chalice private properties at depth (greater than 15 m below ground level). Water will be transferred from storage tanks on existing tracks to drill rigs at drill sites over land using poly pipe.
Movement of drilling muds or water used in drilling	Very Unlikely	Significant	Moderate	Drilling muds and water used in drilling will be captured in tanks on the support vehicles and taken out of the Julimar State Forest for disposal.

*High risk rating reflects inherent risk in the proposed drilling program and does not account for application of controls that reduce the likelihood of the risk.

Chalice has undertaken a *Phytophthora* dieback risk assessment in accordance with the Phytophthora Dieback Management Manual (DBCA, 2020) and this has been included as Appendix 2.

8. DIEBACK MANAGEMENT PRINCIPLES AND STRATEGIES

In general, the risk of spreading *Phytophthora* can be minimised by keeping machinery, equipment, or footwear clean of soil or plant material between dieback classification locations, and by not further dispersing soil or plant material within a site. Subsequently where Dieback is a risk factor, the movement of soil, plant material and water must be managed. These controls are collectively called *Phytophthora* Dieback management.

Clean on Entry (COE) is the primary mechanism to prevent the introduction or spread of dieback. Clean on Entry means:

- Check machine or vehicle and enter if already clean;
- Clean down if found not to be clean and able to clean down; or
- Do not enter if not clean and unable to clean down at the COE site.

COE points have been designed to manage dieback risk within the Julimar State Forest. When a clean down is required at a COE in the Julimar State Forest, all material will be collected and taken out of the Julimar State Forest for disposal.

The management strategy for exploration varies according to the different infestation scenarios described in Table 6.

Table 6: Dieback Management Strategies (DWG 2021)

Infestation Scenario	Phytophthora Hygiene Guidelines
Site that is infested with *Phytophthora* Dieback	« No hygiene considerations are required to enter the site. « Clean down of equipment/vehicles on exit is essential.
Site that is free of *Phytophthora* Dieback (uninfested)	« Precautionary Principle must apply. « 'Clean on entry' is essential. All equipment (including footwear) and vehicles are to be free of mud and soil prior to entering the site.
Site that is Uninterpretable	« Precautionary Principle must apply. « 'Clean on entry and exit' is essential. All equipment (including footwear) and vehicles are to be free of mud and soil prior to entering and exiting the site.
Site that is Unknown	« Precautionary Principle must apply. « 'Clean on entry and exit' is essential. All equipment (including footwear) and vehicles are to be free of mud and soil prior to entering and exiting the site.

8.1 Entry, Exit and Movement Within Julimar State Forest

Entry, exit and movement of personnel and equipment within the Julimar State Forest must occur in accordance with Table 7 and Figure 8.

Table 7: Julimar State Forest Dieback Management Measures

	Entering Farmland	Entering Area south of Julimar Road (uninfested)	Entering area north of Julimar Road (uninterpretable)
Leaving Farmland	Nil requirements	All equipment (including boots, handheld tools and drill rods) and vehicles entering from the south will be cleaned down at the Chalice Washdown bay and be issued a hygiene certificate prior to entering the Julimar State Forest. All equipment (including boots, handheld tools and drill rods) will be cleaned at COE locations as outlined on Figure 8.	Drilling activities will not take place during wet soil conditions in the northern uninterpretable area with the exception of movement of light vehicles and personnel for demobilization and security purposes. All equipment (including boots, handheld tools and drill rods) and vehicles will first be cleaned down at the Chalice Washdown bay and be issued a hygiene certificate prior to entering the Julimar State Forest and will also be cleaned down at the COE locations outlined on Figure 8.
Leaving Area south of Julimar Road	All equipment (including boots and handheld tools) and vehicles will be cleaned down at the Chalice Washdown bay upon entering the farmland.	Nil requirements	Drilling activities will not take place during wet soil conditions in the northern uninterpretable area with the exception of movement of light vehicles and personnel for demobilization and security purposes. All tracked rigs will be cleaned down at the Chalice Washdown Bay (Figure 8) when moving between areas north and south of Julimar Road in the Julimar State Forest. All rubber-tyred vehicles and equipment (including boots, handheld tools and drill rods) will be cleaned down at a COE location (Figure 8) on Julimar Road when moving between areas north and south of Julimar Road in the Julimar State Forest. Crossing between the areas north and south of Julimar Road areas will be minimised where practicable. All equipment (including boots, handheld tools and drill rods) will follow the COE signs as outlined on Figure 8.
Leaving Area north of Julimar Road	All equipment (including boots and handheld tools) and vehicles will	All tracked rigs and track mounted support vehicles will be cleaned down at the Chalice Washdown	Nil requirements

	Entering Farmland	Entering Area south of Julimar Road (uninfested)	Entering area north of Julimar Road (uninterpretable)
	be cleaned down at the Chalice Washdown bay upon entering the farmland.	Bay (Figure 8) when moving between areas north and south of Julimar Road in the Julimar State Forest. All rubber-tyred vehicles and equipment (including boots, handheld tools and drill rods) will be cleaned down at a COE location (Figure 8) on Julimar Road when moving between areas north and south of the Julimar Road in the Julimar State Forest. All equipment (including boots, handheld tools and drill rods) will follow the COE signs as outlined on Figure 8. Crossing between the areas north and south of Julimar Road will be minimised where practicable. Crossing of tracked vehicles will not occur between zones during wet soil conditions.	

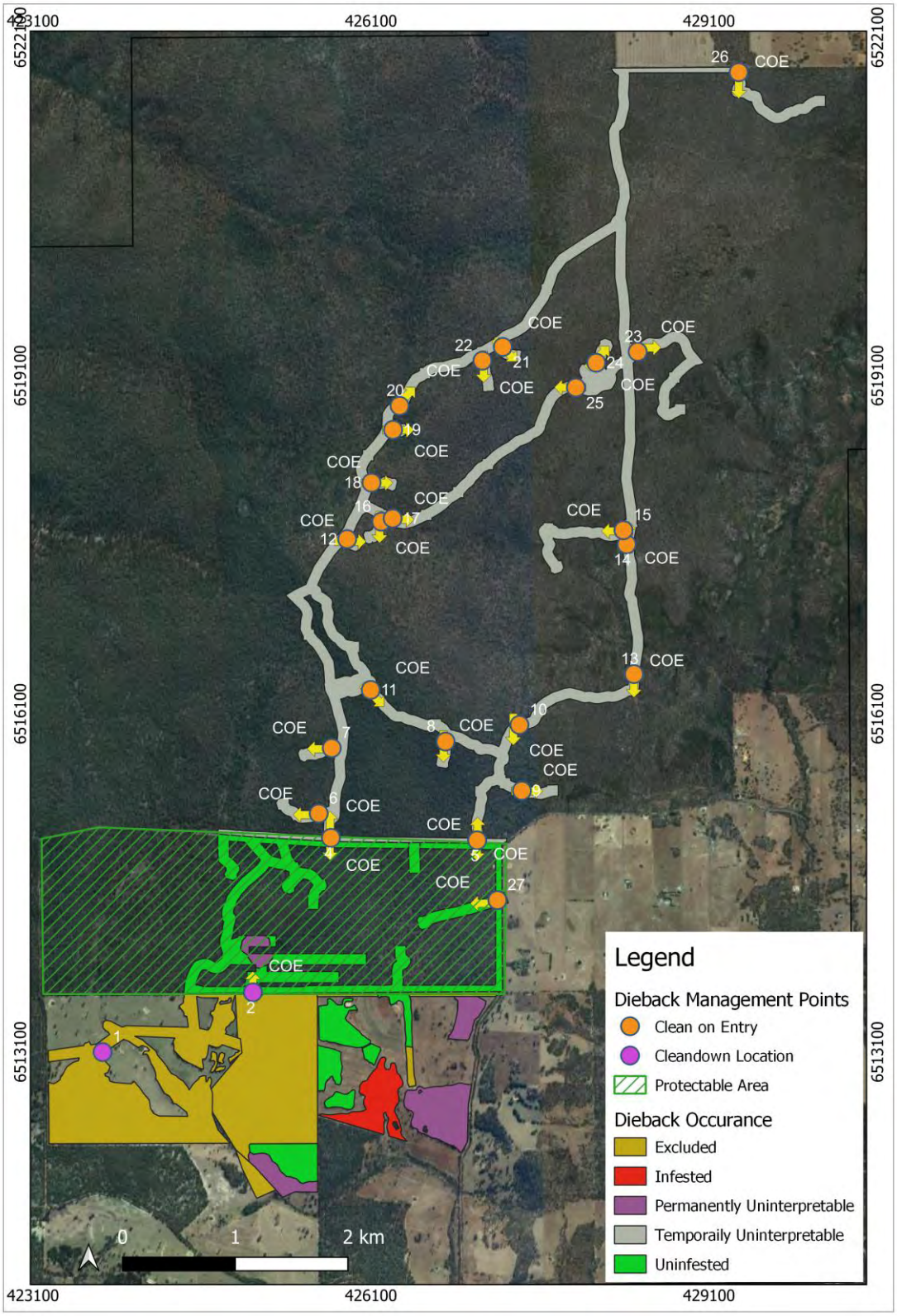


Figure 8: Dieback Status and Clean Down Locations

8.2 General Management Measures

- Drilling or movement of large, tracked vehicles, will not take place during wet soil conditions in the northern uninterpretable area. Wet soil conditions are where soil and moisture combine so that soil sticks to tyres, equipment and/or footwear.
- Designated vehicles will be used. This entails the use of allocated vehicles in dieback zones which will remain within the dieback zones for the duration of the works where practicable.
- All vehicles and equipment (including boots and handheld tools) will be inspected and cleaned down immediately if not clean at designated Clean on Entry (CoE) locations as outlined on Figure 8.
- Drill rods will be inspected and where necessary, cleaned of soil and vegetative material before and after entry and exit of each site using the mobile dry hygiene kit (i.e. hand brush and phytoclean spray).
- Drainage lines and watercourses will be avoided, and the crossing of watercourses will use existing crossing points.
- Signage denoting dieback zones, washdown requirements and CoE points will be installed whilst actively drilling in that area.
- COE locations will be installed on existing tracks. In the unlikely event a vehicle or equipment cannot be cleaned down at a COE location, the vehicle or equipment will need to return to an area where a clean down can be undertaken. This must be undertaken without encroaching on any vegetation by using existing access routes.
- All dieback mapping will be kept up to date (less than 12 months). If the proposed drill program exceeds twelve months, an additional dieback survey will be undertaken.
- If vehicles or equipment (including footwear and handheld tools) have significant levels of soil material attached, a mobile washdown will be undertaken. All material will be bagged and collected and taken out of the Julimar State Forest for disposal. This will be undertaken in all dieback zones.

8.3 Clean Down Procedure

Prior to leaving the Farmland, all vehicles will be cleaned down at the Chalice Washdown bay as outlined in Figure 9.

Figure 9: Chalice Washdown Bay

As vehicles, equipment and personnel will be moving between drill sites within the State Forest, and implementation of designated washdown areas is not possible, mobile (in-field) hygiene practices will be implemented. The following clean down resources and procedures are required.

A dry hygiene kit will accompany each vehicle nominated for State Forest access. The kit will include:

- Hand brush (for footwear, tools, detailed cleaning of vehicles).
- Broom (for vehicles).
- Water.
- Phytoclean, or an equivalent sprayable disinfectant, of adequately concentrated solution to fill:
  - Hand spray (e.g. 1L).
  - Spray canister (e.g. 10L).

Phytoclean to water ratio is effective for spray purposes in mixtures of 1L/10 L of water.

Mobile clean down of footwear and tools:

- Remove visible soil and vegetation from footwear (particularly boot sole) or equipment using hand brush and other implements where required.

« Spray clean soles of footwear with phytoclean solution and allow to air dry briefly.

Mobile clean down of vehicles:

« Use broom and hand brush to remove visible soil and vegetation from the body (undercarriage, bumpers, mud flaps), tyres (tread and mags), cabin floor (mats) and tray.

« Spray exterior of vehicle with phytoclean solution and allow to air dry briefly.

8.4 Training

At least one member of each work team will undertake mandatory Green Card Training provided through DBCA or the Dieback Working Group.

All team members working in the Julimar State Forest will undertake an induction that includes the following dieback related matters:

« Explanation of dieback and causes;

« Dieback zones and related wash down requirements; and

« Guidelines on cleaning vehicles and equipment including confirmation checks to ensure cleanliness.

8.5 Monitoring and Reporting

To ensure compliance with this DMP within the Julimar State Forest, the Project Geologist will complete the Exploration Environmental Checklist as required by the CMP.

Monitoring (via audits and inspections) during exploration work is essential to determine the effectiveness of the *Phytophthora* Dieback management program. It may be an on-going requirement of the tenement conditions and other regulations to provide regular reports and field records (i.e. hygiene certificates, inductions, training, clean down record sheets) on the success of the *Phytophthora* Dieback management program. It is important to note any areas of the program that could be used to improve effectiveness and practicality.

In the event of any non-compliance with this DMP, an incident report shall be submitted to the site supervisor and actions put in place to reduce the likelihood of the incident occurring again.

9. COMMUNICATION

Chalice employees and contractors who are involved in the proposed exploration activities in Julimar State Forest will be required to read this DMP.

The DMP will be available at the site office and within supervisor vehicles. Clean on Entry/Exit points will be identified in the field as outlined on Figure 8.

Information regarding Dieback management will be communicated to all project employees as identified in Table 8.

Table 8: Communications Program

Method	Frequency	Participants	Reference	Record
Induction	Prior to commencement of work	All personnel and contractors	DMP and CMP	Induction attendance sheet
Training			DMP and toolbox	Training attendance sheet
Pre-start Meetings	Daily	Project Personnel	DMP	Minutes of meeting

All field personnel will be made aware of Dieback risks and understand the importance of the management procedures through the Chalice site induction and pre-start meetings. The GM Development and the Exploration Project Geologist will maintain regular contact with work crews to advise of any changes.

10. ACCOUNTABILITY

The GM Development and the Exploration Project Geologist are responsible for ensuring that all field operations are conducted in accordance with the Conservation Management Plan, this DMP and relevant permit and approval requirements. Where *Phytophthora* Dieback is a known or suspected environmental issue, the Exploration Project Geologist has the responsibility for ensuring all field personnel are aware of *Phytophthora* Dieback risks and controls (via risk assessments, inductions, training, information sessions, etc.) and that suitable field management practices are in place to avoid or limit the spread of *Phytophthora* Dieback.

Where special work conditions are imposed on tenements, or where access restrictions are imposed as a result of *Phytophthora* Dieback infestation, or suspected infestation, the GM Development and GM Environment and Community are responsible for ensuring that appropriate permits and/or authorisations are in place prior to commencement of field activities. This document shall not be altered without the authority of the GM Environment and Community.

All field personnel have a responsibility to be fully informed of Dieback risks in field operations and to comply with management plans and operational procedures and implement suitable controls to avoid or limit the spread of Dieback disease, as per legislation and local site requirements. A summary of the roles and responsibilities is given in Table 9.

Table 9: Roles and Responsibilities

GM Environment and Community	« Coordinate development of, and updates to, the DMP. « Liaise with relevant stakeholders as necessary and keep records of consultation. « Ensure all supervisory and management personnel are aware of and understand requirements and responsibilities contained in the DMP. « Conduct visits and inspections to ensure all work complies with commitments and management measures outlined in this DMP.

GM Development	« Determine suitable locations for State Forest entry/exit sites and where necessary, prepare areas for establishment of designated clean down points. « Ensure personnel have access to all information and equipment required to undertake Dieback hygiene management. « Investigate any incidents and non-compliances to this DMP. « Ensure requirements of DBCA and the Company are communicated to contractors prior to arrival at site.
Exploration Project Geologist	« Organise Green Card training for work crews as required. « Conduct daily prestart meetings and work area inspections. « Conduct Clean on Entry inspections for all vehicles and equipment arriving to conduct work in the State Forest and maintain records of results. « Collect Hygiene Certificates from contractors for each vehicle entering the State Forest, or in the event where a hygiene certificate is not available supervise on site clean downs prior to State Forest entry. « Ensure hygiene equipment and consumables are present and maintained at relevant locations and in nominated vehicles. « Ensure copies of this DMP and relevant maps are available for people conducting work within the State Forest. « Conduct employee and contractor environment inductions
Environmental Specialist	« Conduct visits and inspections to ensure all work complies with commitments and management measures outlined in this DMP. « Provide advice and assistance to exploration employees and contractors to ensure compliance with this DMP. « Support the implementation of any corrective and remedial actions arising from audits and incident investigations.
All Julimar Exploration Project Personnel	« Always comply with this DMP and hygiene practices. « Ensure all vehicles/equipment contain a hygiene management kit and updated DMP. « Undertake Green Card Training as required. « Report any incidents to their Supervisors as soon as practicable including non-compliances with the DMP.

REFERENCES

Chalice 2021. Conservation Management Plan Hartog and Baudin Low Impact Exploration Drilling Program Julimar State Forest.

Chalice 2021a. Julimar Project – Farmlands Exploration Program – Dieback Management Plan.

Department of Biodiversity, Conservations and Attractions (2020). Phytophthora Dieback Management Manual. Government of Western Australia.

Department of Mines and Petroleum (2006). Management of Dieback Disease in Mineral Exploration Guidelines (now the Department of Mines, Industry Regulation and Safety). Government of Western Australia.

Department of Parks and Wildlife, (2015). Corporate Policy Statement No. 3 Management of Phytophthora Disease

Dieback Working Group Inc. (2021). Best Practice Guideline: Management of Phytophthora Dieback in the Basic Raw Materials Industries. Dieback Working Group, Perth; Western Australia.

Glevan Consulting (2020). Julimar Exploration project. Phytophthora Dieback Occurrence Assessment. Prepared for Chalice Gold Mines Limited. July 2020. Perth; Western Australia.

Glevan Consulting (2021). Julimar Exploration project. *Phytophthora Dieback Occurrence Assessment.* Prepared for Chalice Mining Limited. August 2021. Perth; Western Australia.

Project Dieback. (2014). *Dieback Public Map*. http://www.dieback.net.au/about/dieback-map.html

Appendices

Appendix 1 Phytophthora Dieback occurrence assessment (Glevan 2021)

Chalice Mining Limited

Julimar Exploration Project September 2021

Phytophthora Dieback occurrence assessment– Version 2.0

GLEVAN
CONSULTING

Client	*Chalice Gold Mines Limited*
Report name	*Julimar Exploration Project September 2021*

This report has been prepared in accordance with the scope of work agreed between Chalice Gold and Glevan Consulting and contains results and recommendations specific to the agreement. Results and recommendations in this report should not be referenced for other projects without the written consent of Glevan Consulting.

Procedures and guidelines stipulated in various manuals, particularly Phytophthora Dieback Interpreters Manual for lands managed by the Department (DBCA), are applied as the base methodology used by Glevan Consulting in the delivery of the services and products required by this scope of work. These guidelines, along with overarching peer review and quality standards ensure that all results are presented to the highest standard.

Glevan Consulting has assessed areas based on existing evidence presented at the time of assessment. The Phytophthora pathogen may exist in the soil as incipient disease. Methods have been devised and utilised that compensate for this phenomenon; however, very new centres of infestation, that do not present any visible evidence, may remain undetected during the assessment.

Executive Summary

Glevan Consulting conducted an assessment of the vegetation associated with the proposed drilling programs of the Julimar Exploration Project for the presence of Phytophthora Dieback. The project area is located in and adjacent to the Julimar State Forest, north-east of Perth, between Bindoon and Toodyay and comprises a total of 620.6 ha in area.

The assessment was conducted between July 27 and August 4, 2021 by Simon Robinson and Peter Chapman of Glevan Consulting. A single Phytophthora Dieback infestation comprising 21 ha was observed during the assessment (Table 4). The infestation is located within the farmland section of the study area (Map 1). A total of 127.5 ha was observed to be uninfested and protectable. Three sections comprising 9.3 ha were observed to be uninterpretable due to a lack of reliable indicator species. The entire section (302.4 ha) north of Julimar Road was classified as temporarily uninterpretable due to fire disturbance. The remaining 132 ha of the project area was excluded from the assessment due to being degraded or void of vegetation.

A desktop assessment of previous *Phytophthora* spp. recoveries for the area indicates that *Phytophthora* has not previously been recovered in or near the project area. Seventeen soil and tissue samples were taken during the assessment, two of which returned a positive result.

Table of Contents

1 Introduction ____ *1*

2 Background ____ *3*

3 Materials and Methods ____ *4*

3.1 Assessment Area ____ 4

3.2 Assessment Method ____ 5

3.3 Other *Phytophthora* Species ____ 6

3.4 Collection of Evidence of Phytophthora Dieback ____ 6

3.5 Soil and Tissue Samples ____ 7

4 Results ____ *9*

4.1 Phytophthora Dieback Occurrence ____ 9

4.2 Disease Symptoms and Expression ____ 9

4.3 Other *Phytophthora* Species ____ 9

4.4 Armillaria Root Disease (ARD) ____ 10

4.5 Sample Results ____ 10

5 Discussion ____ *11*

6 Bibliography ____ *13*

7 Appendices ____ *14*

7.1 Sample Summary ____ 14

7.2 Phytophthora Dieback Occurrence Map ____ 14

7.3 Mapping Metadata ____ 15

7.4 Shapefile Spatial Data ____ 16

List of Figures

Figure 1 - Assessment Area Location 2

List of Tables

Table 1 - Keighery Vegetation Condition Scale 4
Table 2 - Phytophthora Dieback assessment for vegetation condition 5
Table 3 - Determination of requirement for sampling 8
Table 4 - Results Summary of Assessment Area 9
Table 5 Sample Results 14

1 Introduction

Glevan Consulting was commissioned by MBS Environmental Consulting on behalf of Chalice Mining Limited (Chalice) to conduct an assessment of the vegetation associated with the Julimar Exploration Project (the project) for the presence of Phytophthora Dieback. A dieback survey is required as part of baseline studies for the project to inform the environmental management requirements.

The project is located in the Darling Range, north-east of Perth, between Bindoon and Toodyay. The assessment area comprises a total of 620.6 ha (Figure 1) and is largely comprised of existing forest tracks and proposed drilling access routes through the Julimar State Forest (406.7 ha). Sections of remnant vegetation on farmland located adjacent the southern boundary of Julimar State Forest are also included in the assessment area (213.9 ha).

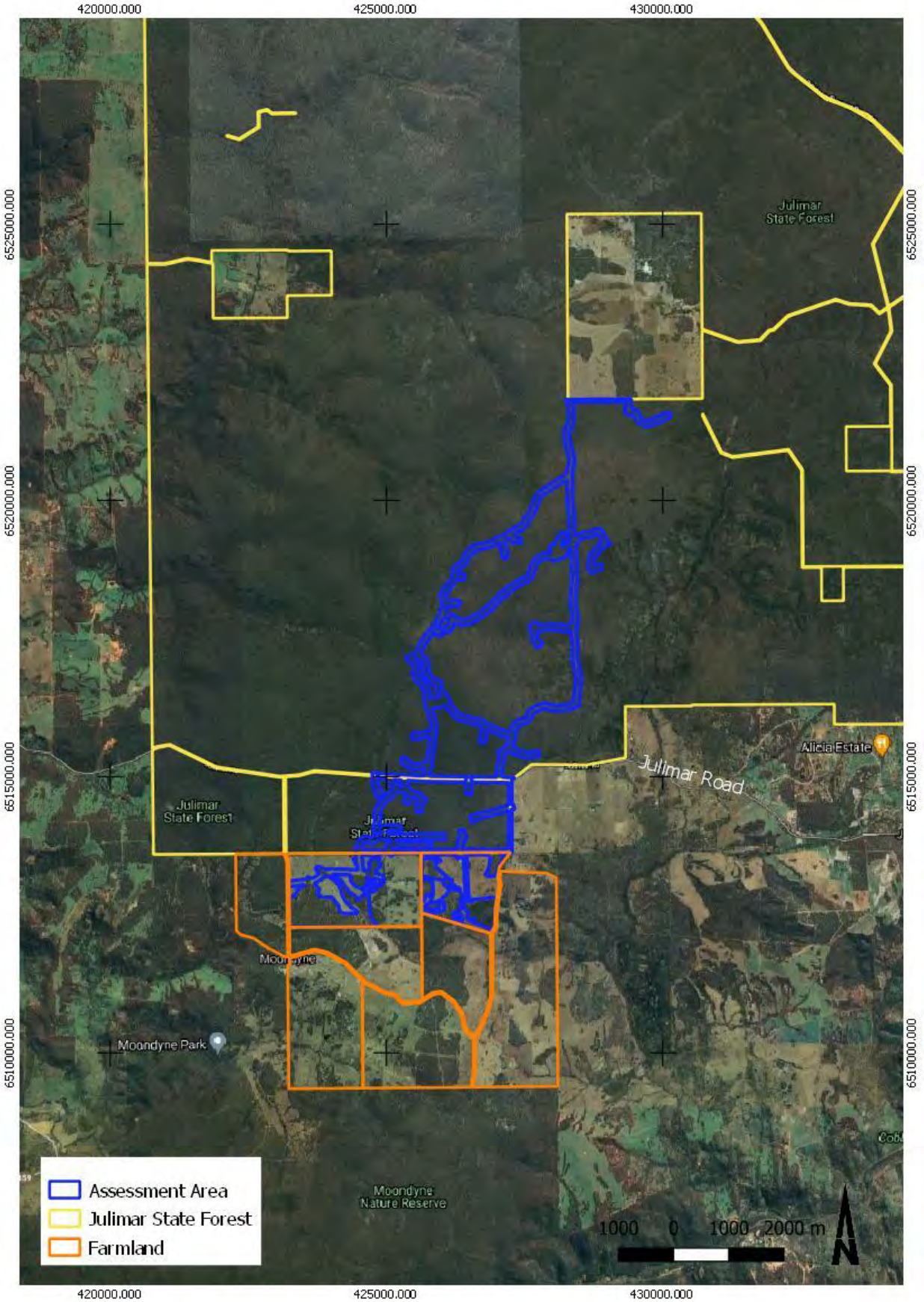


Figure 1 - Assessment Area Location

2 Background

Thousands of Australian native plant species are susceptible to Phytophthora Dieback—a destructive disease caused by the pathogen *Phytophthora cinnamomi* and other Phytophthora species. This disease is a major threat to Australia's biodiversity, placing important plant species at risk of death, local extirpation or even extinction. Its dramatic impact on plant communities can also result in major declines in some insect, bird and animal species due to the loss of shelter, nesting sites and food sources. Phytophthora Dieback can cause permanent damage to ecosystems. Once an area is infested with the pathogen, eradication is usually impossible. Awareness that human activity can easily spread the pathogen will help prevent an increase in the extent of this disease (Commonwealth of Australia, 2018)

Phytophthora spp. are a group of microscopic water moulds that belongs to the class Oomycetes. Oomycetes organisms are filamentous and absorptive and reproduce both sexually and asexually. *Phytophthora* spp. are considered parasitic. The species behave largely as a necrotrophic pathogen causing damage to the host plant's root tissues because of infection and invasion. (Department of Parks and Wildlife, 2015) The pathogen infects a host when it enters at a cellular level and damages the cell structure.

Phytophthora Dieback is the result of interaction between three physical components forming a 'disease triangle': the pathogen (*Phytophthora* spp.), the environment and the host. All three components are needed for the disease to develop over time. The relationship between the presence of *Phytophthora* spp. and the development of Phytophthora Dieback disease is variable and based on the susceptibility of native plant species and the different environmental characteristics, landform types and rainfall zones across bioregions.

Armillaria Rot Disease (ARD) is a pathogen frequently encountered during Phytophthora Dieback assessments. It is caused by an indigenous fungus which is endemic to the south-west of Western Australia, occasionally presenting symptoms consistent with Phytophthora Dieback presence. The impact of the fungus on the vegetation may range from single dead plants to complete devastation of understorey and overstorey species.

3 Materials and Methods

3.1 Assessment Area

As per DPAW (2015), areas within a project's development envelope are excluded from assessment if the vegetation is suffering from significant disturbance. Significant disturbance is based on Vegetation Condition Scale (Keighery, 1994) shown in Table 1. Any remaining area, including the area outside of the development envelope if necessary, is categorised post-assessment into Phytophthora Dieback occurrence categories (**Table 2**, Map 1).

Table 1 - Keighery Vegetation Condition Scale

Scale		Vegetation condition
1	Pristine	Pristine or nearly so; no obvious signs of disturbance.
2	Excellent	Vegetation structure intact; disturbance affecting individual species and weeds are non-aggressive species.
3	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.
4	Good	Vegetation structure significantly altered by very 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 some very aggressive weeds at high density, partial clearing, dieback and grazing.
5	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 frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
6	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.

.

Table 2 - Phytophthora Dieback assessment for vegetation condition

Vegetation Condition	Phytophthora occurrence category
Naturally vegetated areas. Keighery disturbance rating of 3 or less Phytophthora occurrence categorisation is possible.	Infested - Determined to have plant disease symptoms consistent with the presence of *Phytophthora cinnamomi.*
	Uninfested - Determined to be free of plant disease symptoms that indicate the presence of *P. cinnamomi*
	Uninterpretable - Undisturbed areas where susceptible plants are absent, or too few to make a determination of the presence or absence of *P. cinnamomi.*
	Not yet resolved.
Vegetation structure temporarily altered.	Temporarily Uninterpretable - Areas of disturbance where natural vegetation is likely to recover.
Vegetation structure severely altered. Keighery disturbance rating 4 or greater. Phytophthora occurrence assessment is not possible	Excluded.

3.2 Assessment Method

All Phytophthora Dieback detection, diagnosis and mapping are performed to standards and procedures defined in *FEM047 Phytophthora Dieback Interpreter's Manual for lands managed by the department* (DPAW 2015), Chapter 6. These procedures are grounded on the presence of indicator species in the vegetation, and the observance of deaths in these plants. An indicator species is a plant species that is reliably susceptible to *Phytophthora cinnamomi*. Indicator Species Deaths (ISDs) alone do not necessarily indicate disease presence and it is necessary to consider all environmental and ecological factors that may be present. These other factors (as listed in FEM047) include:

- Chronology of deaths;
- Pattern of deaths;
- Topographical position;
- Vectoring – causal agencies, and;
- Biomass and biological diversity reduction.

Other causes of plant deaths need to be considered when determining the presence of Phytophthora Dieback, including (from FEM047):

- *Armillaria Root Disease*
- various cankers;
- insects;
- drought, wind scorch and frost;
- salinity and waterlogging;
- fire and lightning;
- senescence and competition;
- physical damage, and;
- herbicides and chemical spills.

For the majority of the assessment, the assessment type used was the comprehensive type (featuring transect lines) using standards defined by Chapter 8, FEM047. Prior to assessment, all information relevant to the project was assembled to assist the interpretation process (as defined in Chapter 7, FEM047). This information included previous assessments of the area, history of burning and possible other disturbances.

3.3 Other *Phytophthora* Species

Phytophthora species other than *P. cinnamomi* are identified using DNA analysis by the Centre for Phytophthora Science and Management (CPSM) at Murdoch University following the identification of the presence of a *Phytophthora* species in baiting analysis performed by Vegetation Health Service (VHS) at the Department of Biodiversity, Conservation and Attractions (DBCA).

3.4 Collection of Evidence of Phytophthora Dieback

During the assessment process, the collection of evidence to support the field diagnosis was recorded using a tablet running the ESRI Collector application. Waypoints are recorded at locations to show evidence of:

- where field diagnosis is certain or almost certain of Phytophthora Dieback infestation;

- healthy indicator species where field diagnosis is almost certain of the site being uninfested;
- sites with too few or devoid of indicator species, thus supporting uninterpretable classification, or
- areas of disturbance, which are temporarily uninterpretable or excluded from assessment.

Additional waypoints recorded include:

- points requiring soil and tissue sampling;
- points located where samples have been taken;
- points located at ISDs, and
- points that need to be revisited for further examination.

3.5 Soil and Tissue Samples

Soil and tissue samples taken during the assessment were to standards and prescriptions defined in Chapter 11 of FEM047. All samples were analysed in the Vegetation Health Services (DBCA) laboratory using best-practice techniques.

Taking a soil and tissue sample from dead and dying plants is an integral part of assessment – although in some cases sampling is not essential. Sample results provide evidence to support field diagnostic decisions. The following table (**Table 3**) shows the need for sampling to assist the disease diagnosis process (Department of Parks and Wildlife, 2015).

Table 3 - Determination of requirement for sampling

Observable factors indicating likelihood of *Phytophthora cinnamomi* presence				
ISD type	Multiple	Cluster	Scattered	Isolated
Species	Some or most indicator species	Any indicator plant	Any indicator plant	Any indicator plant
Pattern development	Obvious			Not obvious
Chronology	Obvious			Not obvious
Topographic situation	Gully/flat	Lower to mid slope	Mid slope to upper slope	Ridge
Causal agent	Obvious			Not obvious
Requirement for soil and tissue sample	Low	High	High	Low

4 Results

4.1 Phytophthora Dieback Occurrence

A single Phytophthora Dieback infestation comprising 21 ha was observed during the assessment (Table 4). The infestation is located within the farmland section of the assessment area (Map 1). A total of 127.5 ha was observed to be uninfested and protectable. Three sections comprising 37.7 ha were observed to be uninterpretable due to a lack of reliable indicator species. The entire section (302.4 ha) north of Julimar Road was classified as temporarily uninterpretable due to fire disturbance. The remaining 132 ha of the assessment area was excluded from the assessment due to being degraded or void of vegetation.

A desktop assessment of previous *Phytophthora* spp. recoveries for the area indicates that *Phytophthora* has not previously been recovered in or near the project area.

Table 4 - Results Summary of Assessment Area

Category	Area (ha)	% of total area assessed
Infested (with *Phytophthora)*	21.0	3.5
Uninfested	127.5	20.5
Uninterpretable	37.7	6
Temporarily uninterpretable	302.4	49
Excluded	132.0	21
TOTAL AREA	**620.6**	**100.0**

4.2 Disease Symptoms and Expression

Disease expression within the infested area was characterised by multiple ISD's, chronology and reduced biomass. Due to the high levels of disturbance present, it was not possible to determine the location of the actual disease front.

4.3 Other *Phytophthora* Species

No other *Phytophthora* spp. were identified during the assessment.

4.4 Armillaria Root Disease (ARD)

Several infestations associated with ARD were observed during the assessment. The honey-coloured mushrooms and white mycelium typically associated with the disease were observed at several sites throughout the Julimar State Forest and farmland sections. The disease is causing minor to moderate vegetation decline in the infested areas.

4.5 Sample Results

Seventeen soil and tissue samples were taken during the assessment. The results are presented in section 7.1.

5 Discussion

The source of infestation in the infested area is not known. The vegetation is disturbed, appears to have been infested for a considerable amount of time and contains sections of low interpretability. As such, it is not possible to determine the exact extent of infestation or the vector responsible for introducing the disease. The area contains access tracks and a creekline, which are the most likely sources of infestation.

Several sections within the farmland portion of the study area are completely degraded and void of understorey vegetation, most likely due to grazing by cattle. The presence/absence of the disease cannot be mapped in such areas and these sections were excluded from assessment (Map 1). These areas are not likely to recover in the near future and are considered unprotectable. As such, there are no hygiene requirements associated with entering these areas.

The entire section north of Julimar Road has been burnt and could not be interpreted. All tracks and drill hole access routes were driven or walked and all exhibited evidence of fire disturbance. The fire appears to have occurred approximately 12 months ago and it is likely to be at least another 18 months before the vegetation recovers to a point where it can be assessed for Phytophthora dieback presence.

Several sites exhibited evidence of significant vegetation decline, however the decline was not consistent with the presence of Phytophthora Dieback. The plant deaths (largely *Banksia squarrosa*) lacked chronology and there was no evidence of a disease front. Several sites exhibiting this type of vegetation decline were sampled and all of the samples taken produced a negative result. The decline is thought to be drought related and the area has been classified as uninfested (Map 1).

The uninterpretable section mapped in the Julimar State Forest is associated with Wandoo (*Eucalyptus wandoo*) woodland (Map 1). The vegetation within this section does not contain sufficient numbers of reliable indicator species and the dieback status could not be determined. However, given that all of the surrounding vegetation is uninfested, and that no obvious vectors were observed within the uninterpretable area, it is highly likely that the

uninterpretable area is also dieback-free. The boundary between the uninterpretable and uninfested area has been demarcated in the field with black and pink 'tiger' tape, with the knots facing towards the uninterpretable area.

The uninterpretable sections mapped in the farmland areas are also associated with Wandoo woodland. These areas have not been demarcated as there is an obvious boundary between the vegetated uninterpretable areas and the cleared areas surrounding them.

6 Bibliography

Carter, R. (2004). *Arresting Phytophthora Dieback: The Biological Bulldozer.* (K. Vear, & B. Dell, Eds.) WWF Australia.

Commonwealth of Australia. (2018). *Threat abatement plan for disease in natural ecosystems caused by Phytophthora cinnamomi.*

Department of Parks and Wildlife. (2015). *FEM047 Phytophthora Dieback Interpreter's Manual for lands managed by the department.* Unpublished.

DWG. (2011). *What is Dieback?* Retrieved October 13, 2011, from dieback.org.au

Environment Australia. (2001). *Threat Abatement Plan for Dieback caused by the root-rot fungus Phytophthora cinnamomi.*

EPA. (2011). *Phytophthora Dieback*. Retrieved October 13, 2011, from State of the Environment Report 2007: www.soe.wa.gov.au/report/biodiversity/phytophthora-dieback.html

Hardy, G., Colquhoun, I., Shearer, B., & Tommerup, I. (2001). The impact and control of Phytophthora cinnamomi in native and rehabilitated forest ecosystems in Western Australia. *Forest Snow and Landscape Research, 76*(3), 337-343.

Keane, P., & Kerr, A. (1997). Factors affecting disease development. In APPS, J. Brown, & H. Ogle (Eds.), *Plant Pathogens and Plant Diseases* (pp. 287-298). Rockvale Publications.

Keighery, B. (1994). *Bushland Plant Survey: a Guide to Plant Community Survey for the Community.* Wildflower Society of WA (Inc.).

O'Gara, E., Howard, K., Wilson, B., & Hardy, G. (2005). *Management of Phytophthora cinnamomi for Biodiversity Conservation in Australia: Part 2 - National Best Practice Guidelines.* CPSM. Department of Environment and Heritage.

7 Appendices

7.1 Sample Summary

Seventeen soil and tissue samples were taken during the assessment, two of which returned a positive result (Table 5).

Table 5 Sample Results

Sample no	Plant Sampled	Easting	Northing	Result
01	*Banksia squarrosa*	425419	6517067	*Negative*
02	*Banksia grandis*	428238	6520451	*Negative*
03	*Banksia grandis*	428317	6520879	*Negative*
04	*Xanthorrhoea preissii*	428339	6521806	*Negative*
05	*Banksia grandis*	425126	6514712	*Negative*
06	*Banksia grandis*	426671	6514712	*Negative*
07	*Banksia grandis*	426823	6514273	*Negative*
08	*Banksia squarrosa*	427256	6513860	*Negative*
09	*Banksia squarrosa*	425187	6513701	*Negative*
10	*Xanthorrhoea preissii*	426500	6513631	*Negative*
11	*Xanthorrhoea preissii*	426277	6513732	*Negative*
12	*Xanthorrhoea preissii*	427272	6514502	*Negative*
13	*Xanthorrhoea preissii*	426143	6512855	*Positive*
14	*Eucalyptus marginata*	426961	6512776	*Negative*
15	*Adenanthos cygnorum*	426124	6512640	*Positive*
16	*Banksia squarrosa*	425948	6513255	*Negative*
17	*Xanthorrhoea preissii*	425891	6513250	*Negative*

7.2 Phytophthora Dieback Occurrence Map

The provided maps (map 1 and 2) are the Phytophthora Dieback occurrence map.

The assessment area is displayed as a blue boundary line. The following categories are also shown (if present in the assessment area):

- Excluded (shown as uncoloured). Areas of high disturbance where natural vegetation has been cleared and is unlikely to recover to a level that is interpretable.

- Infested (shown as red). Determined from the assessment to have the plant disease caused by *Phytophthora cinnamomi*. Phytophthora Dieback caused by other *Phytophthora* species will be displayed as other colours, typically shades of orange and yellow.
- Uninfested (shown as green). Determined from the assessment to be free of plant disease Phytophthora Dieback.
- Uninterpretable (shown as purple). Undisturbed areas where susceptible plants are absent, or too few to decide the presence or absence of Phytophthora Dieback.
- Temporarily Uninterpretable (shown as grey). Areas of disturbance where natural vegetation is likely to recover.

Additional spatial data that may be shown include:

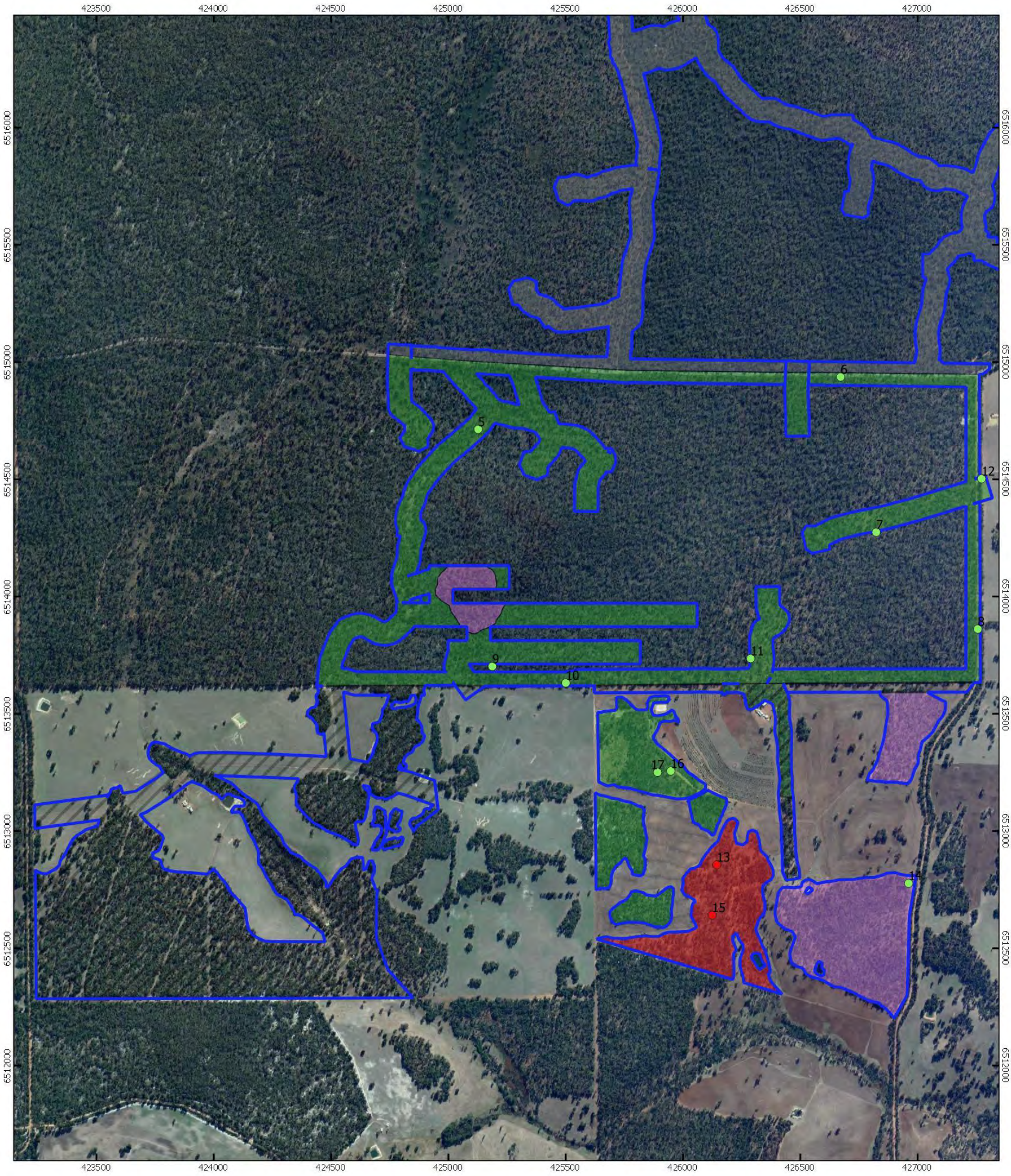
- Sample location

7.3 Mapping Metadata

DATASET DESCRIPTION	
Title	Julimar Exploration Project
Data Created	27-07-2021
Date Last Updated	04-08-2021
Abstract	Phytophthora Dieback Occurrence and sample location shapefiles for the Julimar Exploration Project.
Purpose	Dieback category boundary mapping
Document Number	21-1272
Contact Organisation	Glevan Consulting
Contact Name	Simon Robinson
Contact Position	Phytophthora Dieback Interpreter
Contact Phone	0427 113 336
Contact Email	simon.robinson@glevan.com.au
Lineage	All field data recorded using ESRI Collector on a GPS enabled tablet.
Datum / Coordinate System	GDA94 Zone 50
Geographic Description	Julimar State Forest, north-east of Perth, between Bindoon and Toodyay.
Restrictions	None

7.4 Shapefile Spatial Data

Spatial data is contained in the attached file named Julimar_Exploration_Project_2021_Shapefiles.zip.



Map 1
Phytophthora Dieback
Occurrence Map

Julimar Exploration Project
Chalice Gold Mines Ltd

Occurrence
- Infested
- Uninfested
- Uninfested, Unprotectable
- Uninterpretable
- Temporarily Uninterpretable
- Excluded, Unprotectable

Samples
- Negative
- Positive

Project Boundary

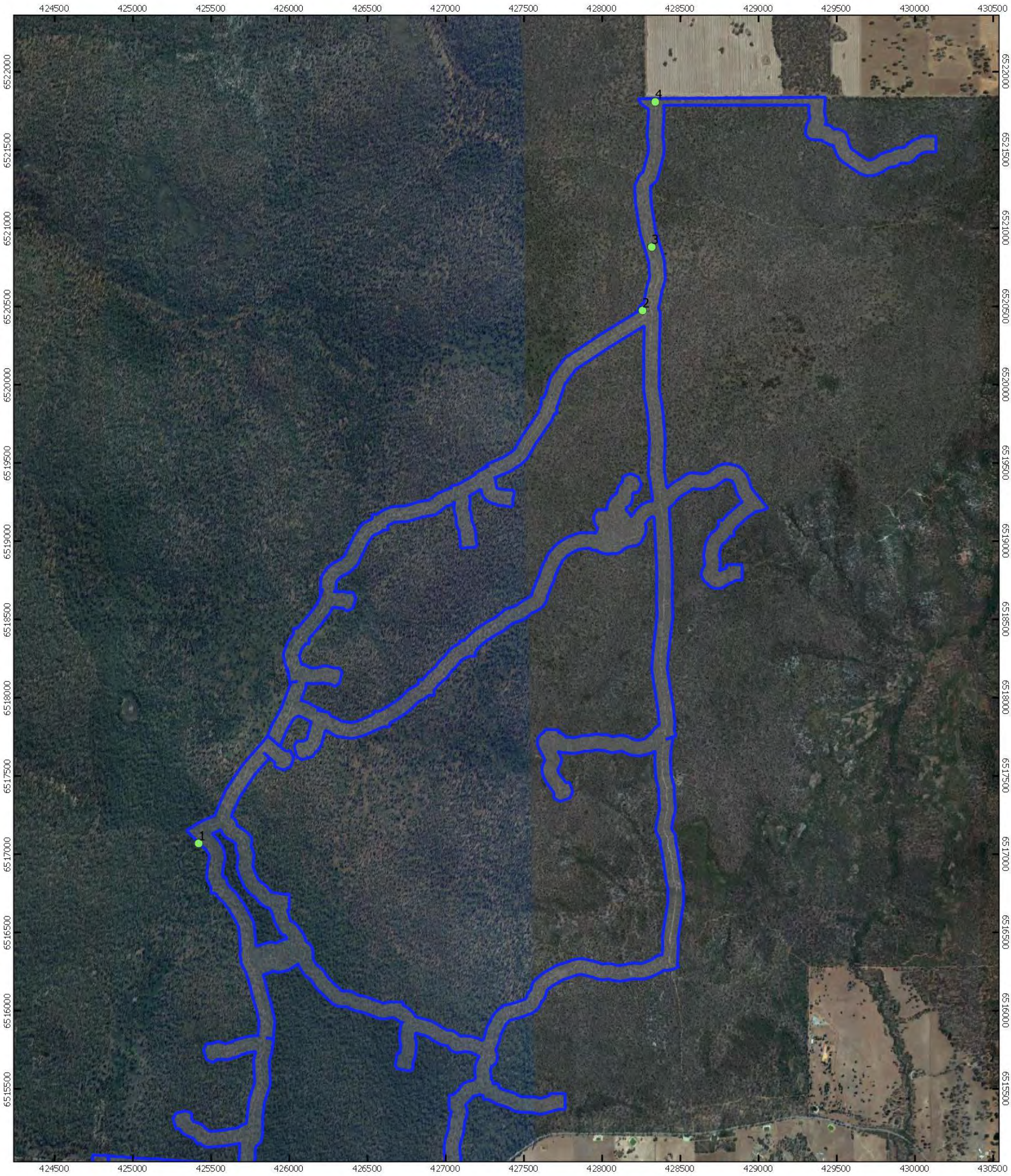
Author: Simon Robinson
Date: 25-08-2021

Datum: GDA94 Zone 50
Mapping expiry: 04-08-2022

250 0 250 500 m

N

GLEVAN CONSULTING



Map 2
Phytophthora Dieback
Occurrence Map

Julimar Exploration Project
Chalice Gold Mines Ltd

Occurrence
- Temporarily Uninterpretable

Samples
- Negative

Project Boundary

Author: Simon Robinson
Date: 25-08-2021

Datum: GDA94 Zone 50
Mapping expiry: 04-08-2022

250 0 250 500 m

N

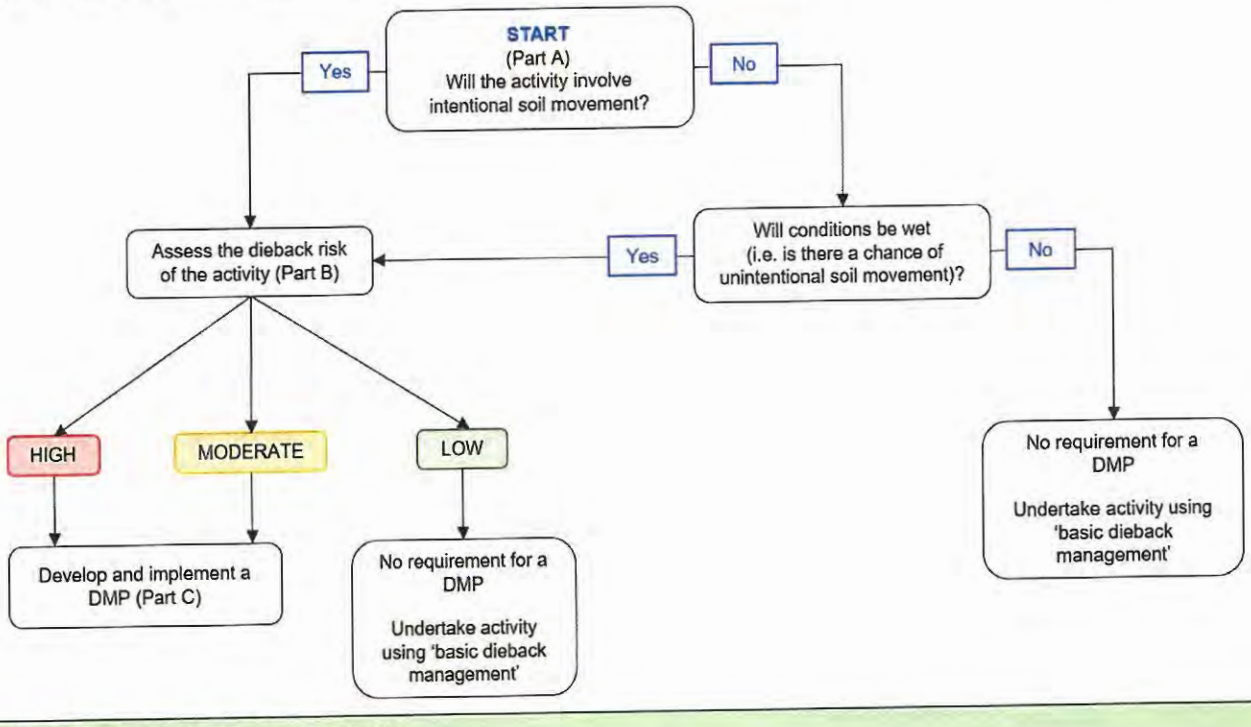
GLEVAN CONSULTING

Appendix 2 Phytophthora Dieback Risk Assessment and Management Plan Form

Department of Biodiversity, Conservation and Attractions	PHYTOPHTHORA DIEBACK RISK ASSESSMENT & MANAGEMENT PLAN FORM	FEM079

PART A: DISTURBANCE ACTIVITY

The decision tree below will help determine if the activity constitutes a disturbance and requires a risk assessment (Part B), and the risk assessment will determine if a DMP is required (Part C).



Details of disturbance activity

Region/District of activity:	Darling Range, Perth Hills	**Date of activity:** *(give date range if a prolonged activity)*	Late Q3 2021 to Late Q3 2022
Location of site of activity: *(Forest Block, Reserve or coordinates)*	Julimar State Forest	**Disease Risk Area:** *(yes or no)*	No
Vegetation type/complex:	*Eucalyptus marginata* and *Corymbia calophylla* woodlands.		
Description of the activity: *(timber harvesting, road upgrade etc.)*	Diamond drilling using small track-mounted drill rigs on a total of 72 drill sites.		
Proponent of the activity: *(DBCA, FPC, MRWA, Water Corp. etc.)*	Chalice Mining Limited (Chalice)		
Departmental objective for dieback management:	To minimise the potential for the introduction or spread of dieback associated with planned disturbance activities.		

Indicate what parts of the form have been completed for the activity described above:

Part	Purpose	Requirement	Tick parts completed
B	Risk Assessment	To be completed if decision tree in Part A indicates that intentional or unintentional soil movement will occur during the activity.	✓
C	DMP	To be completed if risk is assessed in Part B to be 'High' or 'Moderate'	✓
		Dieback Management Plan No. *Allocated by District*	

PART B: RISK ASSESSMENT

Step 1: MOISTURE conditions

Higher moisture during a disturbance activity increases the likelihood that soil will stick to a carrier (e.g. vehicles, equipment and/or footwear). Tick the box adjacent to the moisture conditions that are forecast for the period of the activity. If the activity will continue for an extended period, planning should consider the highest possible risk (wettest) conditions that may occur. If the activity is planned for dry conditions but the conditions change to become wetter prior to or during the activity, a contingency plan is required.

Dry soil	where dust forms when exposed soil is disturbed	
Moist soil	where soil is damp but does not stick to tyres, equipment and/or footwear	
Wet soil	where soil and moisture combine so that soil sticks to tyres, equipment and/or footwear	✓

Step 2: Determine the LIKELIHOOD of introducing or spreading dieback

Circle the description in each column that best describes the activity. An activity may fit between descriptions, in which case write a description into the appropriate blank cell.

The overall likelihood rating is determined by the criteria with the highest rating.

Disturbance type (e.g. action)	Introduction of raw material	Access	Complexity of activity	Extent of activity	Duration of activity	Drainage	Unmanaged access	Likelihood rating
Heavy earth moving, tracked vehicles	Infested or unknown raw material	Access crosses water (irrespective of frequency)			Activity area disturbed & map expired so impossible to revalidate boundaries		Increased public access in area of high public use	**Very likely**
Soil disturbance over a distance		Activity requires frequent access to site	Highly complex	Vehicle traverses several mini-catchments	Activity extends over several wet seasons	Surface water increased		**Likely**
Soil disturbance at single points	Crushed rock with no organic fraction		Complex		Activity occurs during a single wet season		Increased public access, but access restricted and/or site remote	**Possible**
Rubber tyred vehicle, bicycle	'High confidence' uninfested raw material	Activity requires infrequent access to site		Single mini-catchment	Entry in short timeframe under dry conditions	Minimal increase in surface water		**Unlikely**
Human, animal traffic			Not complex	Point or human traffic	Single entry in short timeframe under dry conditions		Activity does not alter frequency of access to site	**Very unlikely**

Step 3: Determine the CONSEQUENCE of introducing or spreading dieback

Determine the potential CONSEQUENCE that introducing or spreading dieback may cause by going through the table below systematically and circling the description in each column that best estimates the consequence.

The overall consequence rating is determined by the criteria with the highest rating.

Area put at risk	Predicted impact	Biodiversity and sensitive areas at risk	Consequence rating
Ongoing potential[1] to completely infest all protectable areas in activity landscape unit[2]	Predicted **very high** impact: (majority of species at the activity area are susceptible and/or introducing dieback will result in extinction of species or populations) **or** Wet areas which contain any *Banksia* species or jarrah	>1 threatened/priority plant or animal species, critical habitat, TEC and/or Ramsar wetlands that is susceptible to dieback **and/or** Old-growth jarrah forest	**Severe**
Potential to infest all protectable areas in activity landscape unit[1]	Predicted **high** impact: (many susceptible species and/or introducing the pathogen will result in loss of populations or localised extinction of species) **or** Where predicted impact cannot be determined, jarrah forest on upland areas	At least one threatened/priority plant or animal species, critical habitat, TEC and/or Ramsar wetlands that is susceptible to dieback **and/or** Sensitive neighbouring property	**Significant**
Potential to infest more than 5% of any protectable area or 4 ha's (whichever is greater – assessor may set a lower minimum protectable area where appropriate)	Predicted **moderate** impact: (moderate numbers of susceptible species and/or introducing the pathogen will result in a reduction in species/populations)		**Intermediate**
	Predicted **low** impact (low numbers of susceptible species)	Fauna Habitat Zones	**Minor**
No protectable areas estimated within any related landscape unit **and/or** The area is already infested[3]	No susceptible species and/or the activity area is in the 'excluded' category. **or** Introducing dieback will have no impact discernible outside natural variation[3]	No threatened/priority plant or animal species; critical habitat; TEC; and/or Ramsar wetlands that are susceptible to dieback. **or** As the activity area is already infested there will be no increased risk to threatened species and communities present[3]	**Insignificant**

[1] Ongoing potential for an area to become infested occurs when the disturbance activity involves construction of permanent infrastructure e.g. roads or camp sites especially high in the landscape

[2] Landscape unit is an area bounded by features such as creeks, ridges, saddles, open roads and/or freehold land

[3] Provide a map showing evidence that area is infested and attach to the risk assessment

Step 4: Determine the overall dieback RISK rating

a) Refer to the table below that corresponds to the soil MOISTURE conditions (Step 1)

b) Circle where the LIKELIHOOD rating (Step 2) intersects the CONSEQUENCE rating (Step 3)

This is the overall dieback RISK rating for the activity.

DRY SOIL

LIKELIHOOD	Disturbance examples	CONSEQUENCE				
		Insignificant	Minor	Intermediate	Significant	Severe
Very likely	tracked machines ripping, pushing soil	Low	Moderate	High	High	High
Likely	snigging/light surface skim over distance	Low	Moderate	Moderate	High	High
Possible	installing posts, exploration drilling	Low	Low	Moderate	Moderate	High
Unlikely	driving with rubber tyres	Low	Low	Low	Moderate	Moderate
Very unlikely	walking	Low	Low	Low	Low	Low

MOIST SOIL

LIKELIHOOD	Disturbance examples	CONSEQUENCE				
		Insignificant	Minor	Intermediate	Significant	Severe
Very likely	tracked machines ripping, pushing soil	Low	High	High	High	High
Likely	snigging/light surface skim over distance	Low	Moderate	High	High	High
Possible	installing posts, exploration drilling	Low	Moderate	Moderate	High	High
Unlikely	driving with rubber tyres	Low	Low	Low	Moderate	High
Very unlikely	walking	Low	Low	Low	Moderate	Moderate

WET SOIL

LIKELIHOOD	Disturbance examples	CONSEQUENCE				
		Insignificant	Minor	Intermediate	Significant	Severe
Very likely	tracked machines ripping, pushing soil	Low	High	High	High	High
Likely	snigging/light surface skim over distance	Low	High	High	High	High
Possible	installing posts, exploration drilling	Low	Moderate	High	High	High
Unlikely	driving with rubber tyres	Low	Moderate	Moderate	High	High
Very unlikely	walking	Low	Low	Low	Moderate	Moderate

Step 5: Can the RISK be reduced by altering the activity or conditions?

If the risk rating is 'High' consideration should be given to:

- Cancelling the activity which avoids the risk; or
- Postponing the activity until conditions are dry for activities scheduled during moist or wet conditions.

If cancelling or postponing is not possible the activity should be re-assessed to determine if the risk can be reduced by altering some of the parameters of the activity. For example, tyred machinery generally causes less soil disturbance and are easier to clean, compared to tracked machines which cause more damage and pick up soil in the cleats which is hard to remove. Refer to the appendices for further guidance on reducing risk associated with an activity.

Step 6: Determine requirements based on RISK rating

Tick the box adjacent to the RISK rating of the activity as determined by the risk table.

High	• Complete Part C based on valid comprehensive dieback interpretation with Regional Manager (or delegate) approval before implementation, and sign-off after close-out • Green Card training[1] for all proponents and contractors involved in activity	✓
Moderate	• Complete Part C based on valid comprehensive dieback interpretation OR conditional dieback occurrence information with Regional Manager (or delegate) approval before implementation, and sign-off after close-out • Green Card training[1] for proponent and contractors involved in activity	
Low	• Part C not required. Activity can proceed using basic dieback management • Green Card training[1] for all proponents and contractors involved in activity	

[1] Green Card training is mandatory for nominated departmental staff

Step 7: Risk Assessment sign-off

	Full Name	Position	Signature	Date
Risk Assessment conducted by:	Melissa Hobson	Environmental Specialist		12/11/2021
Risk Assessment checked by: *(Regional Manager or delegate)*				

Additional comments or conditions:

PART C: DIEBACK MANAGEMENT PLAN

Dieback Management Plan No. *Allocated by District*	

Step 1: Dieback occurrence information & map *(supervising officer/proponent)*

Valid comprehensive occurrence information		or	Conditional occurrence information	
Interpreter report/map no. and/or name	Glevan Consulting (2021). Julimar Exploration project. Phytophthora Dieback Occurrence Assessment. Prepared for Chalice Mining Limited. August 2021. Perth; Western Australia.		Source	

Step 2: DMP meeting *(supervising officer/proponent)*

Date:		Convened by:	
Attended by:			

Step 3: Risk management tactics *(supervising officer/proponent)*

Tactic no.	TACTICS TO BE DEPLOYED *Refer to the Appendices in the Phytophthora Dieback Management Manual for guidance*	To be implemented (✓= required)	Implemented (initialled when complete)	Checked (initialled when checked)
MOISTURE CONDITIONS				
1	Moisture conditions as per Part B/Step1 dry ☐ moist ☐ Wet ✓			
2	Contingency in event that conditions become wetter than those planned for before or during the activity:			
	• postpone/cease activity	X		
	• fall back to low risk area (e.g. infested area)	X		
	• risk reassessed and new DMP developed based on wetter conditions	X		
PROTECTABLE AREAS *(and other management boundaries)*				
3	Protectable area (and management unit boundaries within them) have been established in the field and are identified as P ☐ to P ☐ on the attached dieback management map See Section 6.2 and Figure 8 of the Dieback Management Plan	✓		
4	Management boundaries (unrelated to Protectable Areas) have been established in the field and identified on the management map e.g. mini-catchments, impact etc.	✓		
HYGIENE				
5	Clean on Entry (COE) points and No Soil Movement (NSM) roads identified on map and signs installed in-field (record COE numbers in appropriate boxes):	✓		

Tactic no.	TACTICS TO BE DEPLOYED *Refer to the Appendices in the Phytophthora Dieback Management Manual for guidance*	To be implemented (✓= required)	Implemented (initialled when complete)	Checked (initialled when checked)
	0 COE road access; 26 COE entering vegetation / protectable areas 0 COE NSM			
6	26 COE gates installed and indicated on map against COE no. See Figure 8 of Dieback Management Plan	✓		
7	NA turnarounds for COE points, numbered and marked on map All COE points are located on existing access tracks.	X		
8	COE points NA will be closed to Type NA when the operation is to cease for NA weeks, and on completion of all NA activities all temporary COE will be closed to Type NA by the proponent Drilling activities will not take place during wet soil conditions in the northern uninterpretable area with the exception of movement of light vehicles and personnel for demobilization and security purposes.	✓		
9	Cleandown points established in field and indicated on map How is effluent to be managed for wet cleandown? Drains to an enclosed sump.	✓		
10	Machines and vehicles with portable hygiene kits	✓		
11	Records kept (circle relevant): (COE) (clean down) NSM	✓		
12	Management points (if applicable) numbered on map. Provide detail below on the decision or action that must be taken at each management point: M1: M2: Provided in Table 6 of Dieback Management Plan	✓		
TRAINING AND COMMUNICATION				
13	Staff/contractors with Green Card training	✓		
14	DMP briefings (circle relevant) (at commencement) weekly daily (other) - raised at regular toolboxes	✓		
DISTURBANCE				
15	Machinery type(s): Drill Rigs and Support Vehicles — Machine Nos: TBC	✓		
RAW MATERIALS				
16	Type: Not Applicable — Supplier/Source: Not Applicable	X		
17	Status (attach evidence):	X		
ACCESS				

Tactic no.	TACTICS TO BE DEPLOYED *Refer to the Appendices in the Phytophthora Dieback Management Manual for guidance*			To be implemented (✓= required)	Implemented (initialled when complete)	Checked (initialled when checked)
18	Disease Risk Area permit obtained if required (attach copy) - Not required			X		
19	Access route planned to place least amount of protectable area downslope at risk, and shown on map			X		
20	Road maintenance uses tactics to mitigate harm to protectable areas:	use interpreted boundaries		X		
21		push soil downslope only		X		
22		clean bucket, shovel, auger after digging culverts/holes		X		
23		use uninfested/low risk material to patch road		X		
24	TBC roads to be closed, each road closure is numbered and marked on map			✓		
25	Each road closure has been constructed to effectively control access			✓		
26	Roads effectively closed/rehabilitated within 6 months weeks of end of activity			✓		
27	Road construction uses tactics to mitigate harm to protectable areas:	located in infested/unprotectable categories when possible		X		
28		low in profile		X		
29		high crown for better drainage		X		
30		deep roadside drains & coarse material to minimise erosion		X		
31		mitre/offshoot drain preferentially located towards base of the slope		X		
32	'Green bridge' implemented (mark on map)			X		
33	Activity to be undertaken using split-phase (provide detail):			X		
DURATION						
34	Duration of activity >1 year, engage Interpreter to recheck the boundaries			✓		
EXTENT						
35	Divide area into management units for work in dry, moist or wet (circle relevant)					
36	Select factors to be used to split dry, moist and wet soil management units	1	Protectability	X		
37		2	Presence of biodiversity values	X		
38		3	Predicted impact	X		
39		4	Potential for spread	X		
40		5	Machine/vehicle floatation	X		
41		6	Access prone to bogging	X		
42		7	Ability to control unmanaged access	X		
43		8	Distance from roads	X		
44	Operate to mini-catchments			X		
DRAINAGE						
45	Drainage directed away from protectable areas, and drainage points numbered and marked on map			X		
46	Imported water	Source:		No water released to the environment		
47		Disinfectant type and dosage:		X		

Tactic no.	TACTICS TO BE DEPLOYED *Refer to the Appendices in the Phytophthora Dieback Management Manual for guidance*	To be implemented (✓= required)	Implemented (initialled when complete)	Checked (initialled when checked)
WEEDS				
48	In areas infested with Declared/Prohibited or very high to moderate priority weeds, which are marked [ ] on the map, the proponent (circle appropriate): a) will not enter area b) will clean down machinery when leaving area	X		
ADDITIONAL CONDITIONS				
	Chalice will comply with the Dieback Management Plan	✓		

Step 4: Dieback management map checklist *(supervising officer/proponent)*

Tactics decided on above should be clearly marked on the map using the symbols in brackets. Each point will have a unique no. (e.g. COE1; COE2; X1) and the total number recorded below (e.g. total 2 COE points; 1 road closure)
Note: staff and contractors in the field must be briefed and supplied with a management map

DMP No. recorded on management map ☐	Road drainage points (D): No. ☐
Protectable areas and/or management units ☐	Roads/areas with 'No Soil Movement' (NSM): No. ☐
'Clean on Entry' points (COE): No. ☐	Road closures (X): No. ☐
COE with gates (COE with gates): No. ☐	Turnarounds and roads for rehab. (map legend)
Management points (M): No. ☐	Access route (map legend)
Clean down locations (W): No. ☐	See Figure 5 of Dieback Management Plan

Step 5: Proponent sign-off *(external i.e. non-DBCA proponent)*

I, the undersigned, agree to implement the above DMP:

Soolim Carney	General Manager Environment and Community	Chalice Mining		12/11/2021
Full Name	**Position**	**Agency/Organisation**	**Signature**	**Date**

Step 6: DMP approval *(Regional Manager or delegate)*

I, the undersigned, have reviewed the Risk Assessment and approved the DMP:

Full Name	**Position**	**Signature**	**Date**
Comment *(if required)*			

Step 7: DMP close-out *(supervising officer/proponent)*

All tactics identified in the DMP were implemented as approved? Yes ☐ No ☐

Full Name	**Position**	**Signature**	**Date**
Comment *(if required)*			

Step 8: DMP sign-off *(Regional Manager or delegate)*

I, the undersigned, am satisfied that the DMP has been implemented and closed-out as approved:

Full Name	**Position**	**Signature**	**Date**
Comment *(if required)*			

Step 9: Document management checklist

Records ticked below are filed in the following location:	

	Dieback occurrence information (Interpretation report and map) have been uploaded to DAS or forwarded to Forest Management Branch at femweb@dbca.wa.gov.au
	Dieback Management Map
	Dieback Risk Assessment and Management Plan form (Parts A, B and C)
	COE and clean down records
	Disease Risk Area permit

Appendix 2 Public Access and Traffic Management Plan

Julimar State Forest – Public Access and Traffic Management Plan

Chalice Mining Limited

1. Purpose

This Public Access and Traffic Management Plan applies to exploration activities undertaken by Chalice Mining Limited (Chalice), including contractors, in the Julimar State Forest (JSF) within tenement E70/5119 for the Hartog-Baudin low-impact exploration drilling program.

The Plan sets out the requirements for vehicle and pedestrian movements within the JSF to maintain a safe working environment and public access to the State Forest.

2. Scope

The exploration drilling program comprises 71 drill sites and associated access routes as outlined on Figure 1. It is anticipated that works will commence in late Quarter 4 2021 (subject to gaining approvals) and will last for six to twelve months. Drilling activities will be undertaken 24 hours a day, 7 days a week.

All activities will be undertaken to minimise impacts on members of the public utilising the Julimar State Forest. This Plan will apply to all drill sites that are located on existing access tracks within the JSF.

Level 2, 1292 Hay Street
West Perth, Western Australia
GPO Box 2890, Perth WA 6001
T: +61 8 9322 3960
F: +61 8 9322 5800
info@chalicemining.com
www.chalicemining.com
@chalicemining
chalice-mining

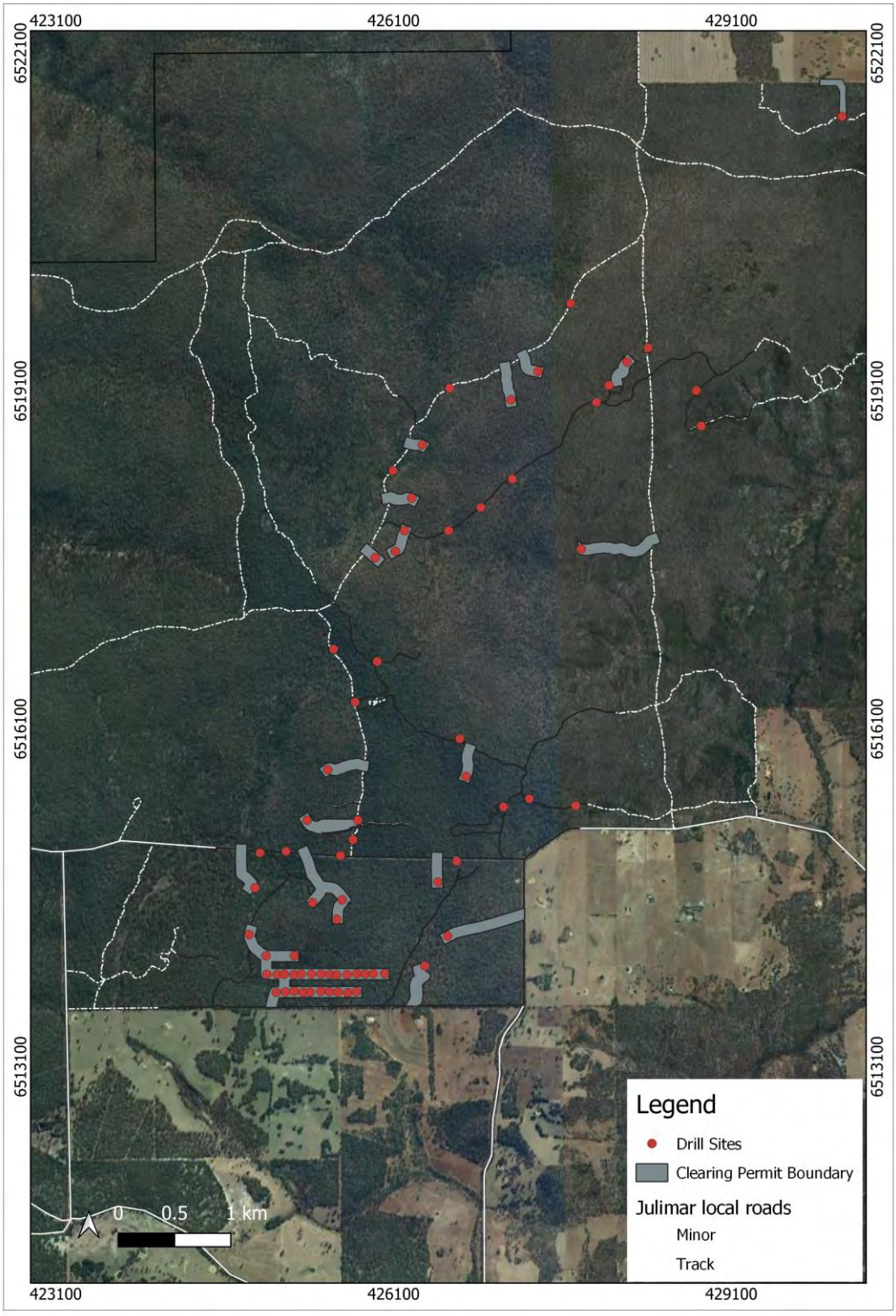


Figure 1: Proposed Drill Program and Access Routes

3. Requirements

Table 1 outlines the traffic management requirements that will be adhered to when working in the State Forest. Main access tracks (including Ferguson, Mortimer and Heine roads) are those tracks that are of sufficient width to allow vehicles to safely pass whilst the drill rig is operating.

Minor access tracks are narrow tracks that may need to be temporarily closed for a period of time to allow drilling activities to be undertaken. Figure 2 outlines the major and minor access tracks within the exploration program area and the potential location of barricades to temporarily close-off access to minor tracks.

Pedestrian access to all tracks will be safely maintained. If pedestrians utilise access tracks that are being used for drilling activities, Chalice and contractor personnel will assist in escorting pedestrians safely around the drill rig and support vehicles.

All tracks within the JSF are non-gazetted. This means that the care, control and management of the road including restricting access does not lie with the government and notification to local government is not required.

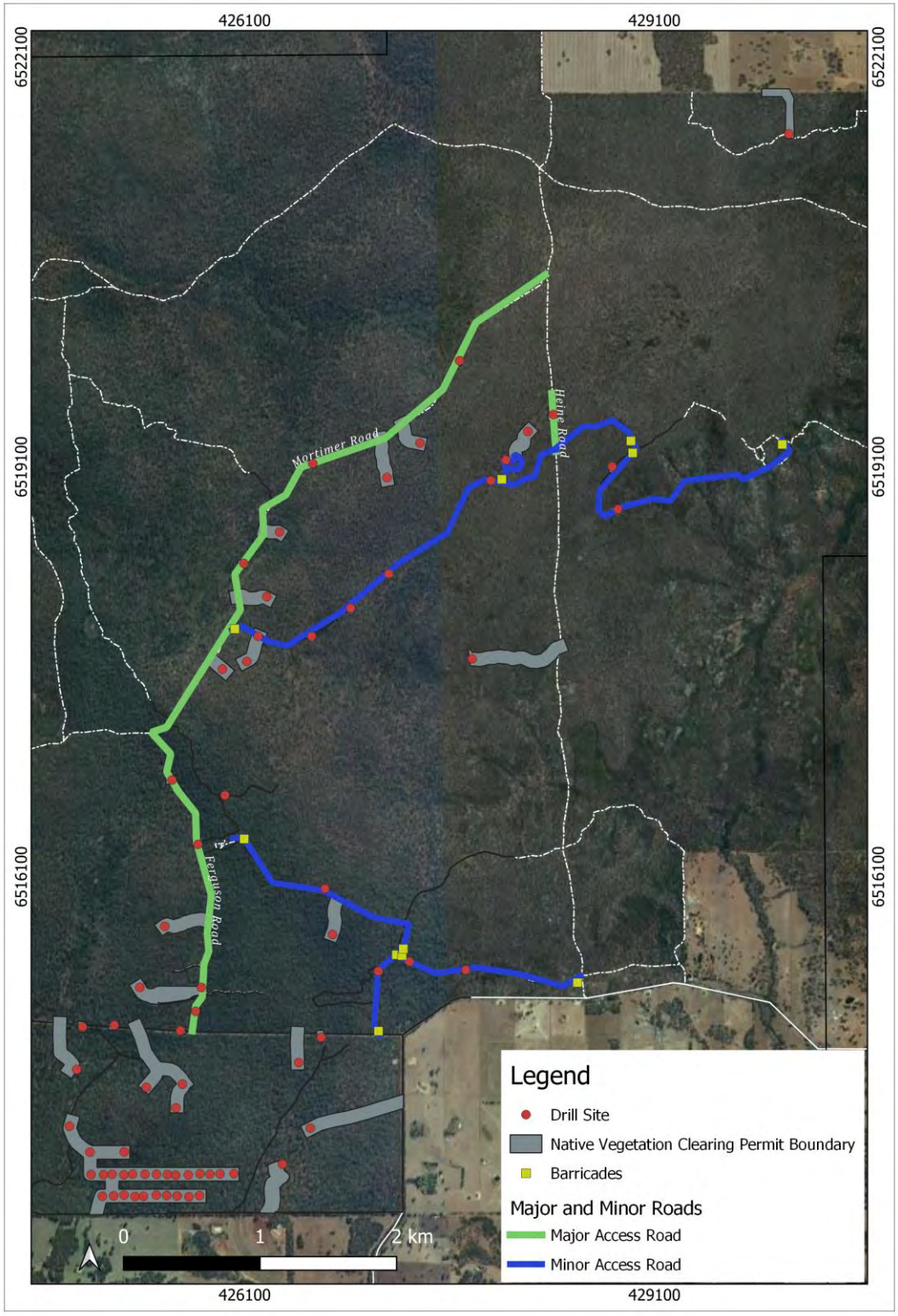


Figure 2: Major and Minor Access Roads

Table 1: Traffic Management Requirements

Aspect	Requirement
General	« Signage will be placed on relevant tracks to advise motorists that drilling activities are occurring when entering from major access roads (i.e. Julimar Road and Keating Road) into the JSF. « Trucks entering or trucks crossing signs on Julimar Road to warn of potential for exploration vehicles to be exiting from either tracks in the State Forest (i.e. Ferguson Road) or temporary access routes. « All drill sites will have warning signage at the following intervals in each direction: « 200 metres – warning of the traffic hazard ahead. « 100 metres – reduction in speed to 10 km/hr. « When entering drill rig exclusion zone (within 20 m of drill rig) – reminder about reduction in speed to 10 km/hr. « Example signage is shown on Figure 3. « Where possible, drill sites have been located to minimise the amount of track that will be blocked. « All Chalice and contractor vehicles will drive to site conditions and in accordance with Western Australian road rules.
Major Access Tracks	« The drill rigs and support vehicles will be configured to safely allow other vehicles to pass. An example of this set up is shown in Figure 4. Drill rigs and support vehicles will be configured at each location depending on site conditions to minimise any risk to the public. « All drill rigs will be orientated with the drilling end of the rig facing away from the access road to reduce the risk to the drilling personnel and members of the public as outlined on Figure 4. « All drill rig support vehicles will be orientated to reduce the risk to the drilling personnel and members of the public. « The drill rig may need to be placed partially off the track to allow sufficient room for other vehicles to safely pass. This is expected to result in less impact to vegetation than creating a separate passing lane. « Sites will be set up to allow a clear line of sight for incoming vehicles and to clearly demarcate the route the public vehicle should use. « Cones or barricading will be utilised to clearly demarcate the drilling work area and drilling personnel are to ensure they do not step outside the drilling working area without checking for traffic hazards. « At night, it is anticipated that lighting required to safely operate the rig will provide an additional control.
Minor Access Tracks	« Narrow minor access tracks will be temporarily closed for a period of time, whilst drilling is underway at that site. « Signage will be installed that notifies road users that the road is closed. « Access will be closed using a soft barricade at the nearest junctions to ensure vehicles do not travel down the track as outlined on Figure 2. « In the event the track users utilise the closed track, signage will be installed signalling that a traffic hazard is ahead and reduction in speed limit is required.
Pedestrians	« Pedestrian access to all tracks will be safely maintained. « In the event that pedestrians utilise access tracks that are being used for drilling activities, Chalice and contractor personnel will assist in escorting the pedestrians safely around the drill rig and support vehicles.

Figure 3: Examples of Signage

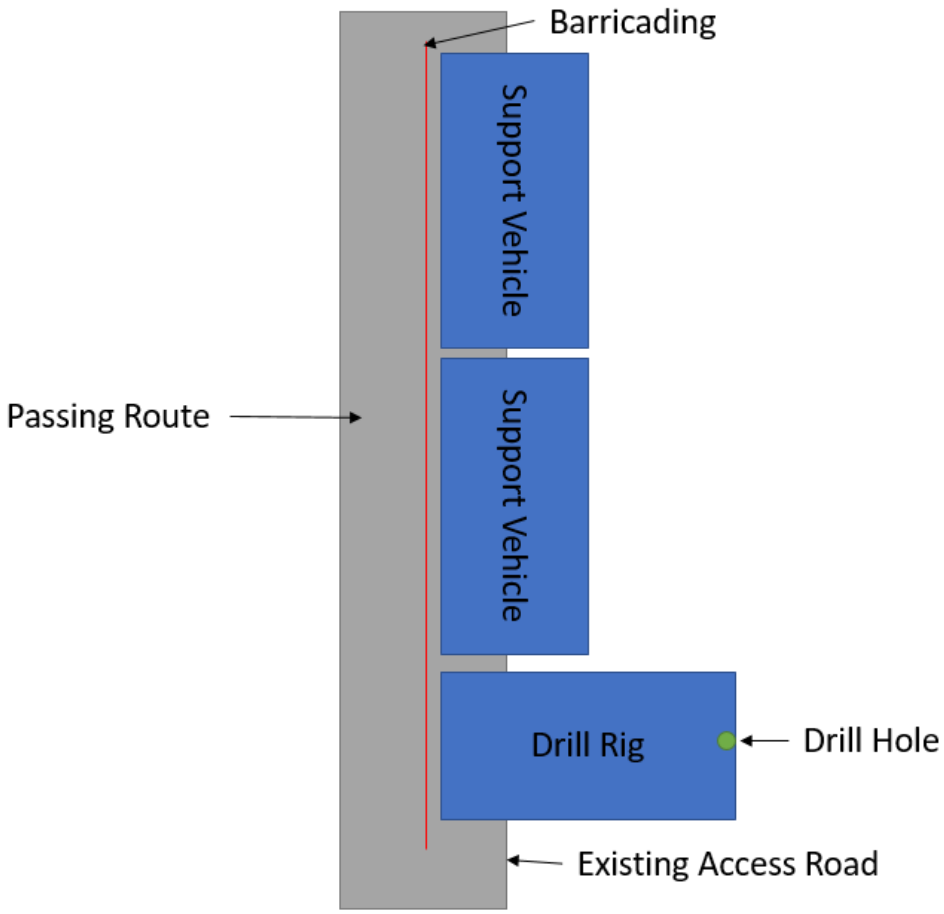


Figure 4: Example of Drill Site Configuration

4. Access Considerations

Chalice will monitor for any proposed public events (such as the Camino Salvador Pilgrim walk trail) in the Julimar State Forest and adapt works accordingly to minimise impacts to the public.

Chalice will liaise with DBCA as the program is undertaken for the following access considerations:

- Western Shield fauna monitoring programs - Chalice will schedule activities to ensure all drilling occurs a minimum distance of four kilometres from fauna monitoring sites seven days prior to monitoring commencing and throughout the monitoring period (currently scheduled for 20 to 24 June 2022) upon notification from DBCA on monitoring locations and timing of monitoring program.
- Western Shield baiting program which involves aerial (quarterly) and manual baiting (every 6 weeks) – Chalice personnel will be made aware of the baiting program, including avoidance of contact with baits as required, during site inductions.

« DBCA prescribed burn program – Chalice will ensure all equipment and personnel are not in an area that is undergoing a prescribed burn. It is acknowledged that a prescribed burn is proposed to occur in 2022 within the JSF.

5. Reporting and Communications

All Chalice and contractor personnel will be made aware of the requirements of this Public Access and Traffic Management Plan.

5.1 External Communications

As outlined in the Conservation Management Plan – Hartog and Baudin Low Impact Exploration Drilling Program – Julimar State Forest, Chalice will provide at least five working days' notice to the Department of Biodiversity, Conservation and Attractions (DBCA) Swan Regional Manager prior to accessing the Julimar State Forest. Notification will include the provision of an itinerary and program of the locations of operations and dates when access roads will be temporarily closed.

Chalice will also inform the DBCA Swan Regional Manager of any changes to the itinerary at least five days in advance (where possible).

5.2 Incident Reporting

In the event of any non-compliance with this Plan, an incident report shall be submitted to the site supervisor and actions put in place to reduce the likelihood of the incident occurring again.

Appendix 3 Reconnaissance Flora Survey of the Hartog and Baudin Targets (Biologic 2021)

Julimar Exploration Project

Reconnaissance and Targeted Flora Survey

Biologic Environmental Survey

Report to MBS Environmental

June 2021

DOCUMENT STATUS				
Revision No.	Author	Review / Approved for Issue	Approved for Issue to	
			Name	Date
1	C. Whyte, D. Reith, K. Geelhoed	C. Winton, C. van den Bergh	T. Giltay (MBS) B. Kendall (Chalice)	11 June 2021
2	C. Whyte	C. van den Bergh	T. Giltay (MBS) B. Kendall (Chalice)	15 June 2021

EXECUTIVE SUMMARY

In support of future environmental approvals, MBS Environmental, on behalf of Chalice Mining Ltd, have commissioned Biologic Environmental Survey Pty Ltd to conduct a reconnaissance flora and vegetation survey and a targeted flora survey across priority areas within the Julimar State Forest, totalling an area of 2,021 ha.

The field survey was conducted over five days, totalling 18 person days in April and May of 2021. The field team lead, Senior Botanist Samuel Coultas, was supported by five field botanists and one Senior Ecologist. Rainfall in the three months prior to the field survey was above the long-term average for the area presenting adequate survey conditions for this level of assessment. Sixty-one relevés were sampled across the site supplemented with opportunistic flora collections and vegetation notes. Access was good and all areas of the Study Area were accessed.

Thirteen conservation significant flora identified in the database search results are annual or cryptic herbs. For these taxa the survey timing was inadequate and presence or absence at the Study Area was unable to be confirmed.

Nineteen vegetation types were identified from the field survey from four broader landforms; hills, drainage lines, valleys and wetland. They are representative of three widely represented Beard vegetation associations occurring throughout the Julimar State Forest. No significant vegetation types occur within the Study Area. No vegetation units recorded in the Study Area resemble significant vegetation communities of the Jarrah Forest bioregion. Ten vegetation types were associated with four conservation significant flora taxa from the Study Area. These vegetation types hold importance as refuge for significant flora, they are:

- *Conospermum densiflorum* subsp. *unicephalatum* (T) was associated with vegetation type V8
- *Drosera* ?*sewelliae* (P2) was associated with vegetation types H1, H2, H3, H4, V3, V4, V5 and V8
- *Beaufortia eriocephala* (P3) was associated with vegetation type H1
- *Lasiopetalum caroliae* (P3) was associated with vegetation types V1 and V2

Five vegetation types, D1, D2, D3, V2 and V7 were noted as containing dry and narrow creeklines with several flora taxa known to grow in low-lying habitat with higher soil moisture levels. It is unlikely that this vegetation is dependent upon continuous access to surface water or groundwater.

Over ninety percent of vegetation in the Study Area was in Excellent condition, with the main disturbances being prescribed burns and informal tracks throughout the area. Three introduced weed species were recorded, but none of these were present in high enough numbers to warrant a change in condition. No Declared Pests, Weeds of National Significance or Priority Alert weeds were found.

TABLE OF CONTENTS

EXECUTIVE SUMMARY III

1 INTRODUCTION 1

1.1 PROJECT BACKGROUND 1
1.2 OBJECTIVE AND SCOPE OF WORKS 1
1.3 BACKGROUND TO PROTECTION OF FLORA 3
1.4 COMPLIANCE 4

2 ENVIRONMENT 5

2.1 BIOGEOGRAPHICAL REGIONALISATION OF AUSTRALIA 5
2.2 CLIMATE 5
2.3 GEOLOGY 6
2.4 SOILS 9
2.5 SOIL-LANDSCAPE MAPPING 9
2.6 HYDROLOGY 12
2.7 FLORA AND VEGETATION 14
2.7.1 Vegetation Associations 14
2.7.2 Vegetation Complexes 15
2.7.3 Bioregional Significance 17
2.7.4 Introduced Taxa 17
Weeds of National Significance 17
Declared Plant Pests 17
Weed Prioritisation 18

3 METHODOLOGY 19

3.1 DESKTOP ASSESSMENT 19
3.1.1 Literature Review 19
3.1.2 Database Searches 20
3.1.3 Likelihood Ranking 20
3.2 FIELD SURVEY 21
3.2.1 Survey Type, Timing and Weather 21
3.2.2 Survey Team and Licensing 22
3.2.3 Flora and Vegetation Survey Design 22
Floristic Sample Sites 22
Targeted Searching 23
3.2.4 Identification of Flora Specimens 26
3.2.5 Vegetation Type and Condition Mapping 26
3.2.6 Potential Limitations and Constraints 26

4 RESULTS AND DISCUSSION 29

4.1 DESKTOP ASSESSMENT 29

4.1.1 Flora of Conservation Significance 29

4.1.2 Vegetation of Conservation Significance 32

4.1.3 Introduced flora 35

Weeds of National Significance 35

Declared Pests 35

Priority Alert Weeds 35

4.2 FIELD SURVEY RESULTS 35

4.2.1 Flora Composition 35

4.2.2 Flora of Conservation Significance 36

Drosera sewelliae (P2) 36

Beaufortia eriocephala (P3) 37

Conospermum densiflorum subsp. unicephalum (T) 38

Lasiopetalum caroliae (P3) 38

4.2.3 Review of Likelihood of Occurrence 39

4.2.4 Flora of "Other" Significance 41

4.2.5 Introduced Flora Taxa 44

4.2.6 Vegetation Types 46

Broad Landforms 46

Vegetation Types 46

4.2.7 Vegetation of Conservation Significance 56

TEC's & PEC's Within the Study Area 56

TEC's & PEC's in the Vicinity of the Study Area 56

4.2.8 Vegetation of "Other" Significance 56

Vegetation in proximity to groundwater and surface water 57

Local and Regional Significance 57

4.2.9 Vegetation Condition 58

5 CONCLUSION 60

6 REFERENCES 61

7 APPENDICES 65

LIST OF FIGURES

Figure 1.1: Study Area and regional location 2

Figure 2.1: Climate data for Northam and Julimar 6

Figure 2.2: Broad geology of the Study Area 8

Figure 2.3: Soils of the Study Area 11
Figure 2.4: Hydrology of the Study Area 13
Figure 2.5: Vegetation complexes of the Study Area 16
Figure 3.1: Comparative rainfall data for Julimar State Forest 22
Figure 3.2: Flora sample sites and traverses 25
Figure 4.1: Conservation significant flora database search results 31
Figure 4.2: Threatened & Priority Communities database search results 34
Figure 4.3: Flora of conservation significance recorded in the Study Area 43
Figure 4.4: Introduced flora recorded in the Study Area 45
Figure 4.5: Vegetation types in the Study Area 55
Figure 4.6: Vegetation condition in the Study Area 59

LIST OF PLATES

Plate 4.1: *Drosera ?sewelliae* (P2) 37
Plate 4.2: *Beaufortia eriocephala* (P3) 37
Plate 4.3: *Conospermum densiflorum* subsp. *densiflorum* (T) 38
Plate 4.4: *Lasiopetalum caroliae* (P3) 39

LIST OF TABLES

Table 1.1 Conservation significance assessment guidelines 3
Table 2.1: Regolith geology at the Study Area (1:500,000) (GSWA, 2020) 7
Table 2.2: WA soil groups within the Survey Area 9
Table 2.3: Soil-landscape mapping within the Survey Area 10
Table 2.4: Regional and local extent of vegetation system associations 14
Table 2.5: Vegetation complexes occurring within the Study Area 15
Table 3.1: Literature review relevant to the Study Area. 19
Table 3.2: Details of database searches conducted. 20
Table 3.3: Flora likelihood decision matrix 21
Table 3.4: Field survey personnel 22
Table 3.5: Potential limitations and constraints 27

Table 4.1: Conservation significant flora of the desktop assessment 29

Table 4.2: TEC & PEC desktop results 32

Table 4.3: Review of likelihood of occurrence post-survey 39

Table 4.4: Flora of "other" significance recorded from the Study Area 41

Table 4.5: Vegetation type and extent recorded from the Study Area. 48

Table 4.6: Vegetation condition extent in the Study Area 58

APPENDICES

Appendix A: State and Federal Conservation Codes 66

Appendix B: Vegetation Structural Formation Terminology 74

Appendix C: Vegetation Condition Rating Scale 79

Appendix D: Literature Review Key Findings 81

Appendix E: Database Search Results 86

Appendix F: Conservation Significant Flora Likelihood of Occurrence 111

Appendix G: Introduced Flora Database Search Results 114

Appendix H: Flora Composition 119

Appendix I: Coordinates for threatened and priority flora recorded in the Study Area 124

Appendix J: Sample Site Data 127

1 INTRODUCTION

1.1 Project Background

In support of future environmental approvals, MBS Environmental (MBS), on behalf of Chalice Mining Ltd (Chalice), commissioned Biologic Environmental Survey Pty Ltd (Biologic) to conduct a reconnaissance flora and vegetation survey and a targeted flora survey across priority areas within the Julimar State Forest and Chalice exploration tenement areas. Two polygon areas comprising a total of 2021 ha were selected for this survey and will be referred to collectively throughout as the "Study Area". The two polygons comprising the Study Area are JSF priority areas 1 and 2 (Hartog) and a 50 ha portion of JSF priority area 3 (Baudin). The Study Area is located approximately 70 kilometres (km) northeast of Perth in the Shire of Toodyay (Figure 1.1).

1.2 Objective and Scope of Works

The overall objective of the reconnaissance and targeted flora and vegetation survey was to identify any significant flora and vegetation values within the Study Area. This was achieved through the following scope of works:

- Undertaking a comprehensive desktop assessment to gather contextual information on the survey area and immediate surrounds; including the review of previous biological surveys and government and non-government databases;
- Undertaking a field assessment to determine the condition of the vegetation;
- Undertaking a field assessment to describe and delineate the vegetation types present;
- For species still detectable and identifiable (i.e., perennials) undertaking targeted searches via meandering traverses;
- Completing an assessment to determine the presence of conservation significant vegetation types/ communities; and
- Preparing and submitting a flora and vegetation report.

420000 425000 430000 435000

6525000 6520000 6515000 6510000

Perth

Julimar State Forest

Dewars Pool - Bindoon Rd

Munyerring Spring Rd

Timberden Dr

Nerramine Dr

Julimar Rd

Beach Rd

Plunkett Rd

Parkland Dr

Davis Rd

Chittering Valley Rd

Keating Rd

Keating Rd

Moondyne Nature Reserve

Avon Valley National Park

Cobbler Pool Rd

Legend

Study Area

Local Road

IBRA Region

Jarrah Forest

Swan Coastal Plain

IBRA Subregion

Dandaragan Plateau

Northern Jarrah Forest

Perth

DBCA Managed Land

National Park

Nature Reserve

Section 5(1)(g) Reserve

State Forest

0 1 2 3 Km

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 11/06/2021

N

Scale: 1:70,000

BOLGART
GINGIN
BINDOON
BEJOORDING
WEST TOODYAY
MUCHEA
TOODYAY

MBS ENVIRONMENTAL

Julimar Exploration Project Reconnaissance and Targeted Flora Survey

Figure 1.1: Study Area and regional location

1.3 Background to Protection of Flora

Within Western Australia, all native flora is protected under the *Biodiversity Conservation Act 2016* (BC Act) and any action that has the potential to impact on native flora needs to be approved by relevant State and/ or Federal departments as dictated by the Western Australian *Environmental Protection Act 1986* (EP Act) and the Federal *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Flora taxa that are determined to be at risk of extinction or in decline are afforded extra protection under these Acts. For the purposes of this report, these are called conservation significant flora taxa. A summary of applicable legislation and status codes is provided in (Table 1.1). Additional information on conservation status codes is provided in (Appendix A).

The EPBC Act identifies Threatened Ecological Communities (TECs) as ecological communities at risk of extinction. The BC Act provides for the statutory listing of TECs by the Minister. The WA Minister for Environment has endorsed 69 ecological communities as threatened under critically endangered (20 communities), endangered (17 communities), vulnerable (28 communities) and presumed totally destroyed (four communities).

For some flora taxa and ecological communities, there is insufficient information to determine their status. These taxa are generally considered by the Environmental Protection Authority (EPA)/ DBCA as 'conservation significant' for all development related approvals and are listed on a 'Priority List'. The Priority List is regularly reviewed and maintained by DBCA. Possible TECs that do not meet the criteria for statutory listing by the Minister for Environment are added to DBCA's 'Priority Ecological Communities' (PECs) lists under Priorities 1, 2, 3 (near threatened) or 4 (conservation dependent).

Table 1.1 Conservation significance assessment guidelines

Agreement, Act or List	Status Codes
FEDERAL	
Environment Protection and Biodiversity Conservation Act 1999 DoEE lists threatened flora, which are determined by the Threatened Species Scientific Committee (TSSC) according to criteria set out in the Act. The Act lists flora that are considered to be of conservation significance under one of eight categories (listed under 'Status Codes').	• Extinct (EX) • Extinct in the Wild (EW) • Critically Endangered (CE) • Endangered (EN) • Vulnerable (VU) • Conservation Dependent (CD)
Threatened Ecological Communities (TECs) are those that are at risk of extinction.	• Critically Endangered (CE) • Endangered (EN) • Vulnerable (VU)
STATE	
Biodiversity Conservation Act 2016 The *Biodiversity Conservation Act 2016* provides for the listing of threatened native flora and Threatened Ecological Communities that need protection as critically endangered, endangered or vulnerable species or ecological communities because they are	Species • Extinct (EX) • Extinct in the Wild (EW) • Critically Endangered (CR) • Endangered (EN) • Vulnerable (VU)

Agreement, Act or List	Status Codes
under identifiable threat of extinction (species) or collapse (ecological communities).	TECs • Presumed Totally Degraded (PD) • Critically Endangered (CR) • Endangered (EN) • Vulnerable (VU)
DBCA Priority list DBCA produces a list of Priority species and ecological communities (*e.g.* Priority Ecological Communities) that have not been assigned statutory protection under the *Biodiversity Conservation Act 2016*. This system gives a ranking from Priority 1 to Priority 4.	• Priority 1 (Poorly known species/ ecological communities) (P1) • Priority 2 (Poorly known species/ ecological communities) (P2) • Priority 3 (Poorly known species/ ecological communities) (P3) • Priority 4 (Rare, Near Threatened, and other species/ecological communities in need of monitoring) (P4)

1.4 Compliance

The survey work was undertaken in accordance with the requirements outlined in the MBS Environmental scope of works. The survey methods adopted were formulated in accordance with the following regulatory guidance:

- EPA (2018) Statement of Environmental Principles, Factors and Objectives;
- EPA (2016c) Environmental Factor Guideline: Flora and Vegetation; and
- EPA (2016b) Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment.

2 ENVIRONMENT

2.1 Biogeographical Regionalisation of Australia

The Study Area is located within the Jarrah Forest bioregion, as described by the Interim Biogeographic Regionalisation for Australia (IBRA) (Thackway & Cresswell, 1995). This bioregion is described as duricrusted plateau of the Yilgarn Craton and is characterised by jarrah (*Eucalyptus marginata*) – marri (*Corymbia calophylla*) forest on laterite gravels and, in eastern parts, by wandoo (*Eucalyptus wandoo*) – marri woodlands on clayey soils. Eluvial and alluvial deposits support *Agonis* shrublands, and in areas of Mesozoic sediments, jarrah forests occur in a mosaic with a variety of species rich shrublands.

The Jarrah Forest bioregion is classified into two subregions, Northern Jarrah Forest (JAF01) and Southern Jarrah Forest (JAF02), of which the Study Area is located within the Northern Jarrah Forest subregion. The Northern Jarrah Forest subregion is characterised by jarrah – marri forest on laterite gravels in the west, with bullich (*Eucalyptus megacarpa*) and blackbutt (*Eucalyptus patens*) in the valleys, grading to wandoo – marri woodlands on clayey soils in the east, with powder bark (*Eucalyptus accedens*) on breakaways (Williams & Mitchell, 2001). There are extensive, but localised, sand sheets with *Banksia* low woodlands, and heath is found on granite rocks and as a common understory of forests and woodlands in the north and east (Williams & Mitchell, 2001). Most of the diversity in the communities occurs on lower slopes or near granite soils where there are rapid changes in site conditions (Williams & Mitchell, 2001).

2.2 Climate

The climate of the region is classified by cool wet winters, and warm, relatively dry summers. Average annual rainfall for the Northern Jarrah Forest subregion is from 1300 millimetres (mm) on the scarp, to approximately 700 mm in the east and north. The nearby weather stations likely to accurately document the long-term average weather and climate, and rainfall, for the Study Area are the Bureau of Meteorology's (BoM) Northam and Julimar Forest weather stations (station numbers 10111 and 9268, respectively), located approximately 44 km to the southeast and 12 km to the east, respectively (BoM, 2020).

The hottest month for Northam is January (mean maximum temperature 34.2°C), while the coolest is July (mean minimum temperature 5.4°C) (length of record from 1902-2020) (BoM, 2020) (Figure 2.1). The average annual rainfall for the Study Area (recorded at the Julimar Forest weather station) is 524 mm (BoM, 2020), with average monthly rainfall peaking from late autumn to early spring (May to September). The highest average monthly rainfall occurs in July (100.6 mm), with the lowest occurring in December (15 mm) (BoM, 2020).

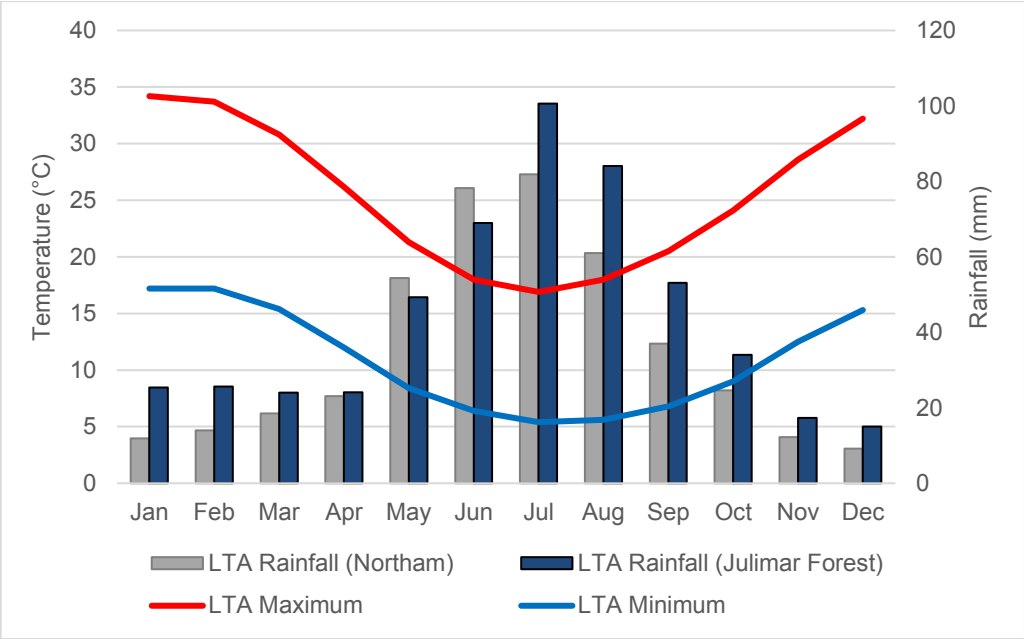


Figure 2.1: Climate data for Northam and Julimar (stations 10111 and 9268, respectively) (BoM, 2020).

2.3 Geology

The Study Area is situated within the Northern Jarrah Forest subregion, which occupies the northern portion of the Darling Plateau to the east of the Darling Scarp (Beard, 1990). It overlies Archaean granite and metamorphic rocks. The plateau is an ancient erosion surface capped by an extensive lateritic duricrust, which has been dissected by later drainage and broken by occasional granite hills (Williams & Mitchell, 2001).

Bedrock geology: Using GSWA (2016) the Study Area is mapped as A-g-Y, and A-mgss-Y (Yilgarn Craton granites). The Study Area itself sits upon igneous and metamorphic rocks making up the Southwest Terrane of the Yilgarn Craton. The target of the minerals exploration by Chalice Mining Ltd is a large interpreted mafic-ultramafic layered intrusive complex comprising nickel-copper-platinum group elements and intrusion related to vanadium-titanium mineralisation (Mattiske, 2019).

Regolith geology of the Study Area is displayed in Table 2.1 and Figure 2.2 (GSWA, 2020). Dominant regolith geology is represented by more than 91% as ferruginous duricrust large bedrock to rubbly surface substrate (Rr-f-YPP), with alluvial unit (Ac-YPP) of clay, silt, sand representing 6.3% and 2.4% as exposed bedrock.

Table 2.1: Regolith geology at the Study Area (1:500,000) (GSWA, 2020)

Regolith Number	Code	Unit Name	Description	Area (ha) / Percentage (%)
423	Ac-YPP	Alluvial/fluvial unit, YPP	Clay, silt, sand, and gravel in fluvial channels	127.1799 / 6.29
480	Rr-f-YPP	Residual or relict unit, YPP	Ferruginous duricrust, massive to rubbly; includes iron-cemented reworked products	1846.213 / 91.33
499	X-YPP	Exposed unit, YPP	Exposed bedrock	48.07731 / 2.38

420000
428000
436000
6528000
6520000
6512000
Flat Rocks Rd
Dewars Pool - Bindoon Rd
Munyerring Spring Rd
Julimar Rd
Timberden Dr
Beach Rd
Davis Rd
Chittering Valley Rd
Keating Rd
Plunkett Rd
Parkland Dr
Cobbler Pool Rd

Legend

- Study Area
- Local Road

Regolith Geology

- Aa-YPP; Alluvial/fluvial unit, YPP
- Ac-YPP; Alluvial/fluvial unit, YPP
- Aw-YPP; Alluvial/fluvial unit, YPP
- C-YPP; Colluvial unit, YPP
- Rr-f-YPP; Residual or relict unit, YPP
- Rs-l-YPP; Residual or relict unit, YPP
- X-YPP; Exposed unit, YPP

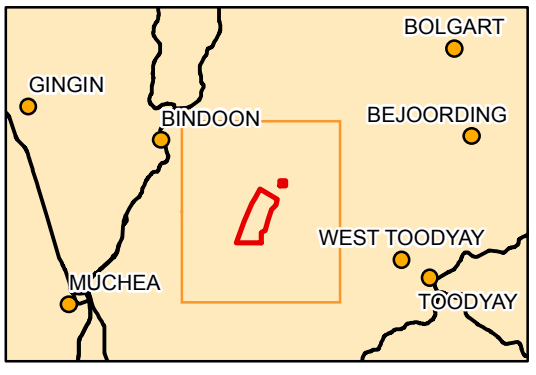
0 2 4 Km

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 01/06/2021

N

biologic Environmental Survey

Scale: 1:75,000



MBS ENVIRONMENTAL

Julimar Exploration Project Reconnaissance and Targeted Flora Survey

Figure 2.2: Broad geology of the Study Area

2.4 Soils

Broadly speaking, soils of the Northern Jarrah Forest subregion are defined as lateritic gravels consisting of up to 5 m or more of ironstone gravels in a yellow, sandy matrix. Related to these are the lateritic podzolic soils with ironstone gravels in a sandy surface horizon, overlying a mottled yellow-brown clay subsoil (Beard, 1990). The Atlas of Australian Soils places the Survey Area within one broad soil landscape unit, JZ2 (Northcote *et al.*, 1968). This unit consists of dissected plateaus having a gentle to moderately undulating relief, and with broad swampy drainage ways and basins. It is characterized by lateritic gravels and block laterite, with chief soils comprising of ironstone gravels with earthy matrices (DEC, 2004). Six different soil groups from four soil supergroups are mapped within the Survey Area, as described in Table 2.2.

On a state level, the soils of WA have been described and standardised by the Department of Agriculture and Food (DAFWA) into 13 soil supergroups and 60 different soil groups (Schoknecht & Pathan, 2013). Mapping for soil groups has been conducted on a probability basis; in other words, each polygon is assigned the soil group that has the highest probability of occurring (DPIRD, 2021d).

Table 2.2: WA soil groups within the Survey Area (DPIRD, 2021d; Schoknecht & Pathan, 2013)

Soil Supergroup	Soil Group	Description	Area (ha) / Percentage (%)
Ironstone gravelly soils	Deep sandy gravel	Ironstone gravel soil, with a predominantly sandy matrix, usually over clay, cemented gravels (ferricrete) or reticulite at >80 cm	518.94 / 25.67
	Loamy gravel	Ironstone gravel soil, with a predominantly loamy matrix, often grading to clay at >30 cm	899.49 / 44.50
	Shallow gravel	Ironstone gravel soil over cemented gravels (ferricrete), rock or other hard or permanently cemented layers at ≤80 cm	510.26 / 25.24
Loamy duplexes	Yellow/brown shallow loamy duplex	Yellow/brown loam over clay at <30 cm	61.29 / 3.03
Deep sands	Pale deep sand	Sand >80 cm deep with white, grey or pale yellow topsoil	24.65 / 1.22
Rocky or stony soils	Stony soil	Soils which are coarse gravelly, stony or rocky throughout	6.85 / 0.34

2.5 Soil-Landscape Mapping

The Study Area falls within the Western Region (2), Avon Province (25), the Eastern Darling Range Zone (253) and the Wundowie and Julimar Systems (see Table 2.3 and Figure 2.3). The WA Department of Agriculture, with support from the National Soil Conservation Program, National Landcare Program and Natural Heritage Trust conducted a 15-year mapping program which provides a soil and land resource inventory for the south-west agricultural areas of

Western Australia (Schoknecht *et al.*, 2004). Soil-landscapes are broken up into regions, provinces, zones and land systems across the state.

Table 2.3: Soil-landscape mapping within the Survey Area (based on DPIRD, 2021b; Schoknecht *et al.*, 2004)

	Description	Area (ha) / percentage (%)
Avon Province	Comprised of Precambrian granites and gneisses with past lateritic weathering. Soils may be calcareous, but red-brown hardpans are uncommon.	
Eastern Darling Range Zone	Moderately to strongly dissected lateritic plateau on granite with eastward-flowing streams in broad shallow valleys, some surficial Eocene sediments. Soils are formed in laterite colluvium or granite weathered in-situ.	
Land Systems		
Wundowie	Intact undulating lateritic terrain with minor rock outcrops in the northeastern Darling Range. “Buckshot” gravels, duricrust and some deep sands vegetated by Jarrah Forest.	1712.19 / 15.30
Julimar	Moderately dissected areas with gravelly slopes and ridges and minor rock outcrop on the eastern side of the Darling Plateau over weathered granite and granitic gneiss. Loamy gravel, shallow duplexes and pale deep sand common. Wandoo woodland.	309.27 / 84.70

420000 428000 436000

6528000 6520000 6512000

Flat Rocks Rd
Dewars Pool - Bindoon Rd
Munyerring Spring Rd
Julimar Rd
Timberden Dr
Beach Rd
Plunkett Rd
Davis Rd
Chittering Valley Rd
Keating Rd
Parkland Dr
Cobbler Pool Rd

Legend

- Study Area
- Local Road

Soil Unit

- JZ2
- Mw31
- Qb29
- Qb32
- Tf3

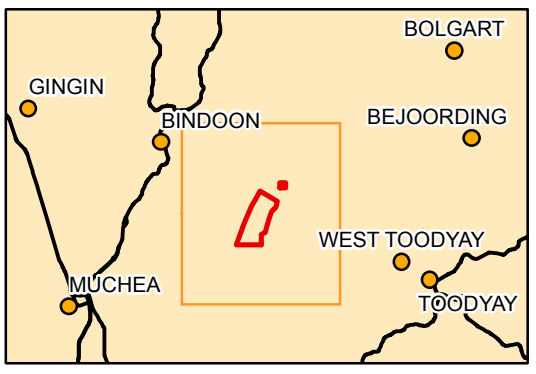
0 2 4 Km

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 01/06/2021

N

biologic Environmental Survey

Scale: 1:75,000



MBS ENVIRONMENTAL

Julimar Exploration Project Reconnaissance and Targeted Flora Survey

Figure 2.3: Soils of the Study Area

2.6 Hydrology

Rivers are the only wetlands of subregional significance in the Northern Jarrah Forest (Williams & Mitchell, 2001). The water courses of the subregion are dominated by the creation of water storage structures (dams and reservoirs) within the forested catchment primarily to provide potable water to the metropolitan area of Perth and irrigation horticulture and agriculture (Williams & Mitchell, 2001). The Study Area is located in the Brockman River subcatchment within the Swan-Avon Main-Avon Catchment of the Swan Coastal Basin (Figure 2.4).

There are two un-named minor watercourses, which form tributaries to Julimar Brook. One intersects the mid-eastern side of the Study Area, the other is just within the southeastern corner. These minor watercourses, originating from Julimar State Forest in the north, flows northwest to southeast through the Study Area entering Julimar Brook approximately 3.2 km to the east. Julimar Brook then feeds into the Avon River 5.6 km south of this confluence. There is also a third un-named watercourse in the northern portion of the Study Area which flows into the Brockman River via Spice Brook and ends in the Chittering-Needonga lakes.

420000 428000 436000

6528000 6520000 6512000

SPICE BROOK
BIGGS BROOK
MUNYERRING BROOK
JULIMAR BROOK
Flat Rocks Rd
Dewars Pool - Bindoon Rd
Munyerring Spring Rd
GAKALING SWAMP
Julimar Rd
Timberden Dr
Beach Rd
Davis Rd
Plunkett Rd
Parkland Dr
MUNNAPIN BROOK
COBBLER POOL
MALKUP BROOK
Cobbler Pool Rd
Chittering Valley Rd
BROCKMAN RIVER
AVON RIVER
LONG POOL
Keating Rd
MORTICUP BROOK

Legend

- Study Area
- Local Road

Surface Hydrology

- Minor
- Major

Water Body

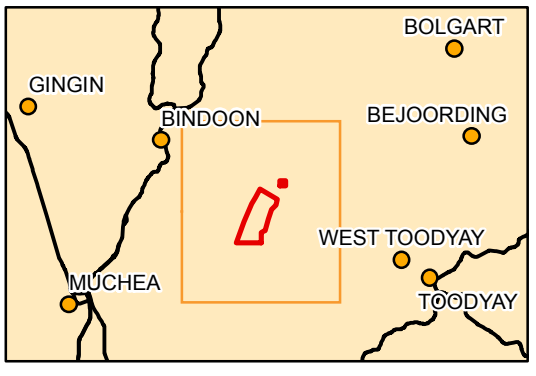
- COBBLER POOL
- GAKALING SWAMP
- LONG POOL

0 2 4 Km

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 01/06/2021

N

Scale: 1:75,000



MBS ENVIRONMENTAL

Julimar Exploration Project Reconnaissance and Targeted Flora Survey

Figure 2.4: Hydrology of the Study Area

2.7 Flora and Vegetation

2.7.1 Vegetation Associations

Vegetation associations of the Study Area were originally mapped by Beard (1975a). Shepherd *et al.* (2002) reinterpreted and updated the vegetation association mapping to reflect the National Vegetation Information System (NVIS Technical Working Group) standards (ESCAVI, 2003). The update also accounts for extensive clearing since the Beard (1975a) mapping. Shepherd *et al.* (2002) created a series of 'systems' to assist in removing mosaic vegetation associations originally mapped by Beard (1975a); however, some mosaics still occur.

The Study Area is located within the East Darling System, and under Shepherd *et al.* (2002) comprises:

- 4.0 Chittering: Jarrah, marri and wandoo *Eucalyptus marginata, Corymbia calophylla, E. wandoo.*
- 968.0 East Darling: Jarrah, marri and wandoo *Eucalyptus marginata, Corymbia calophylla, E. wandoo.*
- 968.2 Chittering: Jarrah, marri and wandoo *Eucalyptus marginata, Corymbia calophylla, E. wandoo.*

The current extent remaining of the vegetation system association exceeds 77% across the four regional scales: State, bioregion (Jarrah Forest), subregion (Northern Jarrah Forest) and Local Government Authority (Shire of Toodyay) (Government of Western Australia, 2018) (Table 2.4). Reservation of the vegetation system associations is good, with the East Darling 968 vegetation system association having greater than 32% of its current extent located within the National Reserve System across the four regional scales (Government of Western Australia, 2018) (Table 2.4).

Table 2.4: Regional and local extent of vegetation system associations within the Study Area (Shepherd *et al.* (2002)).

Scale	Extent (ha / %)		
	Pre-European	Current	Remaining in Reserves
Code: 4.0			
State	15,467	9,097 / 58.82	224/ 2.46
Jarrah Forest	15,457	9,097 / 58.86	224 / 2.46
Northern Jarrah Forest	15,457	9,097/ 58.86	224 / 2.46
LGA	4,964	4,669 / 94.07	-
Code: 968.0			
State	12,680	9,767 / 77.03	4,677 / 47.88
Jarrah Forest	12,680	9,767 / 77.03	4,677 / 47.88
Northern Jarrah Forest	12,680	9,767 / 77.03	4,677 / 47.88
LGA	7,995	6,311 / 78.93	2,576 / 40.81
Code: 968.2			
State	45,068	31,580 / 70.07	40.53 / 0.13
Jarrah Forest	45,068	31,580 / 70.07	40.53 /013
Northern Jarrah Forest	45,068	31,580 / 70.07	40.53 /013
LGA	26,257	24,763 / 94.31	35.30 / 0.14

2.7.2 Vegetation Complexes

Mattiske and Havel (1998) mapped vegetation complexes across the south-west forest region at a scale of 1:50,000 as part of the Regional Forest Agreement (RFA). More recently this dataset has been reviewed to correct errors while the mapping along the Whicher Scarp has been updated to ensure a continuation of complexes defined by Mattiske and Havel (1998) (see Webb *et al.*, 2016).

The survey area coincides with the Pindalup (Pn), Yalanbee (Y5) and the Coolakin (Ck) vegetation complexes (Webb *et al.*, 2016). The Pindalup (PN) vegetation complex is described as: Open forest of *Eucalyptus marginata* subsp. *thalassica-Corymbia calophylla* on slopes and open woodland of *Eucalyptus wandoo* with some *Eucalyptus patens* on the lower slopes in semiarid and arid zones. The Yalanbee (Y5) vegetation complex is described as: Mixture of open forest of *Eucalyptus marginata* subsp. *thalassica-Corymbia calophylla* and woodland of *Eucalyptus wandoo* on lateritic uplands in semiarid to perarid zones. Lastly, the Coolakin vegetation complex is described as: Woodland of *Eucalyptus wandoo* with mixtures of *Eucalyptus patens*, *Eucalyptus marginata* subsp. *thalassica* and *Corymbia calophylla* on the valley slopes in arid and perarid zones.

The Government of Western Australia reports annually on the statistics of the pre-European and current extent for the vegetation complexes of the south-west of Western Australia (Government of Western Australia, 2019). The updated statistics provide details on the progress towards achieving a conservation reserve system that is comprehensive, adequate and representative (CAR Reserve) and the statistics for each local government area (LGA; Shire of Toodyay).

The Coolakin (Ck), Pindalup (Pn) and Yalanbee (Y5) vegetation complexes occur across the Darling Plateau, mostly in the Northern Jarrah Forest subregion, covering 64,205 ha, 128,358 ha, and 83,829 ha, respectively (Government of Western Australia, 2019) (Table 2.5). This represents 39.15%, 76.8%, and 66.2% of the pre-European extent for both vegetation complexes. The Study Area mostly consists of the Yalanbee (Y5) complex (1815 ha, 89.79 %) followed by the Coolakin (Ck) complex (107.87 ha, 5.34 %) and the Pindalup (Pn) complex (98.49 ha, 4.87 %)**Table 2.5: Vegetation complexes occurring within the Study Area and their remaining extent**

Vegetation complex & code	Scale	Pre-European extent (ha)	Current extent remaining (ha / %)	Current extent protected (ha / %)[1]
Coolakin (Ck)	State	163,992	64,205 / 39.15	6,384 / 3.9
	LGA	24,258	12,276 / 50.61	N/A
Pindalup (Pn)	State	167,151	128,358 / 76.8	23,935 / 14.3
	LGA	7,886	6,311 / 80.0	N/A
Yalanbee (Y5)	State	126,610	83,829 / 66.2	7,695 / 6.1
	LGA	21,389	18,455 / 86.3	N/A

1 – Protected refers to lands protected within IUCN Class I-IV reserves for conservation
LGA: Local Government Authority – Shire of Toodyay

420000 428000 436000

6528000 6520000 6512000

Bi Ck Pn Y6 S Mi Y5 Ce Wi D3 D4 He2 My2

Flat Rocks Rd
Dewars Pool - Bindoon Rd
Munyerring Spring Rd
Julimar Rd
Timberden Dr
Parkland Dr
Beach Rd
Plunkett Rd
Davis Rd
Chittering Valley Rd
Keating Rd
Cobbler Pool Rd

Legend

- Study Area
- Local Road

Vegetation Complexes of the South West forest

Darling Plateau - Uplands

- Cooke, Ce
- Dwellingup, D3
- Dwellingup, D4
- Yalanbee, Y5
- Yalanbee, Y6

Darling Plateau - Depressions and Swamps on Uplands

- Swamp, S

Darling Plateau - Valleys

- Bindoon, Bi
- Coolakin, Ck
- Helena 2, He2
- Michibin, Mi
- Murray 2, My2
- Pindalup, Pn

Darling Plateau - Valley Floors and Swamps

- Nooning, No
- Williams, Wi

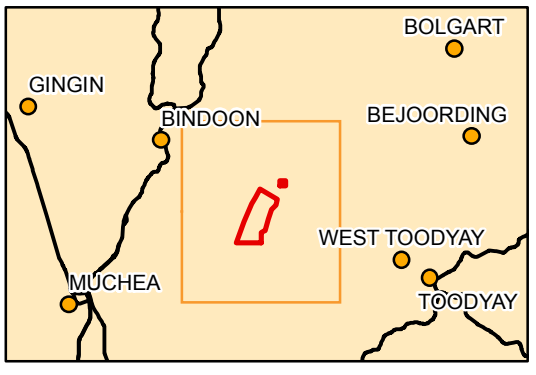
0 2 4 Km

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 01/06/2021

N

biologic Environmental Survey

Scale: 1:75,000



MBS ENVIRONMENTAL

Julimar Exploration Project Reconnaissance and Targeted Flora Survey

Figure 2.5: Vegetation complexes of the Study Area

2.7.3 Bioregional Significance

Under the Convention of Biological Diversity, Australia has worked towards a target of 17% of the continent to be protected as part of the National Reserve System (NRS). In building the NRS, priority is given to under-represented bioregions that have less than 10% of their remaining area protected in reserves (NRSTG, 2009). The Jarrah Forest bioregion is currently adequately represented under the NRS, with greater than 10% of its total area protected in reserves. The Northern Jarrah Forest subregion is also adequately represented, with more than 10% of the subregional area protected in reserves.

The Study Area is located within Julimar State Forest which is crown land. It is also listed on the EPA Redbook Recommended Nature Reserves (C21, The Darking System; (DBCA, 2021d)), and as an Environmentally sensitive area under section 51B of the Environmental Protection Act 1986 (EP Act; (DWER, 2021)).

2.7.4 Introduced Taxa

Weeds of National Significance

The Commonwealth of Australia, in collaboration with the states and territories, has identified 32 Weeds of National Significance (WoNS) based on an assessment process that prioritises these weeds according to their invasiveness, potential for spread and environmental, social and economic impacts. A list of 20 WoNS was endorsed in 1999 and a further 12 were added in 2012.

Landowners and land managers at all levels are responsible for managing WoNS. State and territory governments are responsible for legislation, regulation and administration of weeds. The WoNS were selected as they require coordination among all levels of government, organisations and individuals with weed management responsibilities.

Declared Plant Pests

To protect Western Australian agriculture the Department of Primary Industries and Regional Development (DPIRD) (formerly the Department of Agriculture and Food Western Australia, DAFWA) regulates harmful plants under the *Biosecurity and Agriculture Management Act 2007* (BAM Act). Plants that are prevented entry into the state or have control or keeping requirements within the state are known as declared pests. The main purposes of the BAM Act and its regulations related to Declared Plant Pests (DPP) are to prevent new plant pests from entering Western Australia, manage the impact and spread of those pests already present in the state and safely manage the use of agricultural chemicals.

The BAM Act has categorised the weeds of Western Australia into four main classifications:

- Declared Pests (under Section 22 of the Act);
- Permitted (under Section 11 of the Act);
- Prohibited (under Section 12 of the Act); and
- Permitted requiring a permit (Section 73, BAM Regulations 2013).

Under the BAM Act all declared plant pests are placed in one of three categories:

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

Weed Prioritisation

In 2008 Parks and Wildlife developed and implemented an integrated approach to weed management on Parks and Wildlife-managed lands in WA, the Weed Prioritisation Process. It was updated in 2013 and further revised in 2016. Parks and Wildlife prioritised weeds in each region, based on:

- Invasiveness;
- Ecological impact;
- Potential and current distribution; and
- Feasibility of control.

The resulting priorities focus on weeds considered to be high impact, rapidly invasive and still at a population size that can feasibly be eradicated or contained to a manageable size. This means that weed species that are already widespread may not be ranked as a high priority. The weed prioritisation for the South Coast bioregion has recently been revised by Parks and Wildlife. The key priorities are now centred on ‘Priority Alert’ weeds and weeds that receive a rating for ‘Ecological Impact’ and ‘Invasiveness’.

3 METHODOLOGY

3.1 Desktop Assessment

3.1.1 Literature Review

Background information on the Study Area and surrounds was compiled prior to, during and after the field survey. Historic vegetation mapping conducted by Beard (1975a), Shepherd *et al.* (2002) and Mattiske and Havel (1998), and the IBRA classification system (Williams & Mitchell, 2001), were consulted to provide broad contextual knowledge of the vegetation types likely to be encountered within the Study Area.

A review of publicly available literature relevant to the Study Area was undertaken to compile a list of conservation significant flora and ecological communities with the potential to occur within the Study Area. The eleven reports that were reviewed are listed in Table 3.1.

Table 3.1: Literature review relevant to the Study Area.

Survey Title	Reference	Survey Type	Distance from Study Area (km)
Assessment of Potential Flora, Vegetation and Fauna Values Julimar Project, Bindoon	Mattiske (2019)	Desktop Assessment	Within and surrounding
Julimar exploration project: reconnaissance and targeted flora survey	Biologic (2020)	Reconnaissance and Targeted Flora Survey	Adjacent to the south
Flora and fauna assessment for Muchea North and Chittering study area: Great northern Highway, Muchea to Wubin Upgrade Stage 2 Project	Phoenix (2015)	Flora and Fauna Assessment	12.7 km northwest
Great Northern Highway, Muchea to Wubin Upgrades, Stage 2 – Bindoon Options.	Focused Vision (2017)	Level 2 Flora and Vegetation Assessment and Targeted *Thelymitra stellata* Survey	13 km west northwest
Detailed Flora and Vegetation Assessment, Bindoon Bypass, Great Northern Highway	Focused Vision (2018)	Detailed Flora and Vegetation Assessment	14.7 km west
Instant Product Group: Muchea Lot 195 Detailed (Level 2) Flora and Vegetation Assessment	Maia (2017)	Detailed Flora and Vegetation Assessment	16.8 km west southwest
Toodyay Road Widening Metro and Wheatbelt Regions Biological Surveys	AECOM (2016)	Biological Assessment	20.7 km southeast
Flora and fauna assessment for Calingri to Wubin study areas: Great northern Highway, Muchea to Wubin Upgrade Stage 2 Project	Phoenix (2016)	Flora and Fauna Assessment	20.8 km north northwest
A biological survey of the agricultural zone: vegetation and vascular flora of Drummond Nature Reserve	Keighery *et al.* (2002)	Biological Survey	21 km northeast
Bindoon Defence Training Area Flora Surveys 2011: DFSW Range, DEMS Range, Static Grenade Range No. 2	Ecoscape (2012)	Flora and Vegetation Survey	22.5 km north
Flora and Vegetation: Reserve 2145 and Percy Cullen Oval Gidgegannup	Bennett Environmental (2006)	Flora and Vegetation Survey	31.8 km south

3.1.2 Database Searches

Database searches were undertaken to generate a list of vascular flora taxa previously recorded in the vicinity of the Study Area, including introduced species and taxa of conservation significance. The database searches also identified ecological communities and vegetation types of conservation significance that occur, or may occur, within, and near, the Study Area. Three of the database searches were conducted around a central coordinate (31°26'12.98"S; 116°16'27.98"E), with varying buffers as deemed appropriate (Table 3.2).

Table 3.2: Details of database searches conducted.

Provider	Reference	Database	Parameters
Atlas of Living Australia (ALA)	ALA (2021)	Species occurrence search.	Circle of radius 10 km centred on the coordinates: 31°26'12.98"S; 116°16'27.98"E
Department of Agriculture, Water and the Environment (DAWE)	DAWE (2021)	Protected Matters Search Tool.	Circle of radius 10 km centred on the coordinates: 31°26'12.98"S; 116°16'27.98"E
Department of Biodiversity Conservation and Attractions	DBCA (2021b, 2021c)	Threatened and Priority Ecological Communities.	Buffer of 15 km from supplied Study Area polygon
		Threatened and Priority Flora.	Buffer of 10 km from supplied Study Area polygon
Department of Biodiversity Conservation and Attractions	DBCA (2021a)	NatureMap – species occurrence search	Circle of radius 10 km centred on the coordinates: 31°26'12.98"S; 116°16'27.98"E
Department of Primary Industries and Regional Development (DPIRD)	DPIRD (2021c)	Declared Plants Database – Western Australian Organism List (WAOL).	Search of the entire Shire of Toodyay

3.1.3 Likelihood Ranking

The conservation significant flora taxa identified from the database searches were assessed and ranked on the likelihood of occurring within the Study Area. The rankings were assigned using the following definitions presented in the decision matrix (Table 3.3).

Interpretation of likelihood criteria may vary between species due to several factors influencing species occurrence known distribution, known range, preferred habitat, ecology and/or dispersal capabilities. The assessment of occurrence also takes into consideration how well distributed a species is within known localities. Where necessary, justification for the likelihood ranking will be provided per species. Likelihood rankings will be re-assessed post field survey and may change taking ground truthing into consideration.

Table 3.3: Flora likelihood decision matrix

		Habitat categories (within the Study Area)			
		Core/ critical habitat present	**Suitable habitat present/ within known distribution**	**Marginal habitat present/ adjacent to known distribution**	**No suitable habitat present/ outside of known distribution**
Species Records / Occurrence Categories	**Recorded in the Study Area**	Confirmed	Confirmed	Confirmed	Confirmed
	Recorded within <2 km	Highly Likely	Likely	Possible	Possible
	Recorded within 2-5 km	Likely	Possible	Possible	Unlikely
	Recorded within 5 -20 km	Possible	Possible	Unlikely	Unlikely
	Recorded >20 km	Possible	Unlikely	Unlikely	Highly Unlikely
	Species considered locally/ regionally extinct	Unlikely	Unlikely	Highly Unlikely	Highly Unlikely

3.2 Field Survey

3.2.1 Survey Type, Timing and Weather

A single season reconnaissance flora and vegetation survey was requested by MBS on behalf of Chalice. A reconnaissance survey was also deemed the most appropriate survey approach, considering the timing of the survey (i.e. April / May), the size and condition of the Study Area and the scope. The reconnaissance field survey was undertaken over five days, between the 20th and the 22nd of April, and the 7 and 13 of May 2021. The daytime climatic conditions during the field survey (cool temperatures with minimal rain; BoM, 2021) were adequate to complete the survey with minimal constraints and limitations.

In the thirteen months prior to the field survey (May 2020 to May 2021), the Julimar Forest weather station, located 10 km east of the Study Area, recorded 699.6 mm of rainfall (Figure 3.1) (BoM, 2021). This was above the long-term average (LTA) rainfall for the same period (518.9 mm; BoM, 2021).

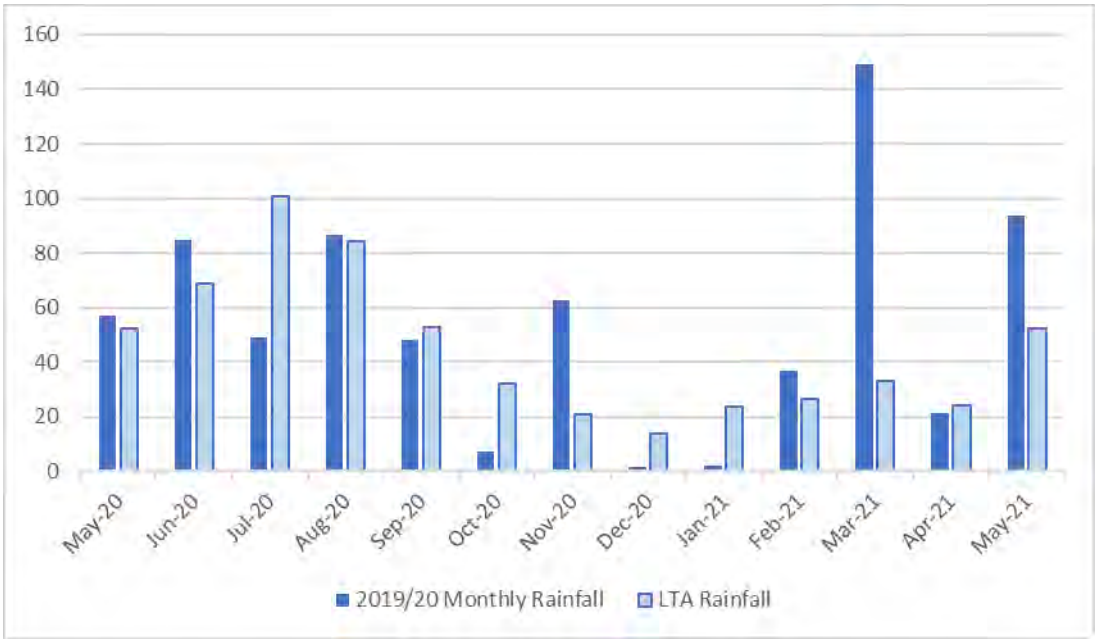


Figure 3.1: Comparative rainfall data for Julimar State Forest(Station 9268; BoM, 2021)

3.2.2 Survey Team and Licensing

The field survey was conducted over five days, totalling 18 person days in April and May of 2021. Specifically, the field days were 20-22 April, 7 and 13 May. The field team was led by Senior Botanist, Samuel Coultas, supported by five Botanists: Emily Eakin-Busher, Clare Whyte, Heather Edwards, Kaylin Geelhoed, Darcy Reith and Ecologist, Mary van Wees.

Table 3.4: Field survey personnel

Biologic Personnel	Project Involvement	Flora Licences	Relevant Botanical Experience
Senior Botanist / Ecologists			
Samuel Coultas	Field survey – 20-22 April & 7 May	FB62000017-2 TFL 60-1819	6+ years
Mary van Wees	Field survey – 13 May	-	7+ years
Botanists			
Emily Eakin-Busher	Field survey – 21-22 April & 7 May	FB62000160 TFL 53-1920	3 years
Clare Whyte	Field survey – 20-21 April, 7 & 13 May; Reporting	FB62000274	3 years
Heather Edwards	Field survey – 21-22 April, 13 May	FB62000281	5 years
Kaylin Geelhoed	Field survey – 21-22 April & 13 May	FB62000238	< 2 years
Darcy Reith	Field survey – 7 May	-	< 2 years

3.2.3 Flora and Vegetation Survey Design

Floristic Sample Sites

Sixty-one relevé sites were recorded from the Study Area. Broad preliminary vegetation units and potential sites therein were determined prior to field mobilisation. These were derived from

a combination of aerial photography (Scale 1:15,000) of the Study Area, Google Earth Pro©, previous vegetation mapping (Beard, 1975b; Mattiske & Havel, 1998; Shepherd *et al.*, 2002) and soil landscape mapping (Northcote *et al.*, 1968). Reconnaissance surveys are traditionally sampled at a low intensity via relevés (unmarked area within which data is collected, EPA, 2016b) and mapping points (unmarked area within which the vegetation unit and condition is broadly described).

Where practical, at least one relevé site was established in each of the preliminary vegetation unit areas (Figure 3.2), to ensure that all vegetation units were captured by the survey and described appropriately in accordance with EPA (2016b) guidelines. The entire Study Area was accessible via vehicle and on foot, with all the major landforms and vegetation units traversed and sampled.

All vascular flora taxa within each relevé, including the height and approximate cover for the dominant species, and additional taxa found during mapping notes and opportunistic searches while traversing the Study Area, were recorded. A brief summary of the vegetation assemblage at each site was also recorded to aid in producing vegetation unit descriptions (NVIS Technical Working Group, 2017) (Appendix B). In addition, the following information was recorded at each site:

- Unique site identification number;
- Date of survey;
- Personnel;
- Central GPS coordinate (GDA 94);
- Site photograph of the representative vegetation unit;
- Soil characteristics (texture and colour);
- Geology (type, size and nature of any rocks, stones, gravel, or outcropping);
- Topography (landform type and aspect);
- Vegetation condition (Appendix C);
- Vegetation structure, including the dominant flora species in the three traditional strata, upper, mid and lower (Appendix B);
- Disturbance (if present);
- Approximate time since last fire; and
- GPS coordinates for conservation significant or introduced flora.

Targeted Searching

Prior to the survey, a list of 78 conservation significant flora and four ecological communities (TECs/PECs) with the likelihood or potential to occur within the Study Area was compiled from the desktop assessment. Field personnel familiarised themselves with photographs, reference samples and descriptions of these taxa and communities before conducting the survey. Once on the ground, active searching was completed across the Study Area whilst traversing between sites (Figure 3.2).

Where conservation significant flora taxa or introduced flora taxa were located in the field, a GPS coordinate of the individual was taken, or, if the taxon existed within a small population, a central coordinate with an approximate 20 m radius was used. Generalised information was collected for each occurrence, including an estimate of the number of individuals, photographs, reproductive status, condition and vegetation description.

Where conservation significant vegetation was located in the field, a central GPS coordinate of the community was taken and the boundary was mapped. Information was collected for each occurrence, including condition, photographs and vegetation description, while technical advice was consulted where necessary.

It should be noted that presence or absence of significant flora considered cryptic, herbs or perennial herbs was unable to be conclusively confirmed from this survey due to inappropriate survey timing. Additionally, this targeted survey forms a preliminary assessment of significant flora occurring within the Study Area and should not be considered conclusive. The southwest botanical region, inclusive of the Jarrah bioregion is a known biodiversity hotspot. As such it is expected to record a higher diversity of flora and significant flora taxa than other botanical regions in Western Australia.

424000

428000

6520000

6516000

BAU-03
BAU-04
HAR-01
HAR-03
HAR-12
HAR-11
HAR-10
HAR-05
HAR-06
HAR-07
HAR-08
HAR-13
HAR-14
HAR-16
HAR-20
HAR-19
HAR-17
HAR-18
HAR-21
HAR-22
HAR-28
HAR-27
HAR-23
HAR-31
HAR-29
HAR-30
HAR-32
HAR-25
HAR-33
HAR-34
HAR-26
HAR-70
HAR-37
HAR-36
HAR-90
HAR-72
HAR-71
HAR-45
HAR-67
HAR-42
HAR-40
HAR-38
HAR-47
HAR-48
HAR-49
HAR-39
Julimar Rd
HAR-54
HAR-53
HAR-52
HAR-55
HAR-51
HAR-56
HAR-57
HAR-59
HAR-65
HAR-63
HAR-64
HAR-66
HAR-62
HAR-61
HAR-60
Plunkett Rd

Legend

Study Area

Local Road

Sampling Type

Relevé

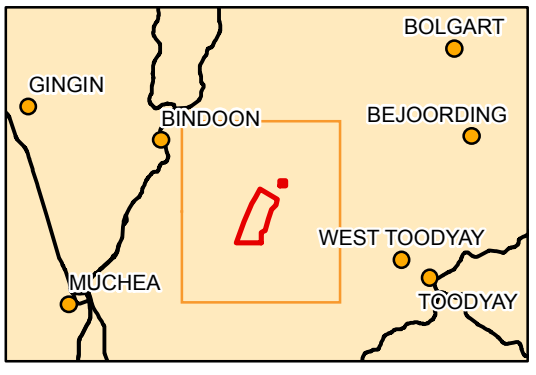
Traverse

0 0.5 1 1.5 Km

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 11/06/2021

N

Scale: 1:28,000



MBS ENVIRONMENTAL

Julimar Exploration Project Reconnaissance and Targeted Flora Survey

Figure 3.2: Flora sample sites and traverses

3.2.4 Identification of Flora Specimens

Plant taxa that could not be identified during the field survey were collected for subsequent identification. Identifications were carried out by Biologic taxonomist Dr. Rachel Meissner with assistance from Botanists Clare Whyte and Darcy Reith, using the Western Australian Herbarium's (WAH) reference collection, taxonomic keys and reference material. All taxa were checked against Florabase© (version 2.9.39; WAH, 1998-) to ensure their currency and validity. Any conservation significant flora taxa, including potential threatened and priority species, range extensions and potential new taxa will be verified and vouchered (if appropriate) at the WAH.

3.2.5 Vegetation Type and Condition Mapping

Broad vegetation mapping was conducted in the field, with relevés placed in vegetation communities that were clearly observable from aerial photography. Boundaries between vegetation types were delineated from field observations as well as by utilising regional aerial photography from various years, and interpreting landforms from 2m contour lines (DPIRD, 2021a; Landgate, 2021). Following the completion of the relevé sampling and taxonomic identifications, the broad vegetation types were further refined based on the review of the floristic data collected from the relevés. The vegetation type mapping was digitised using geographic information systems (GIS) software.

The vegetation types have been described to Level 5 (vegetation association), where possible, in the National Vegetation Information System (NVIS) hierarchical structure (NVIS Technical Working Group, 2017). The vegetation structure information collected was reviewed to describe the vegetation type based on the dominant taxa, foliage cover and height of the three traditional strata (upper, mid and lower/ground). The mapping reliability was completed to a level expected from a reconnaissance survey.

Vegetation condition was defined within the Study Area using the vegetation condition scale adapted from Keighery (1994) and presented in EPA (2016b) (Appendix C). The vegetation condition was determined based on the level of disturbance observed in the Study Area. Condition was recorded at relevés, while additional notes were taken while traversing the Study Area to broadly map vegetation condition boundaries. The vegetation condition mapping was then digitised using GIS software.

3.2.6 Potential Limitations and Constraints

There are a number of possible limitations and constraints that can impinge on the adequacy of vegetation and flora surveys. The limitations of the current assessment are presented in accordance with the Technical Guidance (EPA, 2016b) (Table 3.5).

Table 3.5: Potential limitations and constraints

Limitation	Constraint	Comment
Experience of personnel	No	The field survey was led by Sam Coultas, a senior botanist with over 6 years consulting experience, as well as by senior ecologist Mary van Wees and botanist Clare Whyte, all of whom have direct and relevant experience in the Northern Jarrah Forest subregion.
Scope (floral groups sampled and whether any constraints affect this)	Yes	The scope was a reconnaissance and targeted flora and vegetation survey. The survey was completed in line with EPA (2016a) guidelines for a reconnaissance survey. The survey was undertaken over five days in autumn (20-22 April, 7 & 13 May 2021) reducing the ability to record a comprehensive list of flora present. However, the assemblages and flora present could be interpreted enough to map vegetation types across the Study Area. Threatened and priority flora identified in the desktop assessment were actively searched for whilst traversing the Study Area. According to EPA (2016a), a targeted survey should aim to locate and record the size and extent of all significant flora populations within the Study Area. Given the size of the Study Area and the number of potential conservation significant flora, five days was not adequate to meet this aim. Additionally, the survey was not conducted within the recommended season for south-west WA (i.e. spring) and therefore threatened and priority flora were less detectable and identifiable (i.e. with flowers or fruit).
Proportion of flora identified	Yes	The field survey occurred in April and May which is outside of the optimal period to complete flora surveys within the Jarrah Forest bioregion (i.e. spring). The majority of flora present were sterile and lacking in flowers and/or fruit, which are key characters required for confident identification of flora specimens. One specimen was only identified to family level, as well as 16 specimens only identified down to genus and four specimens tentatively identified to species level. However the scope was a reconnaissance survey which does not necessarily require a complete compilation of flora species present within the Study Area.
Sources of information (recent or historic) and availability of contextual information	No	The Jarrah Forest bioregion has been subjected to numerous biological surveys, and a sufficient amount of contextual work was available to complete the assessment, including within the adjacent Julimar State Forest.
Proportion of the task achieved	No	The entire task achieved within the allotted survey period.
Disturbances (e.g. fire or flood)	No	Recent fires, likely prescribed burns, had altered the structure and cover of vegetation in some areas. This made interpretation of aerial imagery more difficult; however, the vegetation communities were still able to be delineated by using multiple years of regional imagery in combination with floristic data and field observations.

Limitation	Constraint	Comment
Intensity of survey	Yes	Sixty-one relevés were recorded during the field survey and the Study Area was comprehensively traversed ensuring the intensity met the requirements of a reconnaissance flora and vegetation survey. However, the intensity is not considered adequate for a targeted flora survey, especially given the number of conservation significant flora identified from the desktop assessment and the location within the southwest botanical region (See Section 3.2.3, Targeted Searching).
Completeness of survey	No	The survey was adequately completed to meet the requirements of the scope. However, additional detailed and targeted surveys during appropriate survey timing are needed to better determine potential impacts to the flora and vegetation.
Resources (e.g. degree of expertise available)	No	All resources required to complete the survey were available.
Remoteness or access issues	No	The Study Area was accessible either by vehicle or on foot, thus the sampling techniques used during this survey were unconstrained by accessibility or remoteness.
Problems with data and analysis, including sampling biases	No	The majority of collections were sufficiently identified to species level or further and the remaining specimens that had insufficient material for taxonomic purposes are not considered a limitation of the survey.

4 RESULTS AND DISCUSSION

The following section presents and discusses the results of the Survey and places the significant results in a regional and local context, consistent with the requirements of the EPA (2016a).

4.1 Desktop Assessment

4.1.1 Flora of Conservation Significance

A total of 78 conservation significant flora were identified from the desktop assessment (literature review and database search) as occurring in the vicinity of Study Area. Of the 78 significant taxa, 15 are listed as Threatened flora (EPBC Act and BC Act), while the remaining Priority species are: seven Priority 1, 19 Priority 2, 16 Priority 3 and 21 Priority 4. The locations are presented in Figure 4.1. Likelihood of occurrence was assessed for each significant flora. A condensed list containing the confirmed, highly likely, and possible classifications is presented at Table 4.1 and the full likelihood assessment is provided in Appendix F.

Results from Mattiske (2019) have not been included as this was only a desktop assessment of potential values, and did not include any observed records of conservation significant flora. The literature review identified twenty significant taxa not identified in the database searches. Eight of these taxa are not known to occur in the Northern Jarrah Forest subregion and as such have not been included in the likelihood assessment. The remaining twelve taxa were added to desktop results and form part of the total 78 significant flora identified in the desktop assessment.

The desktop assessment identified three taxa occurring within the Study Area: *Drosera sewelliae* (P2), *Persoonia sulcata* (P4) and *Synaphea grandis* (P4). A further two taxa are considered Highly Likely to occur within the Study Area, *Oxymyrrhine coronata* (P4) and *Schoenus natans* (P4), as well as 31 taxa classified as Possible (Table 4.1). The remaining 42 taxa are considered either Unlikely or Highly Unlikely to occur (Appendix F).

Table 4.1: Conservation significant flora of the desktop assessment

Taxon	Description (WAH, 1998-)	Distance from Study Area
Confirmed		
P2	*Drosera sewelliae*	Within
P4	*Persoonia sulcata*, *Synaphea grandis*	
Highly Likely		
P4	*Oxymyrrhine coronata*, *Schoenus natans*	<2 km
Possible		
T	*Eleocharis keigheryi*, *Grevillea bracteosa* subsp. *bracteosa*, *Grevillea corrugata*, *Grevillea curviloba*, *Thelymitra stellata*	2 – 20 km
P1	*Androcalva fragifolia*, *Conostylis caricina* subsp. *elachys*, *Gastrolobium crispatum*, *Lechenaultia magnifica*, *Stylidium vinosum*	

Taxon	Description (WAH, 1998-)	Distance from Study Area
P2	*Acacia browniana* var. *glaucescens*, *Gastrolobium nudum*, *Millotia tenuifolia* var. *laevis*, *Synaphea rangiferops*^, *Verticordia citrella*	
P3	*Acacia drummondii* subsp. *affinis*, *Acacia pulchella* var. *reflexa* acuminate bracteole variant (R.J. Cumming 882), *Adenanthos cygnorum* subsp. *chamaephyton*, *Johnsonia inconspicua*, *Lasiopetalum caroliae*, *Schoenus capillifolius*, *Tetratheca pilifera*, *Verticordia huegelii* var. *tridens*, *Verticordia serrata* var. *linearis*^	
P4	*Calothamnus pachystachyus*, *Chorizema ulotropis*, *Cyanicula ixioides* subsp. *ixioides*, *Hemigenia platyphylla*, *Hibbertia miniata*, *Hydrocotyle lemnoides*, *Stylidium longitubum*	

420000 430000 440000

6540000 6530000 6520000 6510000 6500000

P1

- *Androcalva fragifolia*
- *Conostylis caricina* subsp. *elachys*
- *Gastrolobium crispatum*
- *Lechenaultia magnifica*
- *Stylidium vinosum*
- *Synaphea panhesya*

P2

- *Acacia browniana var. glaucescens*
- *Drosera sewelliae*
- *Grevillea candolleana*
- *Grevillea* sp. Toodyay West (F. Hort et al. 3296)
- *Lasiopetalum decoratum*
- *Millotia tenuifolia* var. *laevis*
- *Tetratheca spartea*
- *Thysanotus* sp. Badgingarra (E.A. Griffin 2511)
- *Tricoryne* sp. Wongan Hills (B.H. Smith 794)
- *Styphelia brevicuspis*
- *Verticordia citrella*

P3

- *Acacia campylophylla*
- *Acacia drummondii* subsp. *affinis*
- *Adenanthos cygnorum* subsp. *chamaephyton*
- *Comesperma rhadinocarpum*
- *Johnsonia inconspicua*
- *Lasiopetalum caroliae*
- *Platysace ramosissima*
- *Schoenus capillifolius*
- *Stylidium cymiferum*
- *Stylidium sacculatum*
- *Tetratheca pilifera*
- *Verticordia huegelii* var. *tridens*

P4

- *Asterolasia grandiflora*
- *Caladenia speciosa*
- *Calothamnus pachystachyus*
- *Chorizema ulotropis*
- *Cyanicula ixioides* subsp. *ixioides*
- *Eucalyptus loxophleba x wandoo*
- *Grevillea drummondii*
- *Hemigenia platyphylla*
- *Hibbertia miniata*
- *Hydrocotyle lemnoides*
- *Oxymyrrhine coronata*
- *Persoonia sulcata*
- *Schoenus natans*
- *Stylidium longitubum*
- *Synaphea grandis*
- *Trithuria australis*

Bulligan Rd
Mount Rd
Dewars Pool - Bindoon Rd
Old Plains Rd
Rockdale Rd
Flat Rocks Rd
Halkea Rd
Toodyay - Bindi Bindi Rd
Blue Plains Rd
Julimar Rd
Plunkett Rd
Cobbler Pool Rd
Morahgup Rd

Legend

- Study Area
- Local Road
- State Road

T,EN

- *Acacia chapmanii* subsp. *australis*
- *Grevillea bracteosa* subsp. *bracteosa*
- *Grevillea curviloba*
- *Hypocalymma sylvestre*
- *Thelymitra stellata*

T,VU

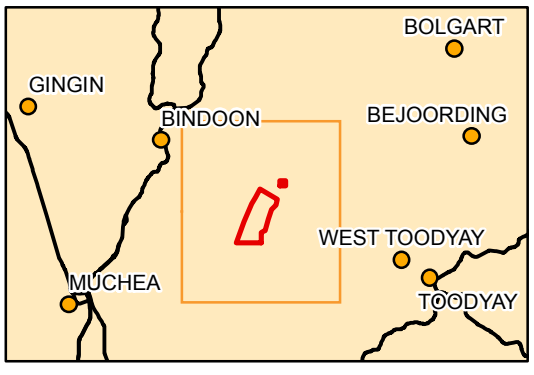
- *Eleocharis keigheryi*
- *Grevillea corrugata*

0 2 4 6 Km

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 09/06/2021

N

Scale: 1:140,000



MBS ENVIRONMENTAL

Julimar Exploration Project Reconnaissance and Targeted Flora Survey

Figure 4.1: Conservation significant flora database search results

4.1.2 Vegetation of Conservation Significance

Searches of the DAWE database with regard to matters of national environmental significance, as listed under the EPBC Act (DAWE, 2021) and the Threatened and Priority Ecological Communities database (DBCA, 2021b) identified four ecological communities of conservation significance occurring within twenty-five kilometres of the Study Area (Figure 4.2, Table 4.2).

The 'Banksia dominated woodlands of the Swan Coastal Plain IBRA region' TEC was identified by both Maia (2017) and Focused Vision (2018). This TEC (and associated sub-community PECs) occurs in the adjacent Swan Coastal Plain bioregion and is not expected to occur within the Study Area. Similarly, the 'Eucalypt woodlands of the Western Australian Wheatbelt' PEC/TEC is not expected to occur within the Study Area, as it does not meet the 300 to 600 mm average annual rainfall isohyet criteria outlined in the conservation advice (DoE, 2015). This leaves two TECs/PECs with the potential to occur within the Study Area:

- Claypans with mid dense shrublands of *Melaleuca lateritia* over herbs
- Wandoo woodland over dense low sedges of *Mesomelaena preissii*

Table 4.2: TEC & PEC desktop results

Community	DBCA conservation code	EPBC	Description	Distance from Study Area
Claypans with mid dense shrublands of *Melaleuca lateritia* over herbs	Priority 1	Threatened - CR	Claypans (predominantly basins) usually dominated by a shrubland of *Melaleuca lateritia* with dense herbs occurring both on the Swan Coastal Plain and Jarrah Forest IBRA regions. These claypans are characterized by aquatic (*Hydrocotyle lemnoides* (P4)) and amphibious flora (e.g. *Glossostigma diandrum*, *Liparophyllum capitatum* and *Eleocharis keigheryi* (T)).	9.7 km N
Wandoo woodland over dense low sedges of *Mesomelaena preissii*	Priority 2	-	Wandoo woodland on clay flats in valleys over dense low sedges of *Mesomelaena preissii*.	18.5 km NE
Eucalypt woodlands of the Western Australian Wheatbelt	Priority 3	Threatened – CR	Eucalypt-dominated woodlands in the Western Australian Wheatbelt region (including outlying patches in the eastern parts of the Northern Jarrah Forest subregion adjacent to the Avon Wheatbelt IBRA region that are off the Darling Range and have annual rainfall <600 mm). Structure is a mature woodland with crown cover of the tree canopy >10%.	11.9 km E

Community	DBCA conservation code	EPBC	Description	Distance from Study Area
Banksia dominated woodlands of the Swan Coastal Plain IBRA region	Threatened & Priority listed	Threatened – EN	Consists of several sub-communities: • *Banksia attenuata* woodlands over species rich dense shrublands ('community type 20a') (T – EN (DBCA)) • Low lying *Banksia attenuata* woodlands or shrublands ('community type 21c') (P3 (DBCA)) • Banksia woodlands of the Gingin area restricted to soils dominated by yellow to orange sands (P2 (DBCA)) • Northern Swan Coastal Plain *Banksia attenuata – Banksia menziesii* woodlands ('community type 23b') (P3 (DBCA))	13 km SW

410000 420000 430000 440000

6540000 6530000 6520000 6510000 6500000

Bindoon Moora Rd
Wells Glover Rd
Great Northern Hwy
Dewars Pool - Bindoon Rd
Crest Hill Rd
Flat Rocks Rd
Bulligan Rd
Mount Rd
Old Plains Rd
Rockdale Rd
Hakea Rd
Toodyay - Bindi Bindi Rd
Coondle West Rd
Julimar Rd
Madden Rd
Blue Plains Rd
Plunkett Rd
Chittering Valley Rd
Keating Rd
Cobbler Pool Rd
River Rd
Morahgup Rd
Lovers L
Toodyay Rd
Chittering Rd

Legend

- Study Area
- Local Road
- State Road

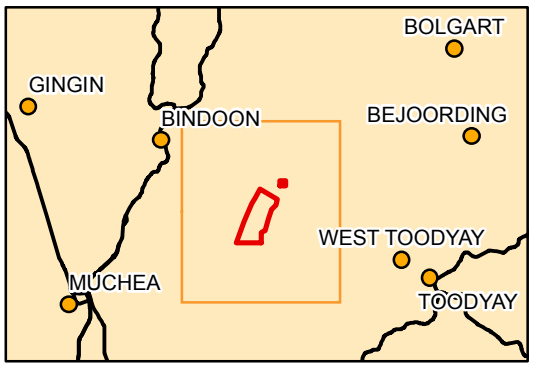
Threatened and Priority Ecological Community

Community - State category, Commonwealth Category

- Banksia Dominated Woodlands of the Swan Coastal Plain IBRA Region - Priority 3, Endangered
- Claypans with mid dense shrublands of *Melaleuca lateritia* over herbs - Priority 1, Critically Endangered
- Eucalypt woodlands of the Western Australian Wheatbelt - Priority 3, Critically Endangered
- Wandoo woodland over dense low sedges of *Mesomelaena preisii* - Priority 2
- York Gum Woodlands of the wheatbelt - Priority 3, Critically Endangered

0 2 4 6 Km

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 08/06/2021



N

biologic Environmental Survey

Scale: 1:140,000

MBS ENVIRONMENTAL

Julimar Exploration Project Reconnaissance and Targeted Flora Survey

Figure 4.2: Threatened and Priority Ecological Communities database search results

4.1.3 Introduced flora

The NatureMap (DBCA, 2020), Atlas of Living Australia (ALA, 2020), Protected Matters (DAWE, 2020) and WAOL (DPIRD, 2020) database searches identified a list of 86 introduced taxa that may potentially occur within the Study Area. The list of introduced taxa known to occur or potentially occur within the Study Area (Appendix G) was reviewed to identify WoNS and DPPs. The literature review also identified one other taxa (*Rumex hypogaeus*) not identified in the desktop survey.

Weeds of National Significance

Of the list of introduced taxa identified during the desktop assessment as occurring in or near the Study Area, 33 are listed as WoNS (Appendix G). Twenty-eight of the WoNS were identified from the WAOL database search for the entire Shire of Toodyay and occur or may potentially occur within the shire boundaries, while the remaining five were identified by the Protected Matters (DAWE, 2020) database search. The 33 taxa include numerous *Rubus, Opuntia*, *Austrocylindropuntia* and *Cylindropuntia* species that are grouped together in the WoNS listing.

Declared Pests

The desktop assessment identified 50 DPs (including numerous cacti species that are all listed as DPs, (Appendix G), previously recorded or potentially located within the Shire of Toodyay.

Priority Alert Weeds

Sixteen introduced taxa have been identified by Parks and Wildlife as 'Priority Alerts' for the South West region, **Asclepias curassavica*, **Baeometra uniflora*, **Casuarina glauca*, **Cenchrus setaceus*, **Commelina benghalensis*, **Cymbalaria muralis* subsp. *muralis*., **Galium aparine*, **Gaura lindheimeri*, **Gazania linearis*, **Hydrocotyle bonariensis*, **Lachenalia bulbifera*, **Lachenalia mutabilis*, **Lachenalia reflexa*, **Moraea miniata*, **Solanum hoplopetalum* and **Tribulus terrestris*. Two of these, **Galium aparine* and **Moraea miniata*, were identified from the WAOL database search. The remaining Priority Alert weeds have not previously been recorded from within or near the Study Area and are not expected to occur in the Study Area.

4.2 Field Survey Results

4.2.1 Flora Composition

A total of 130 vascular flora taxa from 29 families and 62 genera were recorded from the Study Area during the field survey (Appendix H). The total number of vascular flora taxa recorded comprised 127 native taxa and 3 introduced taxa (Appendix H).

The dominant families equate to 48% of the total taxa recorded and comprised Proteaceae (Banksia family; 25 taxa), Myrtaceae (Eucalypt family; 19 taxa) and Fabaceae (Wattle/ Pea family; 18 taxa). Of the 29 families, 11 were represented by one taxon, which equates to 8.4% of the total taxa recorded. The dominant genera make up 29% of the total taxa recorded and comprised *Styphelia* (seven taxa), *Banksia* (seven taxa) and *Hakea*, *Hibbertia*, *Lomandra* and *Acacia,* all of

which had six taxa. Of the 62 genera recorded, 33 were represented by one taxon, which equates to 25% of the total taxa recorded.

Twenty-one taxa observed and collected from the field were difficult to confidently identify to species or infraspecies level. This was mainly due to the specimens/ individuals lacking suitable flowering and/ or fruiting material for confident taxonomic identification. Four taxa have been tentatively identified to species level, fifteen specimens have been identified to genus level, one specimen tentatively identified to genus level (?*Grevillea*. sp. indet) and one specimen to tentatively identified to family level (?Fabaceae sp. indet). An additional six specimens tentatively identified down to species or subspecies level had corresponding specimens which were able to be confidently identified. These indeterminate specimens are not considered to be analogous with the 15 conservation significant listed flora considered likely or possible to occur in the Study Area (Table 4.1).

4.2.2 Flora of Conservation Significance

The desktop assessment identified 15 Threatened federal and state listed flora species as occurring in, or near the Study Area. Prior to the field survey, two threatened flora species, *Eleocharis keigheryi* and *Thelymitra stellata*, were considered possible to occur in the Study Area. Following the completion of the field survey, one threatened flora taxa, *Conospermum densiflorum* subsp. *unicephalatum* (T), was recorded from the Study Area.

The desktop assessment identified 53 priority listed taxa as potentially occurring within the Study Area. Prior to the field trip, two were considered Highly Likely to occur and 26 were considered Possible to occur within the Study Area (Appendix F). Following the completion of the field survey, three priority listed flora taxa, *Drosera* ?*sewelliae* (P2), *Beaufortia eriocephala* (P3) and *Lasiopetalum caroliae* (P3), were recorded from the Study Area. *Beaufortia eriocephala* (P3) was not previously identified in the desktop assessment. Coordinates for all threatened and priority flora taxa are listed in Appendix I.

Conservation significant flora are normally submitted to the WAH for formal identification; however, due to the specimens lacking flowers and/or fruit it is suggested that these locations be revisited in spring and specimens submitted for formal identification.

Drosera sewelliae (P2)

Drosera sewelliae (P2) is a small, rosetted carnivorous perennial herb with orange flowers. It generally occurs on lateritic soils in Jarrah and Marri woodland, with records previously found within the Study Area (WAH, 1998-). This taxon has eleven herbarium records, all of which are located within 25 km of the Study Area, including two records which occur inside of the Study Area (WAH, 1998-). The survey occurred outside of the flowering time for this taxon, however it was readily observable in the field as it was very common, especially in patches of lateritic gravel with reduced leaf litter (Plate 4.1). There are several other pygmy *Drosera* known from the Northern Jarrah Forest subregion, most of which require flowers for confident identification. For this reason, the specimens collected from the Study Area have been tentatively identified as *Drosera* ?*sewelliae*. 1551 individuals from 56 point locations were recorded in the current survey.

In addition to this, another 43 individuals were recorded from the two DBCA locations (the identity of these individuals are assumed to be correct and are referred to as *Drosera sewelliae*). It is recommended to revisit the Study Area in spring so that several flowering specimens can be collected for re-identification.

Plate 4.1: *Drosera ?sewelliae* (P2) habit & lateritic gravel habitat (Biologic photos)

Beaufortia eriocephala (P3)

Beaufortia eriocephala (P3) is an erect shrub growing up to 0.6 m high. It occurs on lateritic sandy soils and commonly has red flowers in September to November (WAH, 1998-). There are currently 28 WAH records for this taxon with the closest record occurring 31 km east of the Study Area (WAH, 1998-). This species has a disjunct distribution, with most occurring from Gingin northwest to Warradarge, and the remainder occurring from Toodyay through to York and Greenhills. The collection of *Beaufortia eriocephala* also represents a slight locality hole (see section 4.2.4). Approximately 10 individuals were recorded from site HAR-47 and was the dominant understorey plant in this location (Plate 4.2). Whilst this species was confidently identified from a sterile specimen, it is recommended to re-collect from the population during spring so that a formal identification can be made at the WAH.

Plate 4.2: *Beaufortia eriocephala* (P3) habitat, flowers & habit (L: Biologic photo. R: Florabase photo (WAH, 1998-))

Conospermum densiflorum subsp. *unicephalum* (T)

Conospermum densiflorum subsp *unicephalatum* (T) is a much-branched shrub growing to 0.6 m high. It has cream/ white and blue flowers in September to November and grows on clay soils (WAH, 1998-). There are currently 16 WAH records for this taxon (WAH, 1998-) with the closest record being 33.3 km north of the Study Area. This threatened taxon is distributed from Wannamal north to Coomberdale. An additional record also exists within the Moore River National Park collected by the NSW Herbarium (ALA, 2021). The collection of *Conospermum densiflorum* subsp *unicephalatum* also represents a slight range extension (see section 4.2.4). During the current survey, one individual was recorded from HAR-39 (vegetation type V8). Whilst this species was confidently identified from a sterile specimen, it is recommended to re-collect from the population during spring so that a formal identification can be made at the WAH.

Plate 4.3: *Conospermum densiflorum* subsp. *densiflorum* (T) habit & habitat (L: Biologic photo. R: Florabase photo (WAH, 1998-))

Lasiopetalum caroliae (P3)

Lasiopetalum caroliae (P3) was previously known as *Lasiopetalum* sp. Toodyay (F. Hort 2689) but was recently formally described (Shepherd & Wilkins, 2017). This taxon is a procumbent, trailing subshrub with relatively small leaves of <4 mm long, and is known to display pale to bright mauve-pink flowers between September and November (Shepherd & Wilkins, 2017; WAH, 1998-). It is found in a variety of habitats including gullies, slopes, and creeklines in sandy clays and loams over laterite and/or granite (WAH, 1998-). There are nineteen records held at the WAH for this species (WAH, 1998-). Most of these records are within 35 km of the Study Area with the exception of two close populations known from the North Bannister area. *Lasiopetalum caroliae* was found from two point locations in valley vegetation in the northeast of Hartog, totalling two individuals. Whilst this species was confidently identified from a sterile specimen, it is recommended to re-collect from the population during spring so that a formal identification can be made at the WAH.

Plate 4.4: *Lasiopetalum caroliae* (P3) habitat & flowers (L: Biologic photo. R: photo from (Shepherd & Wilkins, 2017))

4.2.3 Review of Likelihood of Occurrence

Existing DBCA records for *Drosera sewelliae* (P2), *Persoonia sulcata* (P4) and *Synaphea grandis* (P4) were visited during the field survey to further assess these populations. *Drosera sewelliae* was confirmed pending additional collection of flowering material during spring and thus a confident confirmation of the presence of this taxon in the Study Area. A collection made from the vicinity of the *Persoonia sulcata* (P4) record has subsequently been identified as *Persoonia angustiflora*. This species is common throughout the Northern Jarrah Forest and is not conservation significant. Similarly, a collection made from the vicinity of the *Synaphea grandis* (P4) record was later identified as *Synaphea* sp. Udumung (A.S. George 17058), which is not considered conservation significant. The likelihood of these two taxa have been left as Confirmed, as there is potential that more than one *Synaphea* species co-occur in close proximity. These locations should be revisited in spring when individuals are flowering and in-field differentiation between species is easier. Flowering specimens should also be submitted to the WAH for further investigation and formal identification.

The majority of the 78 conservation significant species identified by the desktop assessment would not have been flowering or fruiting at the time of the field survey. Many perennial species collected were able to be confidently identified with sterile material, however there were several perennial shrubs that could not be confidently identified without flowers and/or fruit. This was taken into account when completing the review of likelihood of occurrence (Table 4.3).

Table 4.3: Review of likelihood of occurrence post-survey

Taxon	Likelihood Pre-Survey	Likelihood Post-Survey	Reasoning
Drosera sewelliae (P2)	Confirmed	Confirmed	Recorded during the current survey.
Persoonia sulcata (P4)	Confirmed	Confirmed	Record ground-truthed during current survey and not recorded.
Synaphea grandis (P4)	Confirmed	Confirmed	
Oxymyrrhine coronata (P4)	Highly Likely	Possible	Suitable habitat present
Schoenus natans (P4)	Highly Likely	Highly Likely	An annual taxon present between Sept-Dec. Suitable habitat found (W1).

Taxon	Likelihood Pre-Survey	Likelihood Post-Survey	Reasoning
Acacia browniana var. *glaucescens* (P2)	Possible	Unlikely	Suitable habitat present. Not flowering. Medium-sized shrub.
Acacia drummondii subsp. *affinis* (P3)	Possible	Unlikely	
Acacia pulchella var. *reflexa* acuminate bracteole variant (R.J. Cumming 882) (P3)	Possible	Unlikely	
Adenanthos cygnorum subsp. *chamaephyton* (P3)	Possible	Unlikely	Suitable habitat present. Not flowering. Prostrate shrub. The other subspecies found, *Adenanthos cygnorum* subsp. *cygnorum*, is easily distinguishable by its upright habit.
Androcalva fragifolia (P1)	Possible	Possible	Suitable habitat present. Not flowering. Prostrate shrub.
Calothamnus pachystachyus (P4)	Possible	Unlikely	Suitable habitat present. Not flowering. Large conspicuous shrub.
Chorizema ulotropis (P4)	Possible	Possible	Suitable habitat present. Not flowering. Prostrate shrub.
Conostylis caricina subsp. *elachys* (P1)	Possible	Possible	Suitable habitat present. Not flowering. Small inconspicuous herb.
Cyanicula ixioides subsp. *ixioides* (P4)	Possible	Possible	
Eleocharis keigheryi (T)	Possible	Highly Unlikely	No surface water present.
Gastrolobium crispatum (P1)	Possible	Unlikely	Some suitable habitat present. Not flowering. Large conspicuous shrub.
Gastrolobium nudum (P2)	Possible	Unlikely	Suitable habitat present. Not flowering. Large conspicuous shrub.
Grevillea bracteosa subsp. *bracteosa* (T)	Possible	Unlikely	
Grevillea corrugata (T)	Possible	Unlikely	
Grevillea curviloba (T)	Possible	Highly Unlikely	No suitable habitat present (winter-wet heath)
Hemigenia platyphylla (P4)	Possible	Unlikely	Some suitable habitat present. Not flowering. Large conspicuous shrub.
Hibbertia miniata (P4)	Possible	Unlikely	Suitable habitat present. Not flowering. Medium-sized shrub.
Hydrocotyle lemnoides (P4)	Possible	Highly Unlikely	No surface water present
Johnsonia inconspicua (P3)	Possible	Possible	Some suitable habitat present. Not flowering. Small inconspicuous herb.
Lasiopetalum caroliae (P3)	Possible	Confirmed	Recorded during the current survey.
Lechenaultia magnifica (P1)	Possible	Unlikely	Suitable habitat present. Not flowering. Medium-sized shrub.
Millotia tenuifolia var. *laevis* (P2)	Possible	Possible	Suitable habitat present. Not flowering. Small inconspicuous herb.
Schoenus capillifolius (P3)	Possible	Possible	Annual sedge – would not have been present at time of survey

Taxon	Likelihood Pre-Survey	Likelihood Post-Survey	Reasoning
Stylidium longitubum (P4)	Possible	Possible	Annual herb – would not have been present at time of survey
Stylidium vinosum (P1)	Possible	Possible	Some suitable habitat present. Not flowering. Small inconspicuous herb.
Synaphea rangiferops (P2)	Possible	Possible	Suitable habitat present. Not flowering. Small shrub.
Tetratheca pilifera (P3)	Possible	Possible	Suitable habitat present. Not flowering. Small inconspicuous shrub/herb.
Thelymitra stellata (T)	Possible	Possible	
Verticordia citrella (P2)	Possible	Possible	Indeterminate *Verticordia* sp. has the potential to be this taxa.
Verticordia huegelii var. *tridens* (P3)	Possible	Unlikely	Suitable habitat present. Not flowering. Medium-sized shrub.
Verticordia serrata var. linearis (P3)	Possible	Unlikely	Some suitable habitat present. Not flowering. Large conspicuous shrub.
Beaufortia eriocephala (P3)	Unlikely	Confirmed	Recorded during the current survey.
Conospermum densiflorum subsp. *unicephalatum* (T)	Unlikely	Confirmed	

4.2.4 Flora of "Other" Significance

The EPA (2016a) advises that flora species, subspecies, varieties, hybrids, and ecotypes may be considered significant for reasons other than listing as a Threatened or Priority Flora taxa. This may include, but is not limited to, range extensions, keystone species, relic status, local endemism, and anomalous features. Such records contribute to a better understanding of the known distributions of taxa by extending the known range and by filling holes in the existing known distributions.

Based on these features, six species are considered to be range extensions and a further five species represent a locality hole (Table 4.4). Some of the locality holes are for relatively common species which have many records throughout the Swan Coastal Plain but which have less collections for adjacent bioregions.

Table 4.4: Flora of "other" significance recorded from the Study Area

Family	Taxon	Significance	Comment
Cyperaceae	*Lepidosperma* aff. *drummondii*	Other	*Lepidosperma drummondii* has a wide and relatively scattered distribution and is known from the Northern Jarrah Forest. The nomenclature "aff." indicates that the specimen is related to or has an affinity to but is not identical to *Lepidosperma drummondii*. The *Lepidosperma* genus has undergone and is still subject to substantial taxonomic revision. The specimen collected may represent a new species or subspecies and may require further investigation and/or submission for formal identification.

Family	Taxon	Significance	Comment
Ericaceae	*Leucopogon* sp. Newdegate (M. Hislop 3585)	LH	Represents a slight locality hole between Bindoon and populations in adjacent IBRA regions Additionally, the majority of records are found in the Geraldton Sandplains, Avon Wheatbelt, Mallee and Esperance bioregions, with only four records known from the Northern Jarrah Forest subregion.
Hemerocallidaceae	*Johnsonia pubescens*	RE	Slight range extension to the east. Closest record is approx. 23.6 km west of Study Area.
Loranthaceae	*Nuytsia floribunda*	LH	Represents a locality hole between the Swan Coastal Plain and records further east of the Study Area. *Nuytsia floribunda* (Australian Christmas Tree) is a common and well-known species and is likely to have been under-collected.
Olacaceae	*Olax scalariformis*	RE	May represent the most eastern record for this species. Closest record is approx. 38.7 km northwest of Study Area.
Dilleniaceae	*Hibbertia ?semipilosa*	RE	May represent the most northern record for this species. Closest record is approx. 22.3 km northwest of Study Area.
Iridaceae	*Patersonia occidentalis*	LH	Represents a slight locality hole between Avon Valley National Park to the south and just south of Calingiri to the north. This is likely reflective of less collections made outside of the Swan Coastal Plain where the majority of records are for this species.
Myrtaceae	*Calothamnus quadrifidus* subsp. *quadrifidus*	LH	Represents a slight locality hole between the Swan Coastal Plain, Toodyay to the south and Mogumber and Calingiri to the north.
Myrtaceae	*Beaufortia eriocephala* (P3)	LH	Represents a slight locality hole between Wongamine to the east and Boonanarring Nature Reserve to the northwest.
Proteaceae	*Banksia dallanneyi* subsp. *sylvestris*	RE	Slight range extension. May represent the most northern record for this species. Closest record is approx. 10.8 km south of the Study Area.
	Banksia sphaerocarpa var. *pumilio*	RE	Not found within Shire of Toodyay. Represents a slight range extension to the southeast. Closest record to the Study Area is approx. 17.2 km west-northwest.
	Conospermum densiflorum subsp. *unicephalatum*	RE	Represents a slight range extension to the south – specimen collected may be the most southern record. Closest record to the Study Area is approx. 28.1 km north.

424000

428000

6520000

6516000

Julimar Rd

Plunkett Rd

Legend

Study Area

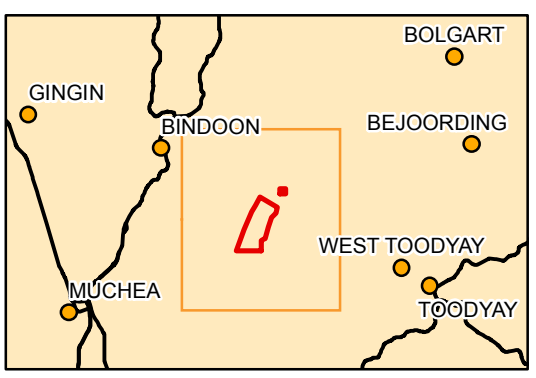
Local Road

Taxon

- *Conospermum densiflorum* subsp. *unicephalatum* - T
- *Drosera sewelliae* - P2
- *Drosera ?sewelliae* - P2
- *Beaufortia eriocephala* - P3
- *Lasiopetalum caroliae* - P3

0 0.5 1 1.5 Km

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 11/06/2021



N

biologic Environmental Survey

Scale: 1:28,000

MBS ENVIRONMENTAL

Julimar Exploration Project Reconnaissance and Targeted Flora Survey

Figure 4.3: Flora of conservation significance recorded in the Study Area

4.2.5 Introduced Flora Taxa

A total of three introduced taxa, **Aira caryophyllaceus*, **Ursinia anthemoides* and **Solanum nigrum* were recorded from the Study Area (Figure 4.4). The introduced taxa are not listed as WoNS, DPs or 'Priority Alert' weeds by Parks and Wildlife. Overall, the majority of the Study Area was free of any introduced weed species.

424000

428000

6520000

6516000

Julimar Rd

Plunkett Rd

Legend

Study Area

Local Road

Taxon

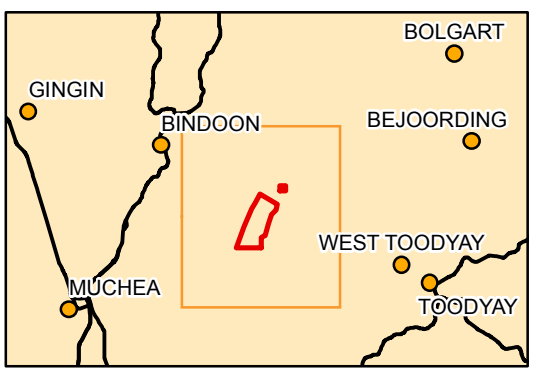
**Aira caryophyllea*

**Solanum nigrum*

**Ursinia anthemoides*

0 0.5 1 1.5 Km

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 11/06/2021



N

biologic Environmental Survey

Scale: 1:28,000

MBS ENVIRONMENTAL

Julimar Exploration Project Reconnaissance and Targeted Flora Survey

Figure 4.4: Introduced flora recorded in the Study Area

4.2.6 Vegetation Types

Broad Landforms

Landform and landscape position are the main driver of water availability within the Jarrah Forest and strongly influence the patterns of vegetation found across the landscape. Four broad landforms were identified within the Study Area (Table 4.5):

- Hills
- Valleys
- Drainage Lines
- Wetland

The dominant broad landform was Hills (1797 ha or 89% of the Study Area) which supported seven vegetation types, followed by Valleys (196 ha or 9.70%) with eight vegetation types, Drainage Lines (15.0 ha or 0.70%) with three vegetation types, and one small 0.09 ha Wetland area which was bare of vegetation at the time of the survey.

Hills consisted of low undulating hills, and included lower, mid and upper slopes as well as broad plateaus. Vegetation across different hillslope positions was relatively uniform consisting of eucalypt woodland and forest, with the exception of small patches that were lacking this eucalypt overstorey (vegetation types H6 and H7). Upper slopes and broad plateaus had a more open vegetation structure and appeared to be more affected by recent prescribed burns with frequent fire scars and bare gravel (corresponding to vegetation type H2).

Valleys were depressed areas at the bottom of hillslopes, including broad floodplains on the western and northern edges of the Study Area (V5, V6) as well as steeper valleys on the eastern side of the Study Area. Vegetation was highly variable across this landform, with most valleys having their own unique vegetation type.

Drainage Lines consisted of defined creeklines where the vegetation was observably different from the adjacent valley vegetation in either composition, structure or cover. It was noted that there were narrow shallow creeklines running through two of the valley vegetation types (V2 and V7); however the vegetation did not differ between the creekline and adjacent valley.

The broad landforms observed roughly correspond to the underlying regolith geology (see Figure 2.2). Exposed bedrock along the eastern side of the Study Area correspond to a number of the mapped Valley vegetation types. Exposed granite outcropping was also noted in this area. The Valley vegetation on the western side of the Study Area broadly matches the underlying alluvial/ fluvial regolith.

Vegetation Types

A total of nineteen vegetation types, inclusive of W1 which was currently devoid of vegetation, were described and delineated from the Study Area (Table 4.5, Figure 4.5) based on the four broad landforms.

Boundaries between vegetation types, especially for eucalypt woodland and forest vegetation types, were difficult to assess using aerial imagery alone. Regional imagery was highly variable between years due to repeated prescribed burns across the Study Area affecting the structure and density of the vegetation. Therefore a combination of regional imagery, ArcGIS imagery, 2 m contour lines, relevé floristic data and other field observations were used to guide vegetation mapping and description of the vegetation types.

The most common vegetation type was H1 comprising 1402 ha or 69% of the Study Area. There were small patches throughout this vegetation type where either only *Eucalyptus marginata* (jarrah) or *Corymbia calophylla* (marri) were present, however delineating the boundaries between these using aerial imagery was not possible. The understorey flora composition was highly consistent across both vegetation type H1 and H2. Vegetation types H1 and H2 were found on sandy loams with pebbles and occasional lateritic outcropping; this broadly corresponds to the underlying ferruginous duricrust regolith unit (see Figure 2.2).

During the current survey vegetation type W1 was a claypan bare of any vegetation, but it is highly likely that following winter rainfall annual flora will germinate and grow. There is a potential that *Schoenus natans* (P4) identified by the desktop assessment may be found in W1 during spring, as its habitat includes claypans and winter-wet depressions.

The vegetation types described for the Study Area broadly correspond to the Pindalup (Pn), Yalanbee (Y5) and the Coolakin (Ck) vegetation complexes. The vegetation broadly represent *Eucalyptus marginata* and *Corymbia calophylla* woodlands with *Eucalyptus wandoo* present. This broad upper stratum combination is consistent with the Pindalup (Pn), Yalanbee (Y5) and Cookakin (Ck) vegetation complexes (Mattiske & Havel, 1998).

The survey occurred out of season for south-west Western Australia, resulting in a low number of taxa flowering and/ or fruiting. There is also likely to be several annual herbs and sedges that were not present at the time of survey. This may have affected description of the vegetation types, especially for vegetation of Valleys and Drainage Lines.

In addition to the eighteen vegetation types and W1 described and delineated from the Study Area, an additional unit, “Cleared” (Cl), was mapped within the Study Area. The Cleared unit coincided with roads, informal tracks and firebreaks. The cleared unit occurred across 12.83 ha or 0.63% of the Study Area (Figure 4.5). Intact native vegetation (all vegetation types and W1) covered 99.37% of the survey area (2009 ha).

Table 4.5: Vegetation type and extent recorded from the Study Area.

Map Code	Veg Code	Description	Sample sites	Extent (ha / %)	Significant Features	Condition	Photo
HILLS							
H1	EmCc BssXpBs HhSrBds	Mid open forest of *Eucalyptus marginata* and *Corymbia calophylla* over mid-tall open shrubland of *Banksia squarrosa* subsp. *squarrosa*, *Xanthorrhoea preissii* and *Banksia sessilis* over low open shrubland of *Hibbertia hypericoides*, *Styphelia retrorsa* and *Banksia dallanneyi* subsp. *sylvestris*	BAU-03, HAR-01, HAR-10, HAR-11, HAR-12, HAR-13, HAR-14, HAR-16, HAR-17, HAR-18, HAR-21, HAR-23, HAR-27, HAR-30, HAR-32, HAR-33, HAR-34, HAR-36, HAR-38, HAR-40, HAR-42, HAR-47, HAR-49, HAR-51, HAR-52, HAR-53, HAR-55, HAR-59, HAR-62, HAR-65, HAR-90	1402 / 69	1x location of *Beaufortia eriocephala*, 35x locations of *Drosera*? *Sewelliae*, 1x DBCA record of *Drosera sewelliae*	Good - Excellent	
H2	EmCc BssXpMr HhPcHl	Low open woodland of *Eucalyptus marginata* and *Corymbia calophylla* over tall open shrubland of *Banksia squarrosa* subsp. *squarrosa*, *Xanthorrhoea preissii* and *Macrozamia riedlei* over low open shrubland of *Hibbertia hypericoides*, *Phyllanthus calycinus* and *Hakea lissocarpha*	HAR-05, HAR-22, HAR-29	148 / 7	10x locations of *Drosera* ?*sewelliae*	Very Good - Excellent	
H3	CcEm AcBss AcBspHh	Low-mid open woodland of *Corymbia calophylla* and *Eucalyptus marginata* over tall shrubland of *Adenanthos cygnorum* and *Banksia squarrosa* subsp. *squarrosa* over low sparse shrubland *of Adenanthos cygnorum*, *Banksia sphaerocephala* var. *pumilio* and *Hibbertia hypericoides*	HAR-19, HAR-20, HAR-28, HAR-31	58 / 2.85	6x locations of *Drosera* ?*sewelliae*	Excellent	

Map Code	Veg Code	Description	Sample sites	Extent (ha / %)	Significant Features	Condition	Photo
H4	EwEmCc BssXp HhSrHl	Mid woodland of *Eucalyptus wandoo*, *Eucalyptus marginata* and *Corymbia calophylla* over mid-tall open shrubland of *Banksia squarrosa* subsp. *squarrosa* and *Xanthorrhoea preissii* over low open shrubland of *Hibbertia hypericoides*, *Styphelia retrorsa* and *Hakea lissocarpha*	HAR-56, HAR-60, HAR-61, HAR-62, HAR-66	158 / 7.8	1x location of *Drosera* ?*sewelliae*	Good - Excellent	
H5	EwEc Xp HhHlBbb	Mid woodland of *Eucalyptus wandoo* and *Eucalyptus accedens* over mid sparse shrubland of *Xanthorrhoea preissii* over low sparse shrubland of *Hibbertia hypericoides*, *Hakea lissocarpha* and *Banksia bipinnatifida* subsp. *bipinnatifida*	BAU-04, HAR-57, HAR-63	29.5 / 1.5		Very Good - Excellent	
H6	Xp BffCqqHh	Tall sparse shrubland of *Xanthorrhoea preissii* over low shrubland of *Banksia fraseri* var. *fraseri*, *Calothamnus quadrifidus* subsp. *quadrifidus* and *Hibbertia hypericoides*	HAR-67	1.1 / 0.05		Excellent	

Map Code	Veg Code	Description	Sample sites	Extent (ha / %)	Significant Features	Condition	Photo
H7	AhXpBss PoHhBc Ls	Tall open shrubland of *Allocasuarina humilis*, *Xanthorrhoea preissii* and *Banksia squarrosa* subsp. *squarrosa* over low open shrubland of *Patersonia occidentalis*, *Hibbertia hypericoides* and *Babingtonia camphorosmae* over low open herbland of *Laxmannia squarrosa*	HAR-72	1.2 / 0.06		Excellent	
VALLEYS							
V1	Ea XpMr BeHlBbb	Low open woodland of *Eucalyptus accedens* over tall sparse shrubland of *Xanthorrhoea preissii* and *Macrozamia riedlei* over low open shrubland of *Bossiaea eriocarpa*, *Hakea lissocarpha* and *Banksia bipinnatifida* subsp. *bipinnatifida*	HAR-07	27.3 / 1.35	1x location of *Lasiopetalum caroliae*	Excellent	
V2	EwEa AlsXp Hh	Mid woodland of *Eucalyptus wandoo* and *Eucalyptus accedens* over mid-tall open shrubland of *Acacia lasiocarpa* var. *sedifolia* and *Xanthorrhoea preissii* over low open shrubland of *Hibbertia hypericoides*	HAR-08	16.1 / 0.79	1x location of *Lasiopetalum caroliae*	Excellent	

Map Code	Veg Code	Description	Sample sites	Extent (ha / %)	Significant Features	Condition	Photo
V3	EmCcEw BsDaXp BcMtSr	Mid open woodland of *Eucalyptus marginata* and *Corymbia calophylla* with isolated *Eucalyptus wandoo* trees over tall open *Banksia sessilis* shrubland over mid shrubland of *Daviesia angulata* and *Xanthorrhoea preissii* over low shrubland of *Babingtonia camphorosmae*, *Melaleuca trichophylla* and *Styphelia retrorsa*	Mapping note	4.13 / 0.20	1x location of *Drosera* ?*sewelliae*	Excellent	
V4	Cc HuAc GcLe	Mid isolated *Corymbia calophylla* trees over tall scattered *Hakea undulata* and *Adenanthos cygnorum* shrubs over mid closed shrubland of *Gastrolobium calycinum* and *Leptospermum erubescens*	HAR-03	28.3 / 1.40	1x location of *Drosera* ?*sewelliae*	Excellent	
V5	EwCcEm LeBssAc BeBcSr	Mid open woodland to isolated trees of *Eucalyptus wandoo*, *Corymbia calophylla* and *Eucalyptus marginata* over tall open shrubland of *Leptospermum erubescens*, *Banksia squarrosa* subsp. *squarrosa* and *Adenanthos cygnorum* over low open shrubland of *Bossiaea eriocarpa*, *Babingtonia camphorosmae* and *Styphelia retrorsa*	HAR-48	71.8 / 3.5	1x location of *Drosera* ?*sewelliae*, 1x DBCA record of *Drosera sewelliae*	Good – Excellent	

Map Code	Veg Code	Description	Sample sites	Extent (ha / %)	Significant Features	Condition	Photo
V6	BssBs HhCsCqq	Tall closed shrubland of *Banksia squarrosa* subsp. *squarrosa* and *Banksia sessilis* over low open shrubland of *Hibbertia hypericoides*, *Calytrix* sp. indet 2, and *Calothamnus quadrifidus* subsp. *quadrifidus*	HAR-45, HAR-54	7.32 / 0.36		Excellent	
V7	Ew TooXp GcBe	Mid open forest of *Eucalyptus wandoo* over mid-tall open shrubland of *Trymalium odoratissimum* subsp. *odoratissimum* and *Xanthorrhoea preissii* over low open shrubland of *Gastrolobium calycinum* and *Bossiaea eriocarpa*	HAR-37, HAR-70	39.9 / 1.97		Excellent	
V8	BssLeAh Bsp	Tall closed shrubland of *Banksia squarrosa* subsp. *squarrosa*, *Leptospermum erubescens* and *Allocasuarina huegeliana* over low open shrubland of *Banksia sphaerocarpa* var. *pumilio*	HAR-39	1.17 / 0.06	1x location of *Conospermum densiflorum* subsp. *unicephalatum*, 1x location of *Drosera ?sewelliae*	Excellent	

Map Code	Veg Code	Description	Sample sites	Extent (ha / %)	Significant Features	Condition	Photo
DRAINAGE LINES							
D1	EaEwCc TooXp PcHlHh	Mid woodland of *Eucalyptus accedens*, *Eucalyptus wandoo* and *Corymbia calophylla* over a tall shrubland of *Trymalium odoratissimum* subsp. *odoratissimum* and *Xanthorrhoea preissii* over a low open shrubland of *Phyllanthus calycinus*, *Hakea lissocarpha* and *Hibbertia hypericoides*	HAR-25	11.5 / 0.57		Excellent	
D2	CcEw TooXp BeTooHs	Mid closed forest of *Corymbia calophylla* with isolated *Eucalyptus wandoo* trees over tall closed shrubland of *Trymalium odoratissimum* subsp. *odoratissimum* and *Xanthorrhoea preissii* over low shrubland of *Bossiaea eriocarpa*, *Trymalium odoratissimum* subsp. *odoratissimum* and *Hibbertia semipilosa*	HAR-26	2.77 / 0.14		Very Good	
D3	Ea Ac HhXgHl	Low open woodland of *Eucalyptus accedens* over tall shrubland of *Acacia celastrifolia* over low open shrubland of *Hibbertia hypericoides*, *Xanthorrhoea gracilis* and *Hakea lissocarpha*	HAR-06	0.77 / 0.04		Excellent	

Map Code	Veg Code	Description	Sample sites	Extent (ha / %)	Significant Features	Condition	Photo
WETLAND							
W1	W1	Wetland – bare clearing of clay	Mapping note	0.09 / 0.004		Very Good	
MAPPING UNIT							
Cl	Cl	Cleared areas – roads, informal tracks and firebreaks		12.83 / 0.63			
			Study Area Total	2021.47 / 100			

424000

428000

6520000

6516000

Julimar Rd

Plunkett Rd

H5
H1
V4
H1
H2
V1
D3
V2
V3
H1
Cl
H3
Cl
D1
V1
H1
H1
Cl
H2
V7
D2
H4
H7
Cl
V6
W1
H6
H1
V5
H1
V8
Cl
V6
H1
H4
H5
H4
Cl

Legend

- Study Area
- Local Road

Vegetation Type

- Cl
- D1
- D2
- D3
- H1
- H2
- H3
- H4
- H5
- H6
- H7
- V1
- V2
- V3
- V4
- V5
- V6
- V7
- V8
- W1

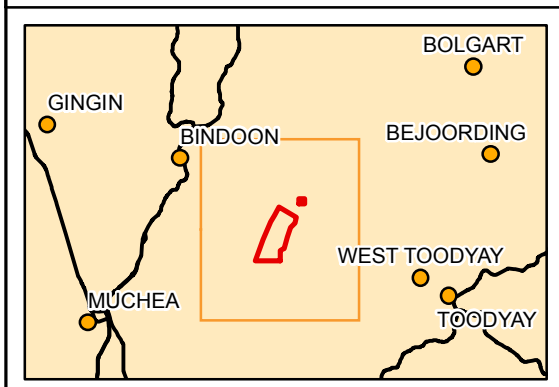
0 0.5 1 1.5 Km

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 08/06/2021

N

biologic Environmental Survey

Scale: 1:28,000



MBS ENVIRONMENTAL

Julimar Exploration Project Reconnaissance and Targeted Flora Survey

Figure 4.5: Vegetation types in the Study Area

4.2.7 Vegetation of Conservation Significance

TEC's & PEC's Within the Study Area

No vegetation associations described from the Study Area are defined as, or representative of the TEC's or PEC's known to occur in the Jarrah Forrest bioregion. No TEC's or PEC's identified in the database searches occur inside or within 9 km of the Study Area (see Section 4.1).

TEC's & PEC's in the Vicinity of the Study Area

Five conservation significant vegetation communities were previously recorded near the Study Area from the desktop assessment (see Table 4.2). Each of these communities are greater than 9 km from the Study Area and the vegetation types recorded in the Study Area lack the key diagnostic species or characteristics for these vegetation communities.

The "Claypans with mid dense shrublands of *Melaleuca lateritia* over herbs" community typically occurs on clay soils in low lying flats that are seasonally wet or inundated and requires clay soils, fresh surface water and a surrounding catchment area (DBCA, 2019; DPaW, 2015). The "Wandoo woodland over dense low sedges of *Mesomelaena preissii*" community is also associated with the "clay pans" PEC/ TEC, with similar habitat requirements (DBCA, 2019). Key diagnostic characteristics were not observed in the Study Area. Specifically, key characteristics include; clay based soil with either *Eucalyptus wandoo* over *Mesomelaena preissii* or a mid dense shrubland of *Melaleuca lateritia*.

The "Eucalypt woodlands of the Western Australian Wheatbelt" community and "York Gum woodlands" community require specific diagnostic species found within the Avon Wheatbelt bioregion and transitional regional areas. Outlier patches occurring within the Jarrah Forest generally occur south of Northam (DoEE, 2016). None of the key Eucalypt species were present in the Study Area. As a result, the Eucalypts woodlands of the Western Australian Wheatbelt TEC does not occur in the Study Area (DoEE, 2016).

The Banksia woodlands of the Swan Coastal Plain TEC is largely restricted to the Perth and Dandaragan subregions of the Swan Coastal Plain bioregion (TSSC, 2016). The community occasionally extends to the immediately adjacent areas on the Darling escarpment within the Northern Jarrah Forest subregion (TSSC, 2016). As the key *Banksia* species (*B. attenuata, B. menziesii, B. prionotes* and *B. ilicifolia*) were not recorded from the Study Area, the presence of the ecological community in the Study Area is highly unlikely.

4.2.8 Vegetation of "Other" Significance

The EPA (2016a) advises that vegetation may be of significance for reasons other than a listing as a TEC or a PEC. This may include, although is not limited to, scarcity, novel combination of species, role as a refuge, restricted distribution and vegetation extent being below a threshold level.

The following vegetation types have a role as a refuge for the four conservation significant flora found:

- *Conospermum densiflorum* subsp. *unicephalatum* was associated with vegetation type V8
- *Drosera* ?*sewelliae* was associated with vegetation types H1, H2, H3, H4, V3, V4, V5 and V8
- *Beaufortia eriocephala* was associated with vegetation type H1
- *Lasiopetalum caroliae* was associated with vegetation types V1 and V2

One individual of Threatened taxon *Conospermum densiflorum* subsp. *unicephalatum* was found within vegetation type V8. This was a dense shrubland in clay with granite-indicator species such as *Allocasuarina huegeliana*. The desktop assessment assessed *Conospermum densiflorum* subsp. *unicephalatum* as Unlikely to occur within the Study Area, hence it was not specifically targeted during the field survey. It is likely that additional individuals may be present within vegetation type V8.

Vegetation in proximity to groundwater and surface water

The Study Area within Julimar State Forest is relatively high in the landscape and thus only supports minor upper catchment values. Drainage Line vegetation types as well as vegetation types V2 and V7 contained narrow dry creeklines. These drainage lines are ephemeral and likely only support surface water following winter rainfall or immediately following substantial rainfall events. As the drainage lines occur in the upper catchments, surface water persistency will be minor and likely only persist during rainfall events.

Vegetation type W1 was a bare clearing of dry clay, which may support a range of annual taxa after winter rains and soil saturation. Vegetation type H3, located on the western side of the Study Area, is likely to be important for surface water runoff into Gakaling Swamp. None of the vegetation within the Study Area is likely to be dependent upon continuous access to surface water or groundwater.

Several flora taxa which are known to grow in low-lying habitat with higher soil moisture levels were found in Valley and Drainage Line vegetation, including *Trymalium odoratissimum* subsp. *odoratissimum*, *Melaleuca incana, Calothamnus lateralis, Hakea varia* and *Jacksonia sternbergiana*. However, these species are not confined to major drainage lines and can grow on lower-mid slopes or seasonally wet flats and depressions. Taxa which are more typical of major rivers or wetlands in the Jarrah Forest bioregion, such as *Eucalyptus rudis, Eucalyptus patens, Melaleuca rhaphiophylla* and *Banksia littoralis* were not found. The drainage lines and valleys of the Study Area allow surface water runoff towards Spice Brook and the Brockman River to the west and Julimar Brook and the Avon River to the east and are important in maintaining hydrological connectivity across the landscape.

Local and Regional Significance

The three vegetation complexes recorded from the Study Area (Pindalup (Pn), Yalanbee (Y5) and the Coolakin (Ck)) were not considered to be locally or regionally significant (Mattiske & Havel, 1998). These vegetation complexes (Mattiske & Havel, 1998) are well represented

across the Northern Jarrah Forest subregion and the Shire of Toodyay, with greater than the 30% threshold for current remaining extent (see Table 2.5).

4.2.9 Vegetation Condition

The condition of the vegetation within the Study Area ranged from Good to Excellent (Table 4.6, Figure 4.6). The majority of the Study Area was in Excellent condition with three or more intact structural layers and species diversity consistent with what is expected for the Northern Jarrah Forest subregion. The main disturbance was from prescribed burns, with vegetation on hills being more fire-affected than the valleys. The condition of vegetation type H2 was downgraded to Very Good as fire frequency had started to affect vegetation structure and cover. Vegetation type D2 was downgraded to Very Good due to substantial crown dieback of mature *Corymbia calophylla* trees. This is likely to be due to water access and availability rather than any fungal pathogens or microbes (i.e., *Quambalaria coyrecup*; marri canker).

A few small areas adjacent to tracks and old borrow pits were also downgraded in condition. The small number of introduced weed species present were in vegetation adjacent to farmland, such as south of Julimar Rd and in Baudin. These weeds were not present in high densities warranting any downgrading of vegetation condition.

The cleared portion of the Study Area has not been assigned a vegetation condition rating as the unit did not support any native flora species.

Table 4.6: Vegetation condition extent in the Study Area

Condition	Extent (ha / %)	Comment
Excellent	1898 / 94	Occurred across the majority of the survey area, including most described vegetation types.
Very Good	109 / 5	Coincided with vegetation types H2 and D2, as well as a few small areas where tracks were more prevalent. Generally supported a vegetation structure that is consistent with undisturbed ecosystems (i.e., upper, mid and lower strata with native species dominating the stratums). Weeds were absent.
Good	2 / 0.1	Coincided with a few small areas adjacent to roads and tracks, some of which had old borrow pits. Native vegetation was still present in these areas but certain species, e.g., *Banksia sessilis*, were growing abundantly in response to ground disturbance. The vegetation supported a structure that mostly resembled a natural ecosystem.
Cleared	13 / 1	Coincided with the cleared informal tracks, roads and firebreaks along fencelines.

424000

428000

6520000

6516000

Julimar Rd

Plunkett Rd

Legend

Study Area

Local Road

Vegetation Condition

Excellent

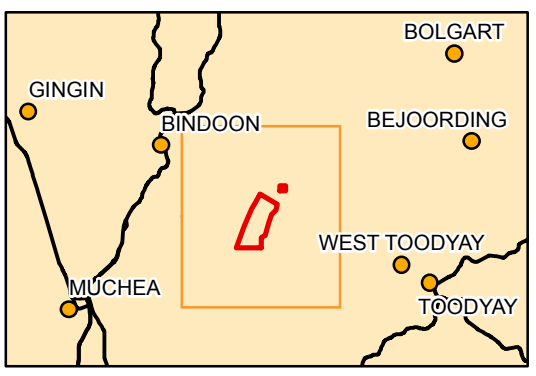
Very Good

Good

Cleared

0 0.5 1 1.5 Km

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 08/06/2021



N

biologic Environmental Survey

Scale: 1:28,000

MBS ENVIRONMENTAL

Julimar Exploration Project Reconnaissance and Targeted Flora Survey

Figure 4.6: Vegetation condition in the Study Area

5 CONCLUSION

A single season reconnaissance flora and vegetation survey and targeted flora survey was completed over five days in April and May 2021 within the Study Area. The desktop assessment revealed substantial flora and vegetation values in the local region, including three priority flora taxa confirmed to occur within the Study Area and 33 taxa either Highly Likely or Possible to occur, as well as two conservation significant ecological communities with potential to occur.

A total of 130 native vascular plant taxa were found throughout the Study Area, from 29 families and 62 genera. Four conservation significant flora were found, as well as 12 taxa considered significant for other reasons as per EPA (2016a) guidelines;

- *Conospermum densiflorum* subsp. *unicephalatum* (T) – one individual from one point location;
- *Drosera ?sewelliae* (P2) – 1,551 individuals from 56 point locations;
- *Beaufortia eriocephala* (P3) – 10 individuals from one point location; and
- *Lasiopetalum caroliae* (P3) – two individuals from one point location

Specimens collected from the vicinity of existing DBCA records for *Synaphea grandis* (P4) and *Persoonia sulcata* (P4) were identified as common species from the *Synaphea* and *Persoonia* genera. Recollection of flowering and/or fruiting material from these locations is required to confirm the presence of these taxa within the Study Area.

Vegetation of the Study Area was mostly in Excellent condition with only three introduced weed species present. Large portions of the Study Area north of Julimar Road had recent evidence of fire, associated with state prescribed burns. Nineteen vegetation types were mapped and delineated across four broad landforms; hills, valleys, drainage lines and wetland. None of these vegetation types are considered to represent any of the TECs/PECs identified by the desktop assessment. Vegetation types H1, H2, H3, H4, V1, V2, V3, V4, V5 and V8 hold importance as refuge for the conservation significant flora found within the Study Area.

6 REFERENCES

AECOM. (2016). *Toodyay Road Widening Metro and Wheatbelt Regions Biological Surveys*. Perth, WA:

ALA, Atlas of Living Australia. (2020). Atlas of Living Australia; Occurrence search (custom search). from ALA,, Atlas of Living Australia http://www.ala.org.au/

ALA, A. o. L. A. (2021). Atlas of Living Australia; Occurrence search (custom search). from ALA, Atlas of Living Australia http://www.ala.org.au/

Beard, J. S. (1975a). The vegetation survey of Western Australia. *Vegetatio, 30*(3), 179-187.

Beard, J. S. (1975b). *Vegetation Survey of Western Australia. 1:1 000 000 Vegetation Series sheet 5 - Pilbara. Map and explanatory notes*. Nedlands Western Australia: University of Western Australia Press.

Beard, J. S. (1990). *Plant life of Western Australia*. Kenthurst, New South Wales: Kangaroo Press.

Bennett Environmental. (2006). *Flora and Vegetation: Reserve 2145 and Percy Cullen Oval Gidgegannup*. Kalamunda, WA:

Biologic. (2020). *Julimar exploration project: reconnaissance and targeted flora survey*.

BoM. (2020). Climate data online. Retrieved 2020, from Bureau of Meteorology http://www.bom.gov.au./climate/data/index.shtml

BoM. (2021). Climate data online. Retrieved 2021, from Bureau of Meteorology http://www.bom.gov.au./climate/data/index.shtml

DAWE, Department of Agriculture, Water and the Environment. (2020). Protected matters search tool (custom search). from DAWE,, Department of Agriculture, Water and the Environment www.environment.gov.au/erin/ert/epbc/index.html

DAWE, Department of Agriculture, Water and the Environment. (2021). Protected Matters Search Tool (custom search). from DAWE,, Department of Agriculture, Water and the Environment www.environment.gov.au/erin/ert/epbc/index.html

DBCA. (2019). *National Recovery Plan for the Clay pans of the Swan Coastal Plain Ecological Community*. Department of Biodiversity, Conservation and Attractions, Perth, Western Australia:

DBCA. (2020). NatureMap; mapping Western Australia's biodiversity (custom search). from Department of Biodiversity, Conservation and Attractions http://naturemap.dec.wa.gov.au./default.aspx

DBCA. (2021a). NatureMap; mapping Western Australia's biodiversity (custom search). from Department of Biodiversity, Conservation and Attractions http://naturemap.dec.wa.gov.au./default.aspx

DBCA. (2021b). Threatened and Priority Ecological Communities Database (custom search). from Department of Biodiversity, Conservation and Attractions http://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/threatened-animals

DBCA. (2021c). Threatened and Priority Flora Database (custom search). Retrieved 2021, from Department of Biodiversity, Conservation and Attractions http://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/threatened-animals

DBCA, Department of Biodiversity, Conservation and Attractions. (2021d). EPA Redbook Recommended Conservation Reserves 1976-1991 (DBCA-029). Retrieved 2021

https://catalogue.data.wa.gov.au/dataset/epa-redbook-recommended-conservation-reserves-1976-1991

DEC. (2004). *Foreshore and channel assessment of Wundowie Wetland and Magnolia Creek*.

DoE, D. o. t. E. (2015). Approved conservation advice (including listing advice) for the Eucalypt woodlands of the Western Australian wheatbelt.

DoEE. (2016). *Eucalypt Woodlands of the Western Australian Wheatbelt: a nationally protected ecological community*. Commonwealth of Australia:

DPaW, Department of Parks and Wildlife. (2015). *Interim Recovery Plan 2015-2020 for Clay pans of the Swan Coastal Plain (Swan Coastal Plain community types 7, 8, 9 and 10a) and Clay pans with mid dense shrublands of Melaleuca lateritia over herbs*. Interim Recovery Plan No. 354. Perth WA:

DPIRD, Department of Primary Industries and Regional Development. (2020). Western Australian Organism List (custom search). from DPIRD,, Department of Primary Industries and Regional Development https://www.agric.wa.gov.au/organisms

DPIRD, Department of Primary Industries and Regional Development. (2021a). 2 metre contours (DPIRD-072). Retrieved from: https://catalogue.data.wa.gov.au/dataset/dpird-2-metre-contours

DPIRD, Department of Primary Industries and Regional Development. (2021b). Soil Landscape Mapping - Systems (DPIRD-064). Retrieved from: https://catalogue.data.wa.gov.au/dataset/soil-landscape-mapping-systems

DPIRD, Department of Primary Industries and Regional Development. (2021c). Western Australian Organism List (custom search). from DPIRD,, Department of Primary Industries and Regional Development https://www.agric.wa.gov.au/organisms

DPIRD, Department of Primary Industry and Regional Development. (2021d). Soil Landscape Mapping - Western Australia attributed by WA Soil Group (DPIRD-076). Retrieved from: https://catalogue.data.wa.gov.au/dataset/soil-landscape-mapping-western-australia-attributed-by-wa-soil-group

DWER, Department of Water and Environmental Regulation (2021). Clearing Regulations - Environmentally Sensitive Areas (DWER-046). Retrieved 2021 https://catalogue.data.wa.gov.au/dataset/clearing-regulations-environmentally-sensitive-areas-dwer-046

Ecoscape. (2012). *Bindoon Defence Training Area Flora Surveys 2011: DFSW Range, DEMS Range, Static Grenade Range No. 2*. North Fremantle, WA:

EPA. (2016a). *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment*. Perth, Western Australia: Environmental Protection Authority.

EPA. (2016b). *Technical Guidance: Sampling Methods for Terrestrial Vertebrate Fauna*. Perth, Western Australia: Environmental Protection Authority.

EPA, Environmental Protection Authority. (2016c). *Environmental Factor Guideline: Flora and Vegetation*. Perth, Western Australia: The Government of Western Australia.

EPA, Environmental Protection Authority. (2018). *Statement of Environmental Principles, Factors and Objectives*. Perth, Western Australia: The Government of Western Australia.

ESCAVI, Executive Steering Committee for Australian Vegetation Information. (2003). *Australian vegetation attribute manual: National vegetation information system (version 6.0)*. Canberra,

Australian Capital Territory: ESCAVI,, Executive Steering Committee for Australian Vegetation Information.

Focused Vision. (2017). *Level 2 Flora And Vegetation Assessment And Targeted Thelymitra Stellata Survey Great Northern Highway, Muchea To Wubin Upgrades, Stage 2 – Bindoon Options*. Spearwood, WA:

Focused Vision. (2018). *Detailed Flora and Vegetation Assessment, Bindoon Bypass, Great Northern Highway*. Spearwood, WA:

Government of Western Australia. (2018). 2017 Statewide Vegetation Statistics incorporating the CAR Reserve Analysis (Full Report). Current as of December 2017. Retrieved from https://catalogue.data.wa.gov.au/dataset/dbca-statewide-vegetation-statistics

Government of Western Australia. (2019). 2018 South West Vegetation Complex Statistics. Current as of March 2019. Retrieved from https://catalogue.data.wa.gov.au/dataset/dbca

GSWA, Geological Survey of Western Australia,. (2016). *1:500,000 State Interpreted Bedrock Geology of Western Australia 2016*.

GSWA, Geological Survey of Western Australia,. (2020). *1:500 000 State regolith geology of Western Australia: Geological Survey of Western Australia, digital data layer*.

Hnatiuk, R. J., Thackway, R., & Walker, J. (2009). Vegetation. In The National Committee on Soil and Terrain (Ed.), *Australian soil and land survey* (Third ed.). Collingwood, Victoria: CSIRO Publishing.

Keighery, B. J. (1994). *Bushland Plant Survey: a Guide to Plant Community Surveys for the Community*. Nedlands, Western Australia: Wildflower Society of Western Australia (Inc.).

Keighery, G. J., Gibson, N., Webb, A., & Muir, W. P. (2002). A biological survey of the agricultural zone: vegetation and vascular flora of Drummond Nature Reserve. *Conservation Science Western Australia, 4*(1), 63-78.

Landgate. (2021). WA regional aerial photography mosaic (LGATE-321). Retrieved from: https://catalogue.data.wa.gov.au/dataset/wa-regional-aerial-photography-mosaic

Maia. (2017). *Instant Product Group: Muchea Lot 195 Detailed (Level 2) Flora and Vegetation Assessment*. Subiaco, WA:

Mattiske. (2019). *Assessment of potential flora, vegetation and fauna values - Julimar Project, Bindoon, WA*. Kalamunda, WA:

Mattiske, & Havel. (1998). *Vegetation mapping in the South West of Western Australia*. Kalamunda, WA:

Northcote, K. H., Beckmann, G. G., Bettenay, E., Churchward, H. M., Van Dijk, D. C., Dimmock, G. M., . . . Wright, M. J. (1968). *Atlas of Australian Soils, Sheets 1 to 10*. Melbourne, Victoria: http://www.asris.csiro.au/themes/Atlas.html#Atlas_References

NVIS Technical Working Group. (2017). *Australian Vegetation Attribute Manual: National Vegetation Information System, Version 7.0* (D. o. t. E. a. Energy Ed.). Canberra: Department of the Environment and Energy.

Phoenix. (2015). *Flora and fauna assessment for Muchea North and Chittering study area: Great Northern Highway, Muchea to Wubin Upgrade Stage 2 Project*. Balcatta, WA:

Phoenix. (2016). *Flora and fauna assessment for Calingiri to Wubin study areas: Great Northern Highway, Muchea to Wubin Upgrade Stage 2 Project*. Balcatta, WA:

Schoknecht, N., & Pathan, S. (2013). *Soil groups of Western Australia: a simple guide to the main soils of Western Australia (4th edn)*. Perth:

Schoknecht, N., Tille, P., & Purdie, B. (2004). *Soil-landscape mapping in south-western Australia*.

Shepherd, D. P., Beeston, G. R., & Hopkins, A. J. M. (2002). *Native vegetation in Western Australia: Extent, type and status*. Perth, Western Australia: Western Australian Department of Agriculture.

Shepherd, K. A., & Wilkins, C. F. (2017). A revision of the *Lasiopetalum floribundum* group (Malvaceae), including recognition of four new species. *Nuytsia, 28*, 273-298.

Specht, R. L., & Specht, A. (1999). *Australian plant communities: dynamics of structure, growth and biodiversity*. Oxford, UK: Oxford University Press.

Thackway, R., & Cresswell, I. D. (1995). *An interim biogeographic regionalisation for Australia: A framework for setting priorities in the National Reserves System Cooperative Program*. Canberra, Australian Capital Territory: Australian Nature Conservation Agency.

TSSC, Threatened Species Scientific Committee. (2016). *Approved Conservation Advice (incorporating listing advice) for the Banksia Woodlands of the Swan Coastal Plain ecological community*.

WAH, Western Australian Herbarium. (1998-). FloraBase-the Western Australian Flora. Retrieved January 2020, from WAH,, Western Australian Herbarium https://florabase.dpaw.wa.gov.au/

Webb, A., Kinloch, J., Keighery, G., & Pitt, G. (2016). *The extension of vegetation complex mapping to landform boundaries within the Swan Coastal Plain landform and forested region of south-west Western Australia*. Unpublished report prepared for the Department of Parks and Wildlife:

Williams, K., & Mitchell, D. (2001). *Jarrah Forest 1 (JF1 - Northern Jarrah Forest subregion)*.

7 APPENDICES

Appendix A: State and Federal Conservation Codes

International Union for Conservation of Nature

Category	Definition
Extinct (EX)	A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.
Extinct in the Wild (EW)	A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.
Critically Endangered (CR)	A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered (see Section V), and it is therefore considered to be facing an extremely high risk of extinction in the wild.
Endangered (EN)	A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered (see Section V), and it is therefore considered to be facing a very high risk of extinction in the wild.
Vulnerable (VU)	A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable (see Section V), and it is therefore considered to be facing a high risk of extinction in the wild.
Near Threatened (NT)	A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.
Least Concern (LTC	A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.
Data Deficient (DD)	A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, and a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.
Not Evaluated (NE)	A taxon is Not Evaluated when it has not yet been evaluated against the criteria.

Environment Protection and Biodiversity Conservation Act 1999

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

Category	Definition
Threatened Ecological Communities	
Critically Endangered	An ecological community is eligible to be included in the critically endangered category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
Endangered	An ecological community is eligible to be included in the endangered category at a particular time if, at that time: (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable	An ecological community is eligible to be included in the vulnerable category at a particular time if, at that time: (a) it is not critically endangered nor endangered; and (b) it is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.

Biodiversity Conservation Act 2016

Category	Definition
Threatened Flora Species	
Critically Endangered (CR)	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". Published under schedule 1 of the *Wildlife Conservation (Rare Flora) Notice 2018* for critically endangered flora.
Endangered (EN)	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". Published under schedule 2 of the *Wildlife Conservation (Rare Flora) Notice 2018* for endangered flora.
Vulnerable (VU)	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". Published under schedule 3 of the Wildlife Conservation (Rare Flora) Notice 2018 for vulnerable flora.
Extinct (EX)	Species where "there is no reasonable doubt that the last member of the species has died", and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act). Published as presumed extinct under schedule 4 of the Wildlife Conservation (Rare Flora) Notice 2018 for extinct flora.
Extinct in the Wild (EW)	Species that "is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form", and listing is otherwise in accordance with the ministerial guidelines (section 25 of the BC Act). Currently there are no threatened flora species listed as extinct in the wild.

Category	Definition
Threatened Ecological Communities	
Critically Endangered (CR)	An ecological community is eligible for listing in the category of critically endangered ecological community at a particular time if, at that time — (a) it is facing an extremely high risk of becoming eligible for listing as a collapsed ecological community in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines; and (b) listing in that category is otherwise in accordance with the ministerial guidelines.
Endangered (EN)	An ecological community is eligible for listing in the category of endangered ecological community at a particular time if, at that time — (a) it is not a critically endangered ecological community; and (b) it is facing a very high risk of becoming eligible for listing as a collapsed ecological community in the near future, as determined in accordance with criteria set out in the ministerial guidelines; and (c) listing in that category is otherwise in accordance with the ministerial guidelines.
Vulnerable (VU)	An ecological community is eligible for listing in the category of vulnerable ecological community at a particular time if, at that time — (a) it is not a critically endangered ecological community or an endangered ecological community; and (b) it is facing a high risk of becoming eligible for listing as a collapsed ecological community in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines; and (c) listing in that category is otherwise in accordance with the ministerial guidelines.
Collapsed	An ecological community is eligible for listing as a collapsed ecological community at a particular time if, at that time — (a) there is no reasonable doubt that the last occurrence of the ecological community has collapsed; or (b) the ecological community has been so extensively modified throughout its range that no occurrence of it is likely to recover — (i) its species composition or structure; or (ii) its species composition and structure.

Department of Biodiversity, Conservation and Attractions Priority Definitions

Category	Definition
Threatened Flora Species	
Priority 1 (P1)	**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.
Priority 2 (P2)	**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.
Priority 3 (P3)	**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.
Priority 4 (P4)	**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.

Category	Definition
Threatened Ecological Communities	
Priority 1 (P1)	**Poorly-known ecological communities** Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤5 occurrences or a total area of ≤ 100ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.
Priority 2 (P2)	**Poorly-known Ecological Communities** Communities that are known from few occurrences with a restricted distribution (generally ≤10 occurrences or a total area of ≤200ha). At least some occurrences are not believed to be under immediate threat (within approximately 10 years) 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 3 (P3)	**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 with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat (within approximately 10 years), or; (iii) communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, inappropriate fire regimes, clearing, hydrological change etc. 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.

Category	Definition
Priority 4 (P4)	**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.** (i) Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands. (ii) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for a higher threat category. (iii) Ecological communities that have been removed from the list of threatened communities during the past five years.
Priority 5 (P5)	**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 B: Vegetation Structural Formation Terminology

NVIS Vegetation Structural Classifications

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
% Crown 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						
tree, palm	>30 Tall 10-30 Mid <10 Low	closed forest	open forest	woodland	open woodland	isolated trees	isolated clumps of trees	trees
tree mallee	10-30 Tall <10 Mid <3 Low	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, fern	>2 Tall 1-2 Mid <1 Low	closed shrubland	shrubland	open shrubland	sparse shrubland	isolated shrubs	isolated clumps of shrubs	shrubs
mallee shrub	10-30 Tall <10 Mid <3 Low	closed mallee shrubland	mallee shrubland	open mallee shrubland	sparse mallee shrubland	isolated mallee shrubs	isolated clumps of mallee shrubs	mallee shrubs

Growth Form	Height ranges (m)	Structural Formation Classes						
heath shrub	>2 Tall 1-2 Mid <1 Low	closed heathland	heathland	open heathland	sparse heathland	isolated heath shrubs	isolated clumps of heath shrubs	heath shrubs
chenopod shrub	>2 Tall 1-2 Mid <1 Low	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 Low <0.5 Low	closed samphire shrubland	samphire shrubland	open samphire shrubland	sparse samphire shrubland	isolated samphire shrubs	isolated clumps of samphire shrubs	samphire shrubs
hummock grass	>2 Tall <2 Tall	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 Mid <0.5 Low	closed tussock grassland	tussock grassland	open tussock grassland	sparse tussock grassland	isolated tussock grasses	isolated clumps of tussock grasses	tussock grasses
other grass	>0.5 Mid <0.5 Low	closed grassland	grassland	open grassland	sparse grassland	isolated grasses	isolated clumps of grasses	other grasses
sedge	>0.5 Mid <0.5 Low	closed sedgeland	sedgeland	open sedgeland	sparse sedgeland	isolated sedges	isolated clumps of sedges	sedges
rush	>0.5 Mid <0.5 Low	closed rushland	rushland	open rushland	sparse rushland	isolated rushes	isolated clumps of rushes	rushes
forb	>0.5 Mid <0.5 Low	closed forbland	forbland	open forbland	sparse forbland	isolated forbs	isolated clumps of forbs	forbs

Growth Form	Height ranges (m)	Structural Formation Classes						
fern	>2 Tall 1-2 Tall <1 Low	closed fernland	fernland	open fernland	sparse fernland	isolated ferns	isolated clumpsof ferns	ferns
bryophyte	<0.5	closed bryophyte land	bryophyte land	open bryophyte land	sparse bryophyte land	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	>30 Tall 10-30 Med <10 Low	closed vineland	vineland	open vineland	sparse vineland	isolated vines	isolated clumps of vines	vines
aquatic	<1 Tall 0-0.5 Low	closed aquatic bed	aquatic bed	open aquatic bed	sparse aquatics	isolated aquatics	isolated clumps of aquatics	aquatics
seagrass	<1 Tall 0-0.5 Low	closed seagrass bed	Seagrass bed	open seagrass bed	sparse seagrass bed	isolated seagrasses	isolated clumps of seagrasses	seagrasses

From: NVIS Structural Formation Terminology (Australian Vegetation Attribute Manual Version 7.0 November 2017 https://www.environment.gov.au/land/publications/australian-vegetation-attribute-manual-version-7)

* Foliage Cover is defined for each stratum as 'the proportion of the ground, which would be shaded if sunshine came from directly overhead'. It includes branches and leaves and is obtained by multiplying Crown Cover with Crown type (Hnatiuk *et al.*, 2009). It is applied to a stratum in a plot, rather than an individual crown, with the NVIS measure for a vegetation type ideally being a summary of several plots. Foliage Projective Cover, which considers only the vertical projection of photosynthetic components (generally leaves), can be measured by line interception methods for tree, shrub and ground layer vegetation (Specht & Specht, 1999).

** Crown Cover (canopy cover) as per Hnatiuk *et al.* (2009). Although relationships between this attribute and Foliage Cover are dependent on season, species, species age etc., the crown cover category classes have been adopted as the defining measure.

*** The percentage cover is defined as the percentage of a strictly defined plot area, covered by vegetation. This can be an estimate and is a less precise measure than using, for example, a point intercept transect method on ground layer, or overstorey vegetative cover. That is, for precisely measured values (e.g. crown densitometer or point intercept transects) the value measured would be 'foliage' cover. Where less precise or qualitative measures are used these will most probably be recorded as 'percentage' cover.

Appendix C: Vegetation Condition Rating Scale

Keighery (1994) Vegetation Condition Rating Scale

Vegetation Condition	Definition
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.
Very Good	Vegetation structure altered, obvious signs of disturbance. Disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds at high density, partial clearing, dieback and grazing.
Completely Degraded	The structure of 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.

Appendix D: Literature Review Key Findings

Study Details	Methods	Results	Significant Findings	Limitations
Mattiske (2019) **Client**: Chalice Gold **Type**: Desktop Assessment **Location**: Julimar Project (within and surrounding) **Timing**: April 2019	• Desktop Assessment	• 1057 potential flora taxa from 343 genera and 99 families • 112 introduced weed taxa from 87 genera and 36 families • Three vegetation types	• 85 threatened and priority species that could potentially occur (22 threatened and 63 priority) • Three PECs and two TECs that could potentially occur: o Claypans with mid dense shrublands of *Melaleuca lateritia* over herbs (PEC–P1, TEC–CR) o Wandoo woodland over dense low sedges of *Mesomelaena preissii* (PEC–P2) o Eucalypt woodlands of the Western Australian Wheatbelt (PEC–P3, TEC–CR) • Six weeds of National Significance: o **Asparagus asparagoides* o **Chrysanthemoides monilifera* subsp. *monilifera* o **Genista monspessulana* o **Rubus fruticosus* o **Salvina molesta* o **Lantana camara*	No significant limitations
Biologic (2020) **Client**: MBS Environmental / Chalice Gold **Type**: Reconnaissance and targeted flora survey **Location**: Julimar Project (adjacent to the south) **Timing**: July 2020	• 15 relevés, 16 mapping points • Targeted searches	• 73 vascular flora taxa from 25 families and 52 genera • Six vegetation units • Completely degraded to very good condition	• No TECs/PECs or conservation significant flora were recorded • Two vegetation types supporting riparian and riverine vegetation	Survey was out of season (in winter)
Phoenix (2015) **Client**: Main Roads WA **Type**: Flora and Fauna Assessment **Location**: Muchea North and Chittering (12.7 km NW) **Timing**: October 2014 and September 2015	• 32 detailed floristic sites (quadrats) • 17 relevé plots • Targeted searches	• 273 flora taxa from 153 genera and 52 families • vegetation communities • 51 introduced weed species	• Seven conservation significant flora taxa recorded: o *Darwinia foetida* (T) o *Eucalyptus caesia* (P4) (no longer a priority taxon) o *Haemodorum loratum* (P3) o *Acacia drummondii* subsp. *affinis* (P3) o *Stylidium squamellosum* (P2) o *Verticordia lindleyi* subsp. *lindleyi* (P4) o *Verticordia serrata* var. *linearis* (P3) • Three Declared Plant Pests: o **Asparagus asparagoides* o **Echium plantagineum* o **Moraea miniata*	No significant limitations

Study Details	Methods	Results	Significant Findings	Limitations
Focused Vision (2017) **Client**: Main Roads WA **Type**: Level 2 Flora and Vegetation Assessment and Targeted Survey **Location**: Muchea to Wubin, Great Northern Highway (13 km W) **Timing**: Spring 2016	• 46 detailed floristic sites (quadrats) • Two relevé plots • Targeted searches	• 350 flora taxa from 183 genera and 56 families • 13 vegetation communities • 40 introduced weed species	• Seven priority flora taxa recorded: o *Gastrolobium* ? *crispatum* (P1) o *Synaphea panhesya* (P1) o *Drosera sewelliae* (P2) o *Acacia drummondii* subsp. *affinis* (P3) o *Adenanthos cygnorum* subsp. *chamaephyton* (P3) o *Anigozanthos humilis* subsp. *chrysanthus* (P4) (listed as P3 at time of survey) o *Hibbertia miniata* (P4)	No significant limitations
Focused Vision (2018) **Client**: Main Roads WA **Type**: Detailed Flora and Vegetation Survey **Location**: Bindoon Bypass, Great Northern Highway (14.7 km W) **Timing**: 2017	• 117 detailed floristic sites (quadrats) • Two relevé plots • Targeted searches	• 12 vegetation units	• Eight priority flora taxa recorded: o *Drosera sewelliae* (P2) o *Hibbertia glomerata* subsp. *ginginensis* (P2) o *Acacia drummondii* subsp. *affinis* (P3) o *Adenanthos cygnorum* subsp. *chamaephyton* (P3) o *Hypolaena robusta* (P4) o *Hibbertia miniata* (P4) o *Jacksonia* ? *sericea* (P4) o *Verticordia paludosa* (P4) • One Declared Plant Pest: o **Chondrilla juncea* • One TEC and two PECs known to occur within or closely adjacent to the Study Area (representative of the Commonwealth-listed Banksia Woodlands of the Swan Coastal Plain TEC)	No significant limitations
Maia (2017) **Client**: Instant Products Group **Type**: Level 2 Flora and Vegetation Survey **Location**: Muchea Lot 195 (16.8 km WSW) **Timing**: March & October 2016	• Nine detailed floristic sites (quadrats) • Eight relevé plots • Targeted searches	• 199 taxa from 130 genera and 52 families • Three vegetation types • 24 introduced weed species	• Two priority flora taxa recorded: o *Acacia drummondii* subsp. *affinis* (P3) o *Haemodorum loratum* (P3) • One Priority Ecological Community: • Low lying *Banksia attenuata* woodlands and shrublands (P3)	No significant limitations

Study Details	Methods	Results	Significant Findings	Limitations
AECOM (2016) **Client**: Main Roads Western Australia **Type**: Biological Survey **Location**: Toodyay Road (20.7 km SE) **Timing**: September and November 2015	• Desktop Assessment • 75 detailed floristic sites (quadrats) • Seven relevé plots • Targeted searches	• 362 flora taxa from 161 genera and 54 families • Four vegetation associations • 38 introduced weed species	• Seven priority flora taxa recorded: o *Banksia nivea* subsp. Morangup (M. Pieroni 94/2) (P2) o *Boronia scabra* subsp. *condensata* (P2) o *Calytrix oncophylla* (P2) o *Grevillea candolleana* (P2) o *Verticordia citrella* (P2) o *Hibbertia montana* (P4) – no longer a priority flora taxon o *Caladenia integra* (P4) • Two Declared Plant Pests recorded: o **Asparagus asparagoides* • **Gomphocarpus fruticosus*	No significant limitations
Phoenix (2016) **Client**: Main Roads WA **Type**: Flora and Fauna Assessment **Location**: Calingiri to Wubin (southernmost point of Study Area was 20.8 km NW) **Timing**: October 2014, February to June 2015 and September to December 2015	• 109 detailed floristic sites (quadrats) • 34 relevé plots • Targeted searches	• 524 flora taxa from 188 genera and 64 families • 25 vegetation associations • 53 introduced weed species	• 13 priority flora taxa recorded: o *Acacia browniana* var. *glaucescens* (P2) o *Acacia drummondii* subsp. *affinis* (P3) o *Acacia isoneura* subsp. *nimia* (P3) o *Acacia scalena* (P3) o *Banksia benthamiana* (P4) o *Banksia serratuloides* subsp. *serratuloides* (T) o *Calothamnus pachystachyus* (P4) o *Daviesia debilior* subsp. *sinuans* (P3) o *Grevillea asparagoides* (P3) o *Hibbertia miniata* (P4) o *Persoonia sulcata* (P4) o *Synaphea rangiferops* (P2) o *Verticordia venusta* (P3) • Five Declared Pests: o **Asparagus asparagoides* (also WoNS) o **Echium plantagineum* o **Rumex hypogaeus* o **Lycium ferocissimum* (also WoNS) o **Opuntia monacantha* (also WoNS)	No significant limitations

Study Details	Methods	Results	Significant Findings	Limitations
Keighery *et al.* (2002) **Client**: Not Applicable (Journal Article) **Type**: Biological Survey **Location**: Drummond Nature Reserve (21 km NE) **Timing**: 1999, 2000, 2001	• Detailed floristic sites (quadrats)	• 439 plant taxa • 10 vegetation units • 34 introduced weed species	• Nine Threatened and Priority taxa recorded: o *Trithuria australis* (P4) (known as *Hydatella leptogyne* (T) at time of survey) o *Eleocharis keigheryi* (T) o *Hydrocotyle lemnoides* (P4) o *Schoenus natans* (P4) o *Acacia chapmanii* subsp. *australis* (T) (listed as P3 at time of survey) o *Stenanthemum tridentatum* (P3) – no longer a priority flora taxon o *Comesperma rhadinocarpum* (P3) (listed as P2 at time of survey) o *Platysace ramosissima* (P3) o *Tricoryne* sp. Wongan Hills (B.H. Smith 794) (P2) (known as *Tricoryne arenicola* at time of survey)	No significant limitations
Ecoscape (2012) **Client**: Department of Defence **Type**: Flora and Vegetation Assessment **Location**: Bindoon Defence Training Area (22.5 km N) **Timing**: November 2011	• Desktop Assessment • Targeted searches	• Direct Fire Support Weapon Range Extension (DSFW): o Four vegetation types • DEMS Firebreak: o Three vegetation types • Static Grenade Range Number 2 Extension (SGR2): • One vegetation type	• DSFW recorded three Priority taxa: o *Persoonia sulcata* (P4) o *Synaphea panhesya* (P1) • DEMS Firebreak recorded four priority taxa: o *Lasiopetalum caroliae* (P3) (previously known as *Lasiopetalum* sp. Toodyay (F. Hort 2689) (P1)) o *Calothamnus pachystachyus* (P4) o *Persoonia sulcata* (P4) • DSFW, DEMS Firebreak and SGR2 all recorded *Astroloma* sp. Cataby (E.A. Griffin 1022) (P4) – now known as *Styphelia oblongifolia* which is not a priority taxon	No significant limitations
Bennett Environmental (2006) **Client**: City of Swan **Type**: Level 2 Flora and Vegetation Survey **Location**: Reserve 2145 and Percy Cullen Oval (31.8 km S) **Timing**: September 2006	• Detailed floristic sites (quadrats) • Targeted searches	• 174 flora taxa from 110 genera and 42 families • Five vegetation units • Eight introduced weed species	• Three priority flora taxa recorded: o *Tetratheca pilifera* (P3) o *Templetonia drummondii* (P4) and *Hibbertia montana* (P4) – no longer priority flora	No significant limitations

Appendix E: Database Search Results

Family	Taxon	Source						Conservation Status			Introduced
		Nature Map	ALA	WA Herb	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
Alismataceae	*Sagittaria platyphylla*						●				Y
Amaranthaceae	*Ptilotus declinatus*	●	●								
	Ptilotus drummondii	●	●								
	Ptilotus manglesii	●	●								
Apiaceae	*Coriandrum sativum*	●	●								Y
	Daucus glochidiatus	●	●								
	Eryngium pinnatifidum	●	●								
	Eryngium pinnatifidum subsp. Umbraphilum (G.J. Keighery 13967)			●				P2			
	Homalosciadium homalocarpum	●	●								
	Platysace ramosissima			●	●			P3			
	Schoenolaena juncea	●	●								
	Xanthosia candida	●	●								
	Xanthosia ciliata	●	●								
	Xanthosia huegelii	●	●								
Apocynaceae	*Calotropis procera*						●				Y
	Cryptostegia madagascariensis						●				Y
	Gomphocarpus fruticosus						●				Y
Araceae	*Pistia stratiotes*						●				Y
	Zantedeschia aethiopica						●				Y
Araliaceae	*Hydrocotyle alata*		●								
	Hydrocotyle callicarpa	●	●								
	Hydrocotyle lemnoides			●	●			P4			
	Hydrocotyle ranunculoides						●				Y
	Trachymene pilosa	●	●								
Asparagaceae	*Asparagus asparagoides*					●	●				Y
	Dichopogon capillipes	●	●								
	Dichopogon preissii		●								

Family	Taxon	Source						Conservation Status			Introduced
		Nature Map	ALA	WA Herb	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	Laxmannia grandiflora		●								
	Laxmannia grandiflora subsp. *grandiflora*	●									
	Laxmannia omnifertilis	●	●								
	Laxmannia squarrosa	●	●								
	Lomandra caespitosa	●	●								
	Lomandra hermaphrodita	●	●								
	Lomandra micrantha	●	●								
	Lomandra micrantha subsp. *micrantha*	●									
	Lomandra preissii	●	●								
	Lomandra sericea	●	●								
	Lomandra spartea	●	●								
	Sowerbaea laxiflora	●	●								
	Thysanotus dichotomus		●								
	Thysanotus multiflorus	●	●								
	Thysanotus patersonii	●	●								
	Thysanotus sparteus	●	●								
	Thysanotus tenellus	●	●								
	Thysanotus thyrsoideus	●	●								
	Thysanotus sp. Badgingarra (E.A. Griffin 2511)			●				P2			
Asteraceae	*Blennospora drummondii*	●	●								
	Brachyscome glandulosa	●	●								
	Brachyscome iberidifolia	●	●								
	Chondrilla juncea						●				Y
	Chrysanthemoides monilifera					●					Y
	Chrysanthemoides monilifera subsp. *monilifera*					●					Y
	Gnephosis drummondii		●								

Family	Taxon	Source						Conservation Status			Introduced
		Nature Map	ALA	WA Herb	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	Gnephosis tenuissima		●								
	Helichrysum leucopsideum	●	●								
	Hyalosperma cotula	●	●								
	Hyalosperma demissum	●	●								
	Hypochaeris glabra	●	●								Y
	Lagenophora huegelii	●	●								
	Lagenophora platysperma		●								
	Lawrencella rosea	●	●								
	Millotia tenuifolia	●	●								
	Millotia tenuifolia var. *laevis*	●		●	●			P2			
	Myriocephalus appendiculatus		●								
	Onopordum acaulon						●				Y
	Pithocarpa pulchella	●	●								
	Pithocarpa pulchella var. *pulchella*	●									
	Podolepis canescens		●								
	Podolepis gracilis		●								
	Podolepis lessonii	●	●								
	Podotheca angustifolia	●	●								
	Podotheca gnaphalioides		●								
	Pterochaeta paniculata	●	●								
	Quinetia urvillei	●	●								
	Rhodanthe corymbosa	●	●								
	Rhodanthe manglesii	●	●								
	Senecio multicaulis		●								
	Senecio multicaulis subsp. *multicaulis*	●									
	Senecio pinnatifolius		●								
	Senecio pinnatifolius var. *latilobus*	●									

Family	Taxon	Source						Conservation Status			Introduced
		Nature Map	ALA	WA Herb	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	Siloxerus multiflorus		●								
	Silybum marianum						●				Y
	Trichocline spathulata	●	●								
	Ursinia anthemoides	●	●								Y
	Ursinia anthemoides subsp. *anthemoides*	●									Y
	Waitzia nitida	●	●								
	Waitzia suaveolens	●	●								
	Waitzia suaveolens var. *suaveolens*	●									
	Xanthium spinosum						●				Y
	Xanthium strumarium						●				Y
Boraginaceae	*Echium plantagineum*						●				Y
Boryaceae	*Borya sphaerocephala*	●	●								
Cactaceae	*Austrocylindropuntia cylindrica*						●				Y
	Austrocylindropuntia subulata						●				Y
	Cylindropuntia fulgida						●				Y
	Cylindropuntia imbricata						●				Y
	Cylindropuntia kleiniae						●				Y
	Cylindropuntia pallida						●				Y
	Cylindropuntia tunicata						●				Y
	Opuntia elata						●				Y
	Opuntia elatior						●				Y
	Opuntia engelmannii						●				Y
	Opuntia ficus-indica						●				Y
	Opuntia microdasys						●				Y
	Opuntia monacantha						●				Y
	Opuntia polyacantha						●				Y
	Opuntia puberula						●				Y

Family	Taxon	Source						Conservation Status			Introduced
		Nature Map	ALA	WA Herb	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	Opuntia stricta						•				Y
	Opuntia tomentosa						•				Y
Campanulaceae	*Isotoma hypocrateriformis*	•	•								
	Isotoma pusilla		•								
	Lobelia rarifolia	•	•								
	Lobelia rhombifolia	•	•								
	Lobelia tenuior		•								
	Monopsis debilis		•								Y
	Wahlenbergia gracilenta		•								
	Wahlenbergia preissii	•	•								
Caryophyllaceae	*Spergularia marina*		•								
Casuarinaceae	*Allocasuarina humilis*	•	•								
	Allocasuarina thuyoides	•	•								
Celastraceae	*Stackhousia monogyna*		•								
	Stackhousia pubescens	•	•								
	Tripterococcus brunonis	•	•								
Centrolepidaceae	*Aphelia cyperoides*		•								
	Aphelia drummondii	•	•								
	Aphelia sp. Albany (B.G.Briggs 596)		•								
	Centrolepis alepyroides		•								
	Centrolepis aristata	•	•								
	Centrolepis drummondiana	•	•								
	Centrolepis glabra		•								
	Centrolepis pilosa		•								
	Centrolepis polygyna		•								
Colchicaceae	*Burchardia multiflora*	•	•								
	Wurmbea dioica		•								

Family	Taxon	Source						Conservation Status			Introduced
		Nature Map	ALA	WA Herb	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	Wurmbea dioica subsp. *alba*	●									
	Wurmbea tenella	●	●								
Crassulaceae	*Crassula closiana*		●								
	Crassula peduncularis		●								
Cyperaceae	*Baumea juncea*	●									
	Chorizandra enodis		●								
	Cyathochaeta avenacea	●	●								
	Eleocharis keigheryi		●	●	●	●		T	VU	VU	
	Isolepis cernua		●								
	Isolepis levynsiana		●								Y
	Isolepis marginata		●								
	Isolepis stellata		●								
	Lepidosperma apricola	●	●								
	Lepidosperma asperatum	●	●								
	Lepidosperma drummondii	●	●								
	Lepidosperma longitudinale	●									
	Lepidosperma pruinosum	●	●								
	Lepidosperma pubisquameum	●	●								
	Lepidosperma sp.	●									
	Lepidosperma squamatum	●	●								
	Schoenus breviculmis	●	●	●							
	Schoenus capillifolius			●				P3			
	Schoenus clandestinus	●	●								
	Schoenus nanus		●								
	Schoenus natans	●		●	●			P4			
	Schoenus odontocarpus		●								
	Schoenus sculptus		●								

Family	Taxon	Source						Conservation Status			Introduced
		Nature Map	ALA	WA Herb	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	Schoenus sp. Toodyay (G.J. Keighery & N. Gibson 2918)			●				P1			
	Schoenus unispiculatus	●	●								
	Tetraria octandra	●	●								
	Tetraria sp. Jarrah Forest (R.Davis 7391)	●	●								
Dilleniaceae	*Hibbertia commutata*	●	●								
	Hibbertia cuneiformis		●								
	Hibbertia diamesogenos	●	●								
	Hibbertia glomerata subsp. *ginginensis*			●				P2			
	Hibbertia hibbertioides		●								
	Hibbertia huegelii	●	●								
	Hibbertia hypericoides	●	●								
	Hibbertia hypericoides subsp. *hypericoides*	●									
	Hibbertia lasiopus	●	●								
	Hibbertia miniata	●		●				P4			
	Hibbertia montana	●									
	Hibbertia polystachya	●	●								
	Hibbertia sp.	●									
	Hibbertia spicata	●	●								
Droseraceae	*Drosera barbigera*	●	●								
	Drosera erythrorhiza	●	●								
	Drosera gigantea	●	●								
	Drosera glanduligera	●	●								
	Drosera heterophylla	●	●								
	Drosera leucoblasta	●	●								
	Drosera macrantha	●	●								

Family	Taxon	Source						Conservation Status			Introduced
		Nature Map	ALA	WA Herb	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	Drosera menziesii	●	●								
	Drosera neesii	●									
	Drosera platystigma	●	●								
	Drosera sewelliae	●		●				P2			
	Drosera spilos	●	●								
	Drosera stolonifera	●	●								
Elaeocarpaceae	*Tetratheca hirsuta*		●								
	Tetratheca hirsuta subsp. *hirsuta*	●									
	Tetratheca pilifera	●		●	●			P3			
	Tetratheca spartea			●				P2			
Ericaceae	*Astroloma ciliatum*	●									
	Astroloma compactum	●	●								
	Astroloma epacridis	●	●								
	Astroloma macrocalyx	●	●								
	Astroloma oblongifolium	●	●								
	Astroloma pallidum	●	●								
	Conostephium preissii	●	●								
	Leucopogon nutans	●	●								
	Leucopogon polymorphus		●								
	Leucopogon propinquus	●	●								
	Leucopogon pulchellus	●	●								
	Leucopogon sp. Northern Scarp (M.Hislop 2233)	●	●								
	Styphelia brevicuspis			●	●			P2			
	Styphelia tenuiflora	●	●								
Euphorbiaceae	*Jatropha gossypiifolia*						●				Y
	Monotaxis grandiflora	●	●								
	Stachystemon virgatus	●	●								

Family	Taxon	Source						Conservation Status			Introduced
		Nature Map	ALA	WA Herb	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
Fabaceae	*Acacia anomala*			●				T	VU	VU	
	Acacia applanata	●	●								
	Acacia barbinervis		●								
	Acacia barbinervis subsp. *barbinervis*	●									
	Acacia baxteri	●	●								
	Acacia browniana		●								
	Acacia browniana var. *glaucescens*	●		●	●			P2			
	Acacia campylophylla				●			P3			
	Acacia celastrifolia	●	●								
	Acacia chapmanii subsp. *australis*			●	●			T	EN	EN	
	Acacia drummondii		●								
	Acacia drummondii subsp. *affinis*	●		●	●			P3			
	Acacia drummondii subsp. *elegans*	●									
	Acacia ericifolia		●								
	Acacia huegelii	●	●								
	Acacia incrassata	●	●								
	Acacia lateriticola	●	●								
	Acacia multispicata	●	●								
	Acacia nervosa	●	●								
	Acacia oncinophylla subsp. *patulifolia*			●				P4			
	Acacia preissiana	●	●								
	Acacia pulchella	●	●								
	Acacia pulchella var. reflexa acuminate bracteole variant (R.J. Cumming 882)			●				P3			
	Acacia sessilis	●	●								
	Acacia squamata	●	●								
	Acacia urophylla	●	●								
	Alhagi maurorum						●				Y

Family	Taxon	Source						Conservation Status			Introduced
		Nature Map	ALA	WA Herb	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	Bossiaea eriocarpa	●	●								
	Bossiaea ornata	●	●								
	Chorizema dicksonii	●	●								
	Chorizema ulotropis			●				P4			
	Daviesia angulata	●	●								
	Daviesia benthamii		●								
	Daviesia decurrens		●								
	Daviesia decurrens subsp. *decurrens*	●									
	Daviesia hakeoides	●	●								
	Daviesia hakeoides subsp. *hakeoides*	●									
	Daviesia preissii	●	●								
	Gastrolobium acutum		●								
	Gastrolobium calycinum	●	●								
	Gastrolobium crispatum	●	●	●	●			P1			
	Gastrolobium dilatatum		●								
	Gastrolobium epacridoides	●	●								
	Gastrolobium nudum			●	●			P2			
	Gastrolobium rhombifolium	●	●								
	Gastrolobium spathulatum	●	●								
	Genista sp. x Genista *monspessulana*					●					Y
	Gompholobium knightianum	●	●								
	Gompholobium marginatum	●	●								
	Gompholobium polymorphum	●	●								
	Gompholobium preissii	●	●								
	Gompholobium tomentosum		●								
	Hovea chorizemifolia	●	●								
	Hovea trisperma	●	●								

Family	Taxon	Source						Conservation Status			Introduced
		Nature Map	ALA	WA Herb	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	Jacksonia alata		●								
	Jacksonia floribunda	●	●								
	Jacksonia sternbergiana		●								
	Kennedia prostrata		●								
	Kennedia stirlingii	●	●								
	Labichea punctata	●	●								
	Parkinsonia aculeata						●				Y
	Prosopis glandulosa x *velutina*						●				Y
	Senna alata						●				Y
	Senna obtusifolia						●				Y
	Sphaerolobium medium		●								
	Templetonia drummondii	●	●								
	Ulex europaeus						●				Y
	Vicia benghalensis	●	●								Y
Gentianaceae	*Cicendia filiformis*		●								Y
Goodeniaceae	*Dampiera alata*	●	●								
	Dampiera incana	●	●								
	Dampiera lavandulacea		●								
	Dampiera linearis	●	●								
	Goodenia arthrotricha					●		T	EN	EN	
	Goodenia claytoniacea		●								
	Goodenia coerulea	●	●								
	Goodenia drummondii		●								
	Goodenia drummondii subsp. *megaphylla*	●									
	Goodenia micrantha	●	●								
	Goodenia mimuloides		●								
	Goodenia pulchella	●	●								

Family	Taxon	Source						Conservation Status			Introduced
		Nature Map	ALA	WA Herb	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	Goodenia pulchella subsp. Wheatbelt (L.W. Sage & F. Hort 795)	•									
	Lechenaultia biloba	•	•								
	Lechenaultia magnifica	•		•	•			P1			
	Scaevola glandulifera	•	•								
	Scaevola phlebopetala		•								
	Scaevola platyphylla	•	•								
	Velleia trinervis	•	•								
Haemodoraceae	*Anigozanthos bicolor*		•								
	Anigozanthos bicolor subsp. *bicolor*	•									
	Anigozanthos humilis		•								
	Anigozanthos humilis subsp. *humilis*	•									
	Anigozanthos manglesii		•								
	Anigozanthos manglesii subsp. *manglesii*	•									
	Conostylis androstemma	•	•								
	Conostylis aurea	•	•								
	Conostylis candicans		•								
	Conostylis caricina subsp. *elachys*	•		•	•			P1			
	Conostylis prolifera	•	•								
	Conostylis setigera	•	•								
	Conostylis setigera subsp. *setigera*	•									
	Conostylis setosa	•	•								
	Haemodorum laxum	•	•								
	Haemodorum simplex	•	•								
	Haemodorum sp.	•									
	Haemodorum sparsiflorum	•	•								
	Tribonanthes longipetala		•								

Family	Taxon	Source						Conservation Status			Introduced
		Nature Map	ALA	WA Herb	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	Tribonanthes porphyrea		●								
Haloragaceae	*Glischrocaryon aureum*		●								
	Gonocarpus cordiger	●	●								
	Myriophyllum drummondii		●								
Hemerocallidaceae	*Agrostocrinum hirsutum*	●	●								
	Caesia micrantha	●	●								
	Caesia sp. Wongan (K.F.Kenneally 8820)		●								
	Dianella revoluta	●	●								
	Dianella revoluta var. *divaricata*	●									
	Dianella revoluta var. *revoluta*	●									
	Johnsonia inconspicua	●		●	●			P3			
	Stypandra glauca	●	●								
	Tricoryne elatior	●	●								
	Tricoryne sp. Wongan Hills (B.H. Smith 794)			●				P2			
Hydatellaceae	*Trithuria australis*			●	●			P4			
	Trithuria bibracteata		●								
	Pauridia occidentalis		●								
	Pauridia vaginata		●								
Iridaceae	*Gladiolus caryophyllaceus*	●	●								Y
	Moraea flaccida						●				Y
	Moraea miniata						●				Y
	Orthrosanthus laxus		●								
	Orthrosanthus laxus var. *gramineus*	●									
	Patersonia juncea	●	●								
	Patersonia rudis	●	●								
	Patersonia rudis subsp. *rudis*	●									

Family	Taxon	Source						Conservation Status			Introduced
		Nature Map	ALA	WA Herb	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	Romulea rosea	●	●								Y
Juncaceae	*Juncus bufonius*		●								Y
	Juncus capitatus		●								Y
Juncaginaceae	*Cycnogeton lineare*		●								
	Triglochin nana		●								
Lamiaceae	*Hemigenia barbata*	●	●								
	Hemigenia platyphylla			●				P4			
	Hemigenia wandooana	●	●								
Lauraceae	*Cassytha glabella*	●	●								
Lentibulariaceae	*Utricularia inaequalis*		●								
	Utricularia multifida		●								
Loganiaceae	*Logania micrantha*	●	●								
Loranthaceae	*Amyema miquelii*	●	●								
	Amyema preissii	●	●								
Malvaceae	*Androcalva fragifolia*			●	●			P1			
	Lasiopetalum caroliae	●	●	●	●			P3			
	Lasiopetalum decoratum			●				P2			
	Lasiopetalum glutinosum		●								
	Lasiopetalum glutinosum subsp. *latifolium*	●									
Menyanthaceae	*Liparophyllum capitatum*		●								
Montiaceae	*Calandrinia corrigioloides*		●								
Myrtaceae	*Babingtonia camphorosmae*	●	●								
	Baeckea preissiana		●								
	Calothamnus pachystachyus			●				P4			
	Calothamnus sanguineus	●	●								
	Calytrix angulata	●	●								
	Calytrix flavescens	●	●								

Family	Taxon	Source						Conservation Status			Introduced
		Nature Map	ALA	WA Herb	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	Calytrix sylvana	●	●								
	Calytrix variabilis	●	●								
	Corymbia calophylla	●	●								
	Darwinia carnea					●		T	CR	EN	
	Ericomyrtus serpyllifolia		●								
	Eucalyptus aspersa	●	●								
	Eucalyptus loxophleba x *wandoo*			●	●			P4			
	Eucalyptus marginata	●	●								
	Eucalyptus marginata subsp. *thalassica*	●									
	Eucalyptus rudis	●	●								
	Eucalyptus wandoo	●	●								
	Eucalyptus wandoo subsp. *wandoo*	●									
	Hypocalymma angustifolium	●	●								
	Hypocalymma sylvestre			●	●	●		T	EN	EN	
	Kunzea glabrescens		●								
	Kunzea praestans		●								
	Leptospermum erubescens	●	●								
	Melaleuca aspalathoides	●	●								
	Melaleuca holosericea	●	●								
	Melaleuca sciotostyla					●		T	EN	EN	
	Melaleuca teretifolia	●	●								
	Melaleuca trichophylla	●	●								
	Melaleuca viminea		●								
	Melaleuca viminea subsp. *viminea*	●									
	Oxymyrrhine coronata	●		●	●			P4			
	Rinzia crassifolia	●	●								
	Tetrapora preissiana	●									

Family	Taxon	Source						Conservation Status			Introduced
		Nature Map	ALA	WA Herb	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	Verticordia citrella			●				P2			
	Verticordia densiflora		●								
	Verticordia densiflora var. *cespitosa*	●									
	Verticordia huegelii var. *tridens*			●				P3			
	Verticordia nobilis	●	●								
	Verticordia plumosa		●								
	Verticordia serrata		●								
	Verticordia serrata var. *ciliata*	●									
	Verticordia serrata var. *serrata*	●									
Olacaceae	*Olax benthamiana*	●	●								
Ophioglossaceae	*Ophioglossum lusitanicum*	●	●								
Orchidaceae	*Caladenia arrecta*	●	●								
	Caladenia deformis		●								
	Caladenia denticulata		●								
	Caladenia discoidea		●								
	Caladenia filamentosa		●								
	Caladenia filifera	●	●								
	Caladenia flava	●	●								
	Caladenia longicauda		●								
	Caladenia reptans		●								
	Caladenia sericea		●								
	Caladenia speciosa			●				P4			
	Calochilus stramenicola	●	●								
	Cyanicula ixioides	●	●								
	Cyanicula ixioides subsp. *ixioides*	●		●				P4			
	Cyanicula sericea	●	●								
	Disa bracteata	●	●								Y

Family	Taxon	Source						Conservation Status			Introduced
		Nature Map	ALA	WA Herb	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	Diuris aff. corymbosa		●								
	Diuris corymbosa	●	●								
	Diuris laxiflora	●	●								
	Diuris longifolia		●								
	Diuris porrifolia	●									
	Drakaea gracilis	●									
	Elythranthera brunonis		●								
	Elythranthera emarginata		●								
	Ericksonella saccharata		●								
	Eriochilus dilatatus		●								
	Eriochilus dilatatus subsp. *undulatus*	●									
	Leporella fimbriata	●	●								
	Lyperanthus nigricans		●								
	Oligochaetochilus vittatus		●								
	Paracaleana nigrita	●									
	Prasophyllum gracile	●	●								
	Prasophyllum ovale		●								
	Pterostylis hamiltonii	●	●								
	Pterostylis nana		●								
	Pterostylis recurva		●								
	Pterostylis vittata	●	●								
	Pyrorchis nigricans	●	●								
	Thelymitra antennifera		●								
	Thelymitra dedmaniarum					●		T	CR	EN	
	Thelymitra stellata	●			●	●		T	EN	EN	
	Thelymitra vulgaris	●	●								
	Urochilus vittatus		●								

Family	Taxon	Source						Conservation Status			Introduced
		Nature Map	ALA	WA Herb	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
Orobanchaceae	*Bellardia trixago*	●	●								Y
	Parentucellia latifolia	●	●								Y
Philydraceae	*Philydrella pygmaea*		●								
Phrymaceae	*Glossostigma diandrum*		●								
Phyllanthaceae	*Phyllanthus calycinus*	●	●								
	Poranthera microphylla	●	●								
Pinaceae	*Pinus radiata*					●					Y
Pittosporaceae	*Billardiera fraseri*	●	●								
	Marianthus bicolor	●	●								
Plantaginaceae	*Gratiola pubescens*		●								
Poaceae	*Aira caryophyllea*	●	●								Y
	Aira cupaniana	●	●								Y
	Amphibromus nervosus		●								
	Amphipogon amphipogonoides	●	●								
	Austrostipa campylachne	●	●								
	Austrostipa hemipogon	●	●								
	Austrostipa macalpinei		●								
	Austrostipa mollis	●	●								
	Avellinia michelii	●	●								Y
	Brachypodium distachyon	●	●								Y
	Briza maxima	●	●								Y
	Briza minor	●	●								Y
	Dichelachne micrantha		●								
	Lachnagrostis filiformis		●								
	Microlaena stipoides		●								
	Neurachne alopecuroidea	●	●								
	Pentameris airoides		●								Y

Family	Taxon	Source						Conservation Status			Introduced
		Nature Map	ALA	WA Herb	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	Pentameris airoides subsp. *airoides*	●									Y
	Poa drummondiana	●	●								
	Polypogon monspeliensis		●								Y
	Rytidosperma acerosum	●	●								
	Rytidosperma caespitosum	●	●								
	Rytidosperma setaceum		●								
Polygalaceae	*Comesperma calymega*	●	●								
	Comesperma ciliatum	●	●								
	Comesperma rhadinocarpum			●				P3			
Pottiaceae	*Barbula calycina*	●									
Primulaceae	*Lysimachia arvensis*		●								Y
Proteaceae	*Adenanthos cygnorum* subsp. *chamaephyton*	●		●	●			P3			
	Adenanthos drummondii	●	●								
	Banksia attenuata		●								
	Banksia bipinnatifida		●								
	Banksia bipinnatifida subsp. *multifida*	●									
	Banksia dallanneyi		●								
	Banksia dallanneyi subsp. *dallanneyi var. dallanneyi*	●									
	Banksia dallanneyi subsp. *dallanneyi var. mellicula*	●									
	Banksia fraseri	●	●								
	Banksia grandis	●	●								
	Banksia menziesii		●								
	Banksia nivea	●	●								
	Banksia polycephala	●	●								
	Banksia sessilis		●								

Family	Taxon	Source						Conservation Status			Introduced
		Nature Map	ALA	WA Herb	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	Banksia sessilis var. *sessilis*	●									
	Banksia sphaerocarpa		●								
	Banksia squarrosa		●								
	Banksia squarrosa subsp. *squarrosa*	●									
	Conospermum densiflorum	●	●								
	Conospermum densiflorum subsp. *unicephalatum*					●		T	EN	EN	
	Conospermum polycephalum	●	●								
	Conospermum stoechadis		●								
	Conospermum triplinervium	●	●								
	Grevillea bracteosa		●								
	Grevillea bracteosa subsp. *bracteosa*	●		●	●			T	EN		
	Grevillea candolleana			●							
	Grevillea corrugata			●	●	●		T	VU	EN	
	Grevillea curviloba			●				T	CR	EN	
	Grevillea drummondii	●	●	●				P4			
	Grevillea pilulifera	●	●								
	Grevillea scabra	●	●								
	Grevillea sp. Gunapin (F. Hort 308)	●	●								
	Grevillea sp. Toodyay West (F. Hort et al. 3296)			●				P2			
	Grevillea synapheae	●	●								
	Grevillea synapheae subsp. *synapheae*	●									
	Hakea lissocarpha	●	●								
	Hakea prostrata		●								
	Hakea ruscifolia	●	●								
	Hakea stenocarpa	●	●								
	Hakea trifurcata	●	●								

Family	Taxon	Source						Conservation Status			Introduced
		Nature Map	ALA	WA Herb	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	Hakea undulata	●	●								
	Hakea varia	●	●								
	Persoonia angustiflora	●	●								
	Persoonia elliptica	●	●								
	Persoonia sulcata	●		●	●			P4			
	Persoonia trinervis	●	●								
	Petrophile brevifolia	●	●								
	Petrophile serruriae	●	●								
	Petrophile striata	●	●								
	Synaphea decorticans	●	●								
	Synaphea grandis	●	●	●	●			P4			
	Synaphea panhesya	●		●	●			P1			
	Synaphea sp. Udumung (A.S. George 17058)	●									
Restionaceae	*Desmocladus asper*	●	●								
	Desmocladus fasciculatus	●	●								
	Desmocladus flexuosus	●	●								
	Lepidobolus preissianus	●	●								
	Leptocarpus coangustatus	●	●								
Rhamnaceae	*Cryptandra nutans*	●	●								
	Stenanthemum coronatum	●	●								
	Trymalium angustifolium	●	●								
	Trymalium odoratissimum		●								
	Trymalium odoratissimum subsp. *odoratissimum*	●									
	Trymalium urceolare	●	●								
	Ziziphus mauritiana						●				Y
Rosaceae	*Rubus anglocandicans*						●				Y

Family	Taxon	Source						Conservation Status			Introduced
		Nature Map	ALA	WA Herb	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	Rubus fruticosus aggregate					●					Y
	Rubus laudatus						●				Y
	Rubus rugosus						●				Y
	Rubus ulmifolius						●				Y
Rubiaceae	*Galium aparine*						●				Y
	Galium murale	●	●								Y
	Galium spurium						●				Y
	Opercularia vaginata	●	●								
Ruppiaceae	*Ruppia polycarpa*	●	●								
Rutaceae	*Asterolasia grandiflora*			●	●	●		P4			
	Boronia busselliana	●									
	Boronia ovata		●								
	Boronia ramosa		●								
	Boronia ramosa subsp. *anethifolia*	●									
	Diplolaena andrewsii					●		T	EN	EN	
	Philotheca nodiflora		●								
	Philotheca nodiflora subsp. *nodiflora*	●									
	Philotheca spicata	●	●								
Salviniaceae	*Salvinia molesta*					●					Y
Santalaceae	*Santalum acuminatum*	●	●								
Sapindaceae	*Diplopeltis huegelii*		●								
	Diplopeltis huegelii subsp. *lehmannii*	●									
Scrophulariaceae	*Phyllopodium cordatum*	●	●								Y
Solanaceae	*Lycium ferocissimum*					●					Y
	Solanum elaeagnifolium						●				Y
	Solanum linnaeanum						●				Y
Stylidiaceae	*Levenhookia pusilla*	●	●								

Family	Taxon	Source						Conservation Status			Introduced
		Nature Map	ALA	WA Herb	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	Levenhookia stipitata	●	●								
	Stylidium adpressum	●	●								
	Stylidium affine	●	●								
	Stylidium albolilacinum	●	●								
	Stylidium androsaceum	●	●								
	Stylidium bindoon	●									
	Stylidium brunonianum	●	●								
	Stylidium calcaratum	●	●								
	Stylidium carnosum	●	●								
	Stylidium ciliatum		●								
	Stylidium cilium	●	●								
	Stylidium cymiferum	●	●	●	●			P3			
	Stylidium despectum	●	●								
	Stylidium dichotomum		●								
	Stylidium diuroides	●	●								
	Stylidium diuroides subsp. *diuroides*	●									
	Stylidium ecorne	●	●								
	Stylidium eriopodum	●	●								
	Stylidium hispidum	●	●								
	Stylidium longitubum				●			P4			
	Stylidium obtusatum		●								
	Stylidium petiolare	●	●								
	Stylidium pulchellum	●	●								
	Stylidium roseoalatum	●	●								
	Stylidium sacculatum			●				P3			
	Stylidium salmoneum	●									
	Stylidium scariosum	●	●								

Family	Taxon	Source						Conservation Status			Introduced
		Nature Map	ALA	WA Herb	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	Stylidium schoenoides	●	●								
	Stylidium sp.	●									
	Stylidium tenue		●								
	Stylidium tenue subsp. *majusculum*	●									
	Stylidium udusicola	●	●								
	Stylidium vinosum	●		●				P1			
Tamaricaceae	*Tamarix aphylla*					●	●				Y
Thymelaceae	*Pimelea argentea*		●								
	Pimelea suaveolens		●								
	Pimelea suaveolens subsp. *suaveolens*	●									
	Pimelea sylvestris	●	●								
Verbenaceae	*Lantana camara*					●	●				Y
Xanthorrhoeaceae	*Chamaescilla corymbosa*	●	●								
	Chamaescilla versicolor	●	●								
	Xanthorrhoea gracilis	●	●								
	Xanthorrhoea preissii	●	●								
Zamiaceae	*Macrozamia fraseri*	●									

Appendix F: Conservation Significant Flora Likelihood of Occurrence

Taxon	Conservation Status			Habit and Habitat	Habitat within Study Area	Within Current Known Distribution	Distance to Nearest Record	Likelihood of Occurrence pre-survey	Likelihood of Occurrence post-survey
	DBCA	EPBC Act	BC Act						
Drosera sewelliae	P2			Fibrous-rooted, rosetted perennial, herb, to 0.06 m high, to 0.025 m wide. Fl. orange, Oct. Laterite & silica sand soils.	Yes	Yes	Within	Confirmed	Confirmed
Persoonia sulcata	P4			Erect, spreading to decumbent shrub, 0.2-1 m high. Fl. yellow, Sep to Nov. Lateritic or granitic soils.	Yes	Yes	1.3 km E	Confirmed	Confirmed
Synaphea grandis	P4			Tufted shrub, ca 0.3 m high. Fl. yellow, Oct to Nov. Laterite.	Yes	Yes	Within	Confirmed	Confirmed
Oxymyrrhine coronata	P4			Erect, open shrub, 0.7-1.5 m high. Fl. pink/white. Brown/yellow gravel over laterite. Slopes, hilltops, flats.	Yes	Yes	1.4 km N	Highly Likely	Possible
Schoenus natans	P4			Aquatic annual, grass-like or herb (sedge), 0.3 m high. Fl. brown, Oct. Winter-wet depressions.	Yes	Yes	0.6 km W	Highly Likely	Highly Likely
Acacia browniana var. *glaucescens*	P2			Multi-stemmed shrub, 0.2-0.5 m high, spreading by subterranean runners. Fl. yellow, Aug. Lateritic gravelly soils.	Yes	Adjacent	2.8 km ENE	Possible	Unlikely
Acacia drummondii subsp. *affinis*	P3			Erect shrub, 0.3-1 m high. Fl. yellow, Jul to Aug. Lateritic gravelly soils.	Possible	Yes	9.0 km W	Possible	Unlikely
Acacia pulchella var. *reflexa* acuminate bracteole variant (R.J. Cumming 882)	P3			Shrub, 0.3-1 m high. Fl. yellow, Jul to Sep. Sandy loam or sandy clay over laterite. Woodland.	Yes	Yes	12.5 km W	Possible	Unlikely
Adenanthos cygnorum subsp. *chamaephyton*	P3			Prostrate, mat-forming, non-lignotuberous shrub, to 0.3 m high. Fl. white-cream-pink-green/green, Jul or Sep to Dec or Jan. Grey sand, lateritic gravel.	Yes	Yes	11.3 km NE	Possible	Unlikely
Androcalva fragifolia	P1			Prostrate shrub 5cm high up to 3m wide, with hairy stems. Fl. White-pink, Oct to Feb. Laterite, loamy sand or sandy clay on flats, slopes, road verges.	Yes	No	14.7 km NNE	Possible	Possible
Calothamnus pachystachyus	P4			Erect, much-branched, often straggly shrub, (0.3-) 0.6-1.7 m high. Fl. red-brown-black, Aug to Oct. Lateritic soils, often gravelly. Ridges, road verges.	Yes	No	16.7 km NNE	Possible	Unlikely
Chorizema ulotropis	P4			Sprawling, open, semi-prostrate shrub, to 0.45 m high. Fl. orange-yellow, Jul to Sep. Moist to dry soils, white sand with gravel, laterite, granite. Outcrops, winter damp to dry areas, flats.	Yes	Adjacent	13.7 km NE	Possible	Possible
Conostylis caricina subsp. *elachys*	P1			Rhizomatous, tufted perennial, grass-like or herb, 0.05-0.1 m high. Fl. cream-yellow, Jul to Aug. Gravel, clayey loam, sand.	Yes	Adjacent	11.2 km NNE	Possible	Possible
Cyanicula ixioides subsp. *ixioides*	P4			Tuberous, perennial, herb, 0.05-0.15 m high. Fl. yellow, Aug to Oct. Laterite, gravel.	No	Yes	3.2 km ENE	Possible	Possible
Eleocharis keigheryi	T	VU	VU	Rhizomatous, clumped perennial, grass-like or herb (sedge), to 0.4 m high. Fl. green, Aug to Nov. Clay, sandy loam. Emergent in freshwater: creeks, claypans.	Yes	Yes	11.0 km N	Possible	Highly Unlikely
Gastrolobium crispatum	P1			Tall shrub, to 2.5 m high. Fl. yellow&orange&red, Sep to Oct. Yellow or brown sandy loam, red laterite soils. Steep gullies, slopes, ridges, breakaways.	Yes	Adjacent	5.1 km W	Possible	Unlikely
Gastrolobium nudum	P2			Spreading, twiggy shrub, to 0.8 m high. Fl. orange&red, Feb. Red-brown clay, brown loam, gravel, laterite, granite. Flats, slopes, hilltops, ridges, valleys, breakaways.	Possible	Yes	10.0 km SSE	Possible	Unlikely
Grevillea bracteosa subsp. *bracteosa*		EN		Spindly shrub, 1-2 m high. Fl. Green or pink, Aug to Oct. Hilltops, flats, slopes, laterite clay-loam soils.	Yes	Adjacent	11.9 km NE	Possible	Unlikely
Grevillea corrugata		VU	EN	Shrub, 1.5-2.5 m high. Fl. white, ? Aug to Sep. Gravelly loam. Roadsides.	Possible	Yes	6.7 km W	Possible	Unlikely
Grevillea curviloba		CR	EN	Prostrate to erect shrub, 0.1-2.5 m high. Fl. white-cream, Aug to Oct. Grey sand, sandy loam. Winter-wet heath.	No	Yes	14.1 km E	Possible	Highly Unlikely
Hemigenia platyphylla	P4			Spreading shrub, 0.2-1.5 m high. Fl. blue-purple, Sep to Nov. Sandy & loamy soils. Granite rocks, slopes.	Yes	Adjacent	18.1 km NNE	Possible	Unlikely
Hibbertia miniata	P4			Decumbent or erect shrub, 0.1-1 m high. Fl. orange/orange-red, Aug to Nov. Lateritic gravelly soils.	Yes	Yes	6.0 km E	Possible	Unlikely
Hydrocotyle lemnoides	P4			Aquatic, floating annual, herb. Fl. purple, Aug to Oct. Swamps.	Yes	Yes	11.1 km N	Possible	Highly Unlikely
Johnsonia inconspicua	P3			Rhizomatous, tufted perennial, grass-like or herb, 0.1-0.3 m high, to 0.2 m wide. Fl. green-white/pink, Oct to Nov. White-grey or black sand. Low dunes, winter-wet flats.	Yes	Yes	3.4 km N	Possible	Possible
Lasiopetalum caroliae	P3			Low shrub, to 0.3 m high. Fl. pink/purple, Sep to Oct. Brown sandy loam clay over laterite. Slopes, drainage lines, hilltops, outcrops.	Yes	Yes	4.8 km W	Possible	Confirmed
Lechenaultia magnifica	P1			Erect perennial, herb or shrub (subshrub), to 0.6 m high. Fl. White or blue, November. Brown, grey, yellow or white sand, brown sandy loam, laterite. Slopes and flats.	Yes	Adjacent	14.1 km NE	Possible	Unlikely
Millotia tenuifolia var. *laevis*	P2			Ascending to erect annual, herb, 0.02-0.1 m high. Fl. yellow, Sep to Oct. Granite or laterite soils.	Yes	Yes	10.7 km NW	Possible	Possible
Schoenus capillifolius	P3			Semi-aquatic tufted annual, grass-like or herb (sedge), 0.05 m high. Fl. green, Oct to Nov. Brown mud. Claypans.	Yes	Yes	11.6 km N	Possible	Possible
Stylidium longitubum	P4			Erect annual (ephemeral), herb, 0.05-0.12 m high. Fl. pink, Oct to Dec. Sandy clay, clay. Seasonal wetlands.	Yes	Yes	10.9 km N	Possible	Possible
Stylidium vinosum	P1			Perennial herb, 0.08-0.2 m high. Fl. white with pink/red throat markings, Sept-Nov. Grey/white sands over laterite. Slopes, flats.	Possible	Yes	3.5 km E	Possible	Possible
Synaphea rangiferops^	P2			Shrub, ca 0.3 m high. Fl. yellow, Jul to Sep. Sandy loam, gravel.	No	Yes	13.7 km NW	Possible	Possible
Tetratheca pilifera	P3			Spreading shrub, 0.1-0.3 m high. Fl. purple, Aug to Oct. Gravelly soils.	Yes	Yes	3.4 km NE	Possible	Possible
Thelymitra stellata		EN	EN	Tuberous, perennial, herb, 0.15-0.25 m high. Fl. yellow & brown, Oct to Nov. Sand, gravel, lateritic loam.	Possible	Yes	8.3 km E	Possible	Possible
Verticordia citrella	P2			Erect, slender shrub, 0.3-1 m high. Fl. yellow, Oct to Nov. Gravelly loam or sand. Low-lying damp areas, swamps.	Yes	Adjacent	8.7 km SE	Possible	Possible
Verticordia huegelii var. *tridens*	P3			Shrub, 0.15-0.6 m high. Fl. green-yellow/red, Sep to Nov. Sandy or gravelly loam. Winter-wet areas, low hills.	Yes	Yes	14.6 km NNE	Possible	Unlikely
Verticordia serrata var. *linearis*^	P3			Shrub, to 1 m high. Fl. other, Sep to Oct. White sand, gravel. Open woodland.	Possible	Yes	13.7 km SW	Possible	Unlikely
Acacia anomala		VU	VU	Slender, rush-like shrub, 0.2-0.5 m high. Fl. yellow, Aug to Sep. Lateritic soils. Slopes.	No	No	14.1 km SW	Unlikely	Highly Unlikely
Acacia chapmanii subsp. *australis*		EN	EN	Upright, compact, intricate shrub, 0.3-1 m high. Fl. yellow, Aug to Sep. Sandy clay or gravel, grey sand. Plains, swampy areas.	Yes	No	21.1 km NE	Unlikely	Highly Unlikely
Acacia oncinophylla subsp. *patulifolia*	P4			Shrub, 0.5-2.5(-3) m high, 'minni-ritchi' bark, phyllodes 4-9 cm long, 3-6 mm wide. Fl. yellow, Aug to Nov or Nov to Dec. Granitic soils, occasionally on laterite.	Possible	No	10.8 km S	Unlikely	Highly Unlikely
Asterolasia grandiflora	P4			Slender open shrub, 0.2-0.6(-0.8) m high. Fl. pink/white, Jul to Oct. Lateritic soils, clay over granite. Breakaways, hills.	Possible	No	13.5 km ENE	Unlikely	Highly Unlikely

Taxon	Conservation Status			Habit and Habitat	Habitat within Study Area	Within Current Known Distribution	Distance to Nearest Record	Likelihood of Occurrence pre-survey	Likelihood of Occurrence post-survey
	DBCA	EPBC Act	BC Act						
Beaufortia eriocephala (not originally identified in desktop assessment)	P3			Erect, compact shrub, 0.3-0.6 m high. Fl. red, Sep to Nov. Lateritic sandy soils. Slopes.	No	Yes	36 km E	Unlikely	Confirmed
Boronia scabra subsp. condensata^	P2			Erect shrub, 0.25-0.7 m high. Fl. pink, Aug. Sandy clay or gravel. Upper slopes, edges of lateritic breakaways.	No	Yes	27.1 km SE	Unlikely	Highly Unlikely
Caladenia speciosa	P4			Tuberous, perennial, herb, 0.35-0.6 m high. Fl. white-pink, Sep to Oct. White, grey or black sand.	Possible	Yes	22.3 km NE	Unlikely	Unlikely
Calytrix oncophylla^	P2			Shrub, 0.4-0.8 m high. Fl. purple-blue, Sep to Nov. Stony loam. Lateritic breakaways.	No	No	17.8 km SE	Unlikely	Highly Unlikely
Comesperma rhadinocarpum	P3			Perennial, herb 15 - 40cm high. Narrow-fruited. Fl. blue, Oct to Nov. Sandy, lateritic soils.	Possible	Yes	21.5 km NE	Unlikely	Unlikely
Conospermum densiflorum subsp. *unicephalatum*		EN	EN	Erect, much-branched shrub, 0.3-0.6 m high, inflorescence a spike. Fl. cream/white & blue, Sep to Nov. Clay soils. Low-lying areas.	Yes	No	33.3 km N	Unlikely	Confirmed
Darwinia carnea		CR	EN	Spreading shrub, 0.2-0.45 m high. Fl. green & red, Oct to Dec. Lateritic loam & gravel.	Yes	Yes	27.5 km NNW	Unlikely	Highly Unlikely
Daviesia debilior subsp. *sinuans*^	P3			Straggling shrub, to 0.8 m high. Fl. yellow & red/purple, May to Jul. Gravelly lateritic clay.	Yes	No	17.1 km NNE	Unlikely	Highly Unlikely
Diplolaena andrewsii		EN	EN	Erect shrub, 0.5-1 m high. Fl. red, Jul to Oct. Loam, clay. Granite outcrops & hillsides.	Possible	No	18.1 km SSW	Unlikely	Highly Unlikely
Eryngium pinnatifidum subsp. Umbraphilum (G.J. Keighery 13967)	P2			Tuberous herb, to 0.05 m high, to 0.15 m wide. Fl. white/blue. Brown or grey sandy clay. Winter wet flats.	No	No	11.6 km WSW	Unlikely	Unlikely
Goodenia arthrotricha		EN	EN	Erect perennial, herb, to 0.4 m high. Fl. blue, Oct to Nov. Gravel. Granite rocks, slopes.	Possible	No	18.0 km NW	Unlikely	Unlikely
Grevillea candolleana	P2			Spreading shrub, 0.2-0.8 m high. Fl. white-cream, Aug to Sep. Laterite, lateritic loam. Hillsides.	Possible	Adjacent	8.5 km S	Unlikely	Highly Unlikely
Grevillea drummondii	P4			Spreading to erect shrub, 0.2-2(-2.5) m high. Fl. cream & yellow & red, Jun to Sep. Lateritic soils (sandy clay, gravel, loam, sand), sand over granite. Rocky hillsides, boulders, granite outcrops.	Yes	No	13.4 km NE	Unlikely	Highly Unlikely
Grevillea sp. Toodyay West (F. Hort et al. 3296)	P2			Erect branching shrub to 1m high. Fl. cream, Aug to Sept. Rocky loam, clay over granite on hillsides, gullies, breakaways, drainage lines.	No	No	14.8 km ENE	Unlikely	Highly Unlikely
Hibbertia glomerata subsp. *ginginensis*	P2			Erect shrub, to 0.5 m high. Fl. yellow, Jul to Sep. Sand, brown clay, laterite. Near roadsides.	No	No	13.5 km SW	Unlikely	Highly Unlikely
Hypocalymma sylvestre		EN	EN	Spreading shrub, 0.6 m high. Fl. yellow, Aug. Yellow-brown sandy loam. Woodland on lateritic hilltop.	Possible	Adjacent	6.1 km W	Unlikely	Highly Unlikely
Hypolaena robusta^	P4			Dioecious rhizomatous, perennial, herb, ca 0.5 m high. Fl. Sep to Oct. White sand. Sandplains.	No	No	19.4 km W	Unlikely	Unlikely
Lasiopetalum decoratum	P2			Erect shrub to 1.5m tall. Fl. pink, Oct to Dec. Brown loam/clay/sand with laterite on hillslopes, gully, hilltop breakaway	Possible	No	17.6 km ENE	Unlikely	Highly Unlikely
Platysace ramosissima	P3			Perennial, herb, to 0.3 m high. Fl. white-cream, Oct to Nov. Sandy soils.	Possible	Yes	23.0 km NE	Unlikely	Unlikely
Schoenus sp. Toodyay (G.J. Keighery & N. Gibson 2918)	P1			Small annual, herb. Brown loam over gravel. Flat upland areas.	Possible	No	14.2 km SSE	Unlikely	Unlikely
Stylidium cymiferum	P3			Rosetted perennial, herb, 0.12-0.35 m high. Fl. yellow, Oct to Nov. Brown loam over laterite. Uplands, Wandoo woodland.	Yes	No	12.6 km NE	Unlikely	Unlikely
Stylidium squamellosum^	P2			Caespitose perennial, herb, 0.12-0.35 m high. Fl. yellow, Oct to Nov. Brown to red-brown clay loam. Winter-wet habitats and depressions, open woodland, shrubland.	No	No	19.3 km W	Unlikely	Unlikely
Styphelia brevicuspis	P2			Erect and spreading shrub to 2m tall. Fl. white, Jan, May, June. Clay loam with gravel in gullies, slopes, drainage lines, breakaways.	Possible	No	14.1 km ENE	Unlikely	Highly Unlikely
Synaphea panhesya	P1			Erect shrub, 0.3-0.6 m high. Fl. yellow, Aug to Sep. Gravelly loam & sandy gravel.	Yes	No	11.5 km NE	Unlikely	Highly Unlikely
Tetratheca spartea	P2			Leafless multi-stemmed shrub to 30cm tall. Fl. Pink/magenta/mauve, Aug, Sept, Nov. Clay-loam with lateritic gravel in gullies, lateritic breakaways, slopes.	Possible	No	17.1 km NE	Unlikely	Unlikely
Thysanotus sp. Badgingarra (E.A. Griffin 2511)	P2			Perennial, herb (with tuberous roots), ca 0.35 m high. Fl. blue, Dec. Grey sand with lateritic gravel.	No	No	9.0 km W	Unlikely	Unlikely
Trithuria australis	P4			Small aquatic herb. Fl. red-purple, Oct to Nov. Grey/black silty clay. Edge of wetland, seasonal wet clay flats, swamps.	Possible	Yes	21.1 km NE	Unlikely	Highly Unlikely
Verticordia lindleyi subsp. *lindleyi*^	P4			Erect shrub, 0.2-0.75 m high. Fl. pink, May or Nov to Dec or Jan. Sand, sandy clay. Winter-wet depressions.	No	No	19.8 km W	Unlikely	Highly Unlikely
Acacia campylophylla	P3			Dense, rigid, spreading shrub, 0.1-0.6 m high. Fl. yellow, Jul to Aug. Lateritic gravelly soils.	Possible	No	21.8 km NE	Highly Unlikely	Highly Unlikely
Banksia nivea subsp. Morangup (M. Pieroni 94/2)^	P2			Non-lignotuberous shrub, 0.15-1.5 m high. Fl. cream-yellow-orange-pink/red-brown, Apr. Dry-wet laterite with loam-clay-gravel.	Possible	No	21.7 km SSE	Highly Unlikely	Highly Unlikely
Banksia serratuloides subsp. *serratuloides*^	T			Low, bushy, lignotuberous shrub, 0.3-1 m high. Fl. yellow, Jul to Sep. Loam or clay loam over laterite, sandy gravel.	Possible	No	38.2 km N	Highly Unlikely	Highly Unlikely
Caladenia integra^	P4			Tuberous, perennial, herb, 0.2-0.5 m high. Fl. green & red, Sep to Oct. Clayey loam. Granite outcrops, rocky slopes.	No	No	27.1 km SE	Highly Unlikely	Highly Unlikely
Eucalyptus loxophleba x *wandoo*	P4			(Mallee) or tree, 4-20 m high, bark rough black-brown on trunk. Sandy clay or loam.	Possible	No	21.4 km NE	Highly Unlikely	Highly Unlikely
Melaleuca sciotostyla		EN	EN	Spreading shrub, 0.6-1.5 m high. Fl. Aug. Orange clayey sand with lateritic pebbles. Scree slopes.	No	No	42.6 km N	Highly Unlikely	Highly Unlikely
Stylidium sacculatum	P3			Creeping perennial, herb, 0.05-0.15 m high. Fl. white-pink, Oct to Nov. Clayey sand or sand. Lower slopes and flats. Open Wandoo or Marri woodland, Allocasuarina shrubland.	Possible	No	21.5 km NE	Highly Unlikely	Highly Unlikely
Thelymitra dedmaniarum		CR	EN	Tuberous, perennial, herb, to 0.8 m high. Fl. yellow, Nov to Dec or Jan. Granite.	Possible	No	26.0 km SSW	Highly Unlikely	Highly Unlikely
Tricoryne sp. Wongan Hills (B.H. Smith 794)	P2			Multi-stemmed, open, caespitose rhizomatous, perennial, herb, to 0.2 m high. Yellow to grey sand, gravelly clay quartz, laterite, limestone. Midslopes and uplands.	Possible	No	21.5 km NE	Highly Unlikely	Highly Unlikely
Verticordia paludosa^	P4			Erect shrub, 0.3-0.9 m high. Fl. pink-white, Jan to May. White/grey sand. Winter-wet flats.	No	No	35.8 km NW	Highly Unlikely	Highly Unlikely

Appendix G: Introduced Flora Database Search Results

Family	Taxon	Source				DP	WoNS	Ecological Impact	Invasiveness
		NatureMap	ALA	EPBC	WAOL				
Alismataceae	*Sagittaria platyphylla*				•	Yes	Yes	Not assessed	Not assessed
Apiaceae	*Coriandrum sativum*	•	•			No	No	Not assessed	Not assessed
Apocynaceae	*Calotropis procera*				•	Yes	No	Not assessed	Not assessed
	Cryptostegia madagascariensis				•	Yes	No	Not assessed	Not assessed
	Gomphocarpus fruticosus				•	Yes	No	Unknown	Rapid
Araceae	*Pistia stratiotes*				•	Yes	No	Not assessed	Not assessed
	Zantedeschia aethiopica				•	Yes	No	High	Moderate
Araliaceae	*Hydrocotyle ranunculoides*				•	Yes	No	Not assessed	Not assessed
Asparagaceae	*Asparagus asparagoides*			•	•	Yes	Yes	High	Rapid
Asteraceae	*Chondrilla juncea*				•	Yes	No	Not assessed	Not assessed
	Chrysanthemoides monilifera			•		No	No	Not assessed	Not assessed
	Chrysanthemoides monilifera subsp. *monilifera*			•		No	Yes	Not assessed	Not assessed
	Hypochaeris glabra	•	•			No	No	Medium	Rapid
	Onopordum acaulon				•	Yes	No	Not assessed	Not assessed
	Silybum marianum				•	Yes	No	Unknown	Moderate
	Ursinia anthemoides	•	•			No	No	Unknown	Rapid
	Ursinia anthemoides subsp. *anthemoides*	•				No	No	Unknown	Rapid
	Xanthium spinosum				•	Yes	No	Not assessed	Not assessed
	Xanthium strumarium				•	Yes	No	Not assessed	Not assessed
Boraginaceae	*Echium plantagineum*				•	Yes	No	Low	Moderate
Cactaceae	*Austrocylindropuntia cylindrica*				•	Yes	Yes	Not assessed	Not assessed
	Austrocylindropuntia subulata				•	Yes	Yes	Not assessed	Not assessed
	Cylindropuntia fulgida				•	Yes	Yes	Not assessed	Not assessed
	Cylindropuntia imbricata				•	Yes	Yes	Not assessed	Not assessed

Family	Taxon	Source				DP	WoNS	Ecological Impact	Invasiveness
		NatureMap	ALA	EPBC	WAOL				
	Cylindropuntia kleiniae				•	Yes	Yes	Not assessed	Not assessed
	Cylindropuntia pallida				•	Yes	Yes	Not assessed	Not assessed
	Cylindropuntia tunicata				•	Yes	Yes	Not assessed	Not assessed
	Opuntia elata				•	Yes	Yes	Not assessed	Not assessed
	Opuntia elatior				•	Yes	Yes	Not assessed	Not assessed
	Opuntia engelmannii				•	Yes	Yes	Not assessed	Not assessed
	Opuntia ficus-indica				•	Yes	Yes	Not assessed	Not assessed
	Opuntia microdasys				•	Yes	Yes	Not assessed	Not assessed
	Opuntia monacantha				•	Yes	Yes	Low	Slow
	Opuntia polyacantha				•	Yes	Yes	Not assessed	Not assessed
	Opuntia puberula				•	Yes	Yes	Not assessed	Not assessed
	Opuntia stricta				•	Yes	Yes	Low	Slow
	Opuntia tomentosa				•	Yes	Yes	Not assessed	Not assessed
Campanulaceae	*Monopsis debilis*		•			No	No	Low	Rapid
Cyperaceae	*Isolepis levynsiana*		•			No	No	Not assessed	Not assessed
Dicranaceae	*Campylopus introflexus*	•				No	No	Not assessed	Not assessed
Euphorbiaceae	*Jatropha gossypiifolia*				•	Yes	Yes	Not assessed	Not assessed
Fabaceae	*Alhagi maurorum*				•	Yes	No	Not assessed	Not assessed
	Genista sp. X *Genista monspessulana*			•		No	Yes	Not assessed	Not assessed
	Parkinsonia aculeata				•	Yes	Yes	Not assessed	Not assessed
	Prosopis glandulosa x *velutina*				•	Yes	Yes	Not assessed	Not assessed
	Senna alata				•	Yes	No	Not assessed	Not assessed
	Senna obtusifolia				•	Yes	No	Not assessed	Not assessed
	Ulex europaeus				•	Yes	Yes	High	Moderate
	Vicia benghalensis	•	•			No	No	Unknown	Slow

Family	Taxon	Source				DP	WoNS	Ecological Impact	Invasiveness
		NatureMap	ALA	EPBC	WAOL				
Gentianaceae	*Cicendia filiformis*		●			No	No	Low	Rapid
Iridaceae	*Gladiolus caryophyllaceus*	●	●			No	No	Not assessed	Not assessed
	Moraea flaccida				●	Yes	No	High	Moderate
	Moraea miniata				●	Yes	No	Not assessed	Not assessed
	Romulea rosea	●	●			No	No	Not assessed	Not assessed
Juncaceae	*Juncus bufonius*		●			No	No	Low	Rapid
	Juncus capitatus		●			No	No	Low	Rapid
Orchidaceae	*Disa bracteata*	●	●			No	No	Unknown	Rapid
Orobanchaceae	*Bellardia trixago*	●	●			No	No	Not assessed	Not assessed
	Parentucellia latifolia	●	●			No	No	Unknown	Rapid
Pinaceae	*Pinus radiata*			●		No	No	High	Rapid
Poaceae	*Aira caryophyllea*	●	●			No	No	Unknown	Rapid
	Aira cupaniana	●	●			No	No	Unknown	Rapid
	Avellinia michelii	●	●			No	No	Unknown	Unknown
	Brachypodium distachyon	●	●			No	No	Unknown	Unknown
	Briza maxima	●	●			No	No	Unknown	Rapid
	Briza minor	●	●			No	No	Unknown	Rapid
	Pentameris airoides		●			No	No	Unknown	Unknown
	Pentameris airoides subsp. *airoides*	●				No	No	Unknown	Unknown
	Polypogon monspeliensis		●			No	No	Medium	Unknown
Primulaceae	*Lysimachia arvensis*		●			No	No	Not assessed	Not assessed
Rhamnaceae	*Ziziphus mauritiana*				●	Yes	No	Not assessed	Not assessed
Rosaceae	*Rubus anglocandicans*				●	Yes	Yes	High	Moderate
	Rubus fruticosus aggregate			●		Yes	Yes	High	Moderate
	Rubus laudatus				●	No	No	Not assessed	Not assessed

Family	Taxon	Source				DP	WoNS	Ecological Impact	Invasiveness
		NatureMap	ALA	EPBC	WAOL				
	Rubus rugosus				•	No	No	Not assessed	Not assessed
	Rubus ulmifolius				•	Yes	Yes	High	Moderate
Rubiaceae	*Galium aparine*				•	Yes	No	Not assessed	Not assessed
	Galium murale	•	•			No	No	Low	Unknown
	Galium spurium				•	Yes	No	Not assessed	Not assessed
Salviniaceae	*Salvinia molesta*			•		No	Yes	Not assessed	Not assessed
Scrophulariaceae	*Phyllopodium cordatum*	•	•			No	No	Not assessed	Not assessed
Solanaceae	*Lycium ferocissimum*			•		No	Yes	High	Moderate
	Solanum elaeagnifolium				•	Yes	Yes	Not assessed	Not assessed
	Solanum linnaeanum				•	Yes	No	Medium	Moderate
Tamaricaceae	*Tamarix aphylla*			•	•	Yes	Yes	Not assessed	Not assessed
Verbenaceae	*Lantana camara*			•	•	Yes	Yes	Not assessed	Not assessed

Appendix H: Flora Composition

42 Zamiaceae

Macrozamia riedlei

115 Orchidaceae

Eriochilus dilatatus
Leporella fimbriata
Pyrorchis nigricans

124 Iridaceae

Orthrosanthus laxus var. *gramineus*
Orthrosanthus laxus var. *laxus*
Patersonia occidentalis
Patersonia sp. Indet

126 Xanthorrhoeaceae

Xanthorrhoea gracilis
Xanthorrhoea preissii

128 Asparagaceae

Laxmannia ?squarrosa
Laxmannia squarrosa
Lomandra ?effusa
Lomandra ?caespitosa
Lomandra caespitosa
Lomandra hermaphrodita
Lomandra sericea
Lomandra sp. Indet
Lomandra spartea

130 Hemerocallidaceae

Johnsonia pubescens

138 Haemodoraceae

Conostylis ?setigera
Conostylis aculeata
Conostylis setigera subsp. *setigera*
Haemodorum sp. Indet

156 Cyperaceae

Lepidosperma aff. *drummondii*
Lepidosperma pubisquameum
Lepidosperma sp. Indet
Lepidosperma tenue

159 Restionaceae

Desmocladus ?asper
Desmocladus asper
Lepidobolus preissianus

163 Poaceae

* *Aira caryophyllea*
Neurachne alopecuroidea

175 Proteaceae

Adenanthos cygnorum subsp. *cygnorum*
Banksia bipinnatifida subsp. *bipinnatifida*
Banksia dallanneyi subsp. *sylvestris*
Banksia fraseri var. *fraseri*
Banksia grandis
Banksia sessilis
Banksia sphaerocarpa var. ?*pumilio*
Banksia sphaerocarpa var. *pumilio*
Banksia squarrosa subsp. *squarrosa*
Conospermum densiflorum subsp. *unicephalatum* (T)
?Grevillea sp. Indet
Grevillea bipinnatifida subsp. *bipinnatifida*
Grevillea pilulifera
Grevillea synapheae subsp. *synapheae*
Hakea incrassata
Hakea lissocarpha
Hakea prostrata
Hakea trifurcata
Hakea undulata
Hakea varia
Persoonia angustiflora
Persoonia elliptica
Petrophile striata
Stirlingia latifolia
Synaphea decorticans
Synaphea sp. Indet
Synaphea sp. Udumung (A.S. George 17058)

181 Dilleniaceae

Hibbertia ?semipilosa
Hibbertia commutata
Hibbertia hibbertioides var. *hibbertioides*
Hibbertia huegelii
Hibbertia hypericoides subsp. *hypericoides*
Hibbertia lasiopus
Hibbertia semipilosa

201 Fabaceae

?Fabaceae sp. Indet
Acacia celastrifolia
Acacia drummondii subsp. *drummondii*
Acacia drummondii subsp. *elegans*
Acacia lasiocarpa var. *sedifolia*
Acacia pulchella
Acacia saligna
Acacia sp. Indet
Bossiaea aquifolium subsp. *aquifolium*
Bossiaea eriocarpa
Bossiaea ornata
Daviesia angulata
Daviesia preissii
Daviesia sp. Indet
Gastrolobium calycinum
Gompholobium knightianum
Gompholobium marginatum

Jacksonia furcellata
Jacksonia sternbergiana
Kennedia prostrata

203 Polygalaceae

Comesperma calymega

208 Rhamnaceae

Trymalium odoratissimum subsp. *odoratissimum*

217 Casuarinaceae

Allocasuarina huegeliana
Allocasuarina humilis

247 Phyllanthaceae

Phyllanthus calycinus

281 Myrtaceae

Babingtonia camphorosmae
Beaufortia eriocephala (P3)
Calothamnus lateralis
Calothamnus quadrifidus subsp. *quadrifidus*
Calytrix ?angulata
Calytrix sp. Indet 1
Calytrix sp. Indet 2
Calytrix sp. Indet 3
Corymbia calophylla
Eucalyptus accedens
Eucalyptus drummondii
Eucalyptus marginata
Eucalyptus wandoo
Hypocalymma angustifolium
Hypocalymma sp. Indet
Kunzea praestans
Leptospermum erubescens
Melaleuca incana
Melaleuca trichophylla
Verticordia densiflora var. *cespitosa*
Verticordia sp. Indet

309 Malvaceae

Lasiopetalum caroliae
Malvaceae sp. Indet

311 Thymelaeaceae

Pimelea argentea
Pimelea sp. indet

336 Olacaceae

Olax scalariformis

339 Loranthaceae

Amyema miquelii

Nuytsia floribunda

346 Droseraceae

Drosera ?*sewelliae* (P2)
Drosera erythrorhiza
Drosera sewelliae (P2)

403 Ericaceae

Leucopogon pulchellus
Leucopogon sp. Newdegate (M. Hislop 3585)
Styphelia epacridis
Styphelia macrocalyx
Styphelia oblongifolia
Styphelia pallida
Styphelia propinqua
Styphelia retrorsa
Styphelia tenuiflora

417 Solanaceae

* *Solanum nigrum*

432 Lamiaceae

Hemigenia wandooana

452 Stylidiaceae

Stylidium ?*brunonianum*
Stylidium diuroides
Stylidium eriopodum
Stylidium hispidum
Stylidium sp. Indet

458 Goodeniaceae

Lechenaultia ?*biloba*

460 Asteraceae

* *Ursinia anthemoides*

Appendix I: Coordinates for threatened and priority flora recorded in the Study Area

Date	Species	Abundance	Latitude	Longitude
22/04/2021	*Beaufortia eriocephala*	1	-31.492563	116.2118025
20/04/2021	*Conospermum densiflorum* subsp. *unicephalatum*	10	-31.4951593	116.2345388
7/05/2021	*Drosera ?sewelliae*	1	-31.4564454	116.2505179
22/04/2021	*Drosera ?sewelliae*	30	-31.4565491	116.2326993
7/05/2021	*Drosera ?sewelliae*	10	-31.4637912	116.244132
7/05/2021	*Drosera ?sewelliae*	2	-31.4657556	116.2482689
7/05/2021	*Drosera ?sewelliae*	20	-31.4658947	116.2501347
13/05/2021	*Drosera ?sewelliae*	1	-31.46748124	116.2387535
22/04/2021	*Drosera ?sewelliae*	1	-31.4704869	116.2237645
22/04/2021	*Drosera ?sewelliae*	20	-31.4747317	116.2209516
22/04/2021	*Drosera ?sewelliae*	0	-31.4731772	116.2184898
13/05/2021	*Drosera ?sewelliae*	50	-31.4752249	116.2157149
13/05/2021	*Drosera ?sewelliae*	25	-31.4798179	116.2202231
20/04/2021	*Drosera ?sewelliae*	1	-31.484622	116.2340474
20/04/2021	*Drosera ?sewelliae*	5	-31.495176	116.2345437
21/04/2021	*Drosera ?sewelliae*	50	-31.507694	116.2249702
13/05/2021	*Drosera ?sewelliae*	30	-31.486221	116.2294185
20/04/2021	*Drosera ?sewelliae*	50	-31.4842306	116.2351272
21/04/2021	*Drosera ?sewelliae*	8	-31.498202	116.2132615
21/04/2021	*Drosera ?sewelliae*	16	-31.49032599	116.2197015
21/04/2021	*Drosera ?sewelliae*	15	-31.46645932	116.2213295
22/04/2021	*Drosera ?sewelliae*	20	-31.49154489	116.2110576
22/04/2021	*Drosera ?sewelliae*	20	-31.49134938	116.2116585
22/04/2021	*Drosera ?sewelliae*	1	-31.49529643	116.2183992
7/05/2021	*Drosera ?sewelliae*	9	-31.4403218	116.2650815
13/05/2021	*Drosera ?sewelliae*	12	-31.4629249	116.2333743
13/05/2021	*Drosera ?sewelliae*	200	-31.4868082	116.2293833
20/04/2021	*Drosera ?sewelliae*	20	-31.4818186	116.2322672
22/04/2021	*Drosera ?sewelliae*	20	-31.4484087	116.2363142
22/04/2021	*Drosera ?sewelliae*	40	-31.4513891	116.240539
22/04/2021	*Drosera ?sewelliae*	30	-31.4522219	116.2422607
22/04/2021	*Drosera ?sewelliae*	60	-31.47362798	116.2184921
22/04/2021	*Drosera ?sewelliae*	90	-31.46865938	116.2458615
22/04/2021	*Drosera ?sewelliae*	1	-31.47384227	116.21902
22/04/2021	*Drosera ?sewelliae*	40	-31.4510657	116.2402124
22/04/2021	*Drosera ?sewelliae*	1	-31.450962	116.2400288
22/04/2021	*Drosera ?sewelliae*	30	-31.4478125	116.2351814
22/04/2021	*Drosera ?sewelliae*	20	-31.4490652	116.2334492
22/04/2021	*Drosera ?sewelliae*	20	-31.4513873	116.2407978
22/04/2021	*Drosera ?sewelliae*	10	-31.4521452	116.2422342
22/04/2021	*Drosera ?sewelliae*	45	-31.4521133	116.242339
22/04/2021	*Drosera ?sewelliae*	70	-31.47119266	116.2217321
22/04/2021	*Drosera ?sewelliae*	65	-31.47253503	116.225267
22/04/2021	*Drosera ?sewelliae*	20	-31.47255537	116.2252976
22/04/2021	*Drosera ?sewelliae*	50	-31.47267553	116.2253569
22/04/2021	*Drosera ?sewelliae*	50	-31.47295029	116.2253545
22/04/2021	*Drosera ?sewelliae*	40	-31.45668665	116.2373198
7/05/2021	*Drosera ?sewelliae*	15	-31.4596598	116.2532145
7/05/2021	*Drosera ?sewelliae*	3	-31.4639855	116.2502204

Date	Species	Abundance	Latitude	Longitude
7/05/2021	*Drosera ?sewelliae*	50	-31.4611156	116.2400472
7/05/2021	*Drosera ?sewelliae*	30	-31.4610877	116.2398285
7/05/2021	*Drosera ?sewelliae*	20	-31.4609386	116.2393381
7/05/2021	*Drosera ?sewelliae*	6	-31.4606509	116.2404001
7/05/2021	*Drosera ?sewelliae*	20	-31.4610173	116.2406688
7/05/2021	*Drosera ?sewelliae*	10	-31.4614942	116.243603
7/05/2021	*Drosera ?sewelliae*	60	-31.4606657	116.2394905
7/05/2021	*Drosera ?sewelliae*	15	-31.460595	116.2395061
7/05/2021	*Drosera ?sewelliae*	3	-31.4604971	116.2403936
7/05/2021	*Lasiopetalum caroliae*	1	-31.4610941	116.2550604
7/05/2021	*Lasiopetalum caroliae*	1	-31.4620756	116.2522171

Appendix J: Sample Site Data

Julimar Project Site BAU-03

Date	7/05/2021
Described by	SC & CW
Type	R
Location	MGA Zone 50
	430298 mE; 6521373 mN
	116.2664 E -31.440251 S
Veg Condition	Excellent
Soil	Sandy Loam
Rock Type	Laterite
Fire Age	1-3 yrs,3-5 yrs
Habitat	Undulating Low Hills
Vegetation	Open *Eucalyptus marginata* woodland with scattered *Corymbia calophylla* over tall open shrubland of *Banksia squarrosa* subsp. *squarrosa* and *Xanthorrhoea preissii* over open low shrubland of *Hibbertia hypericoides* subsp. *hypericoides*, *Hibbertia huegelii*, and *Grevillea synapheae* subsp. *synapheae*.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Banksia dallanneyi subsp. *sylvestris*				HAR36-03	
Banksia squarrosa subsp. *squarrosa*				BAU03-01	
Bossiaea eriocarpa					
Conostylis setigera subsp. *setigera*					
Corymbia calophylla					
Eucalyptus marginata					
Grevillea synapheae subsp. *synapheae*				CWSCopp02	
Hibbertia huegelii					
Hibbertia hypericoides subsp. *hypericoides*					
Hibbertia lasiopus				HAR36-07	
Macrozamia riedlei					
Styphelia tenuiflora				BAU03-02	
Xanthorrhoea preissii					

Julimar Project Site BAU-04

Date	7/05/2021
Described by	SC & DR
Type	R
Location	MGA Zone 50 430041 mE; 6521189 mN 116.2637 E -31.441896 S
Veg Condition	Excellent
Soil	Sandy Clay Loam
Rock Type	Laterite
Fire Age	1-3 yrs
Habitat	Drainage Area/ Floodplain
Vegetation	Mid *Eucalyptus wandoo* forest over tall *Banksia squarrosa* subsp. *squarrosa* shrubland over mid open *Leptospermum erubescens* and *Xanthorrhoea preissii* shrubland.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Banksia dallanneyi subsp. *sylvestris*					
Banksia squarrosa subsp. *squarrosa*					
Bossiaea eriocarpa					
Eucalyptus wandoo					
Hakea lissocarpha					
Hibbertia hypericoides subsp. *hypericoides*					
Lepidobolus preissianus				BAU04-01	
Leptospermum erubescens					
Xanthorrhoea preissii					

Julimar Project Site HAR-01

Date	22/04/2021
Described by	SC & HE
Type	R
Location	MGA Zone 50
	427322 mE; 6520518 mN
	116.2351 E -31.447776 S
Veg Condition	Excellent
Soil	Sandy Loam
Rock Type	Laterite
Fire Age	>10 yrs
Habitat	Undulating Low Hills
Vegetation	Mid *Eucalyptus marginata* and *Corymbia calophylla* forest over tall open *Banksia squarrosa* subsp. *squarrosa* shrubland over mid open *Xanthorrhoea preissii* shrubland over low open *Hibbertia hypericoides* subsp. *hypericoides* and *Styphelia retrorsa* shrubland.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Banksia squarrosa subsp. *squarrosa*					
Corymbia calophylla					
Eucalyptus marginata					
Hibbertia hypericoides subsp. *hypericoides*					
Styphelia retrorsa				HAR39-02	
Xanthorrhoea preissii					

Julimar Project Site HAR-03

Date	22/04/2021
Described by	SC & HE
Type	R
Location	MGA Zone 50 427104 mE; 6520262 mN 116.2327 E -31.450079 S
Veg Condition	Excellent
Soil	Sandy Clay Loam
Rock Type	Laterite
Fire Age	>10 yrs
Habitat	Drainage Area/ Floodplain
Vegetation	Mid scattered *Corymbia calophylla* trees over tall scattered *Hakea undulata* and *Adenanthos cygnorum* subsp. *cygnorum* shrubs over mid closed *Gastrolobium calycinum* and *Leptospermum erubescens* shrubland.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Adenanthos cygnorum subsp. *cygnorum*					
Allocasuarina humilis				CWSCOPP06	
Banksia dallanneyi subsp. *sylvestris*					
Calothamnus quadrifidus subsp. *quadrifidus*				HAR67-01	
Corymbia calophylla					
Daviesia angulata				CWSCOPP04	
Gastrolobium calycinum				HAR37-05	
Hakea prostrata					
Hakea undulata					
Hibbertia hypericoides subsp. *hypericoides*					
Johnsonia pubescens					
Leptospermum erubescens					

Julimar Project Site HAR-05

Date	7/05/2021
Described by	EEB & CW
Type	R
Location	MGA Zone 50
	428785 mE; 6519566 mN
	116.2504 E -31.456463 S
Veg Condition	Excellent
Soil	Sandy Loam
Rock Type	Laterite
Fire Age	1-3 yrs
Habitat	Undulating Low Hills
Vegetation	*Eucalyptus marginata* and *Corymbia calophylla* open woodland over *Xanthorrhoea preissii*, *Macrozamia riedlei* and *Banksia squarrosa* subsp. *squarrosa* tall open shrubland over *Hibbertia hypericoides* subsp. *hypericoides*, *Hibbertia* ?*semipilosa*, and *Phyllanthus calycinus* low open shrubland.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Banksia grandis					
Banksia sessilis					
Banksia squarrosa subsp. *squarrosa*					
Corymbia calophylla					
Drosera ?*sewelliae*				CWSCOPP01	
Eucalyptus marginata					
Gompholobium marginatum					
Grevillea synapheae subsp. *synapheae*				CWSCOPP02	
Hibbertia ?*semipilosa*				HAR70-01	
Hibbertia hypericoides subsp. *hypericoides*					
Hibbertia lasiopus				HAR36-07	
Lomandra hermaphrodita					
Macrozamia riedlei					
Phyllanthus calycinus					
Styphelia tenuiflora				BAU03-02	
Xanthorrhoea preissii					

Julimar Project Site HAR-06

Date	7/05/2021
Described by	EEB & CW
Type	R
Location	MGA Zone 50
	429181 mE; 6519183 mN
	116.2545 E -31.459935 S
Veg Condition	Excellent
Soil	Sandy Clay Loam
Rock Type	Laterite
Fire Age	>10 yrs
Habitat	Minor Drainage Line
Vegetation	*Eucalyptus accedens* low open woodland over *Acacia celastrifolia* tall shrubland over *Hibbertia hypericoides* subsp. *hypericoides*, *Xanthorrhoea gracilis* and *Hakea lissocarpha* low open shrubland.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Acacia celastrifolia				HAR06-01	
Acacia drummondii subsp. *elegans*				EBCWOPP01	
Eucalyptus accedens					
Eucalyptus marginata					
Hakea lissocarpha					
Hibbertia hypericoides subsp. *hypericoides*					
Hibbertia lasiopus					
Styphelia retrorsa				HAR39-02	
Xanthorrhoea gracilis					

Julimar Project Site HAR-07

Date	7/05/2021			
Described by	EEB & CW			
Type	R			
Location	MGA Zone	50		
	429225	mE;	6519051	mN
	116.2550	E	-31.461130	S
Veg Condition	Excellent			
Soil	Clay Loam			
Rock Type	Laterite, Quartz			
Fire Age	1-3 yrs,3-5 yrs			
Habitat	Hillslope			
Vegetation	Open *Eucalyptus accedens* woodland over *Xanthorrhoea preissii*, *Macrozamia riedlei* scattered shrubs over low open shrubland of *Bossiaea eriocarpa*, *Hakea lissocarpha* and *Banksia bipinnatifida* subsp. *bipinnatifida*.			

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Acacia drummondii subsp. *elegans*				EBCWOPP01	
Acacia lasiocarpa var. *sedifolia*				HAR07-03	
Banksia bipinnatifida subsp. *bipinnatifida*				HAR07-02	
Bossiaea eriocarpa					
Eucalyptus accedens					
Hakea lissocarpha					
Lasiopetalum caroliae				HAR07-04	
Lomandra ?effusa				HAR07-05	
Lomandra spartea				HAR07-01	
Macrozamia riedlei					
Xanthorrhoea preissii					

Julimar Project Site HAR-08

Date	7/05/2021			
Described by	EEB & CW			
Type	R			
Location	MGA Zone	50		
	428962	mE;	6518947	mN
	116.2522	E	-31.462058	S
Veg Condition	Excellent			
Soil	Sandy Clay Loam			
Rock Type	Granite, Laterite			
Fire Age	3-5 yrs			
Habitat	Hillslope			
Vegetation	*Eucalyptus wandoo* and *Eucalyptus accedens* mid to low open woodland over *Acacia lasiocarpa* var. *sedifolia* low open shrubland.			

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
?*Grevillea* sp. Indet				HAR08-01	
Acacia lasiocarpa var. *sedifolia*				HAR07-03	
Eucalyptus accedens					
Eucalyptus wandoo					
Hakea lissocarpha					
Lasiopetalum caroliae				HAR07-04	

Julimar Project Site HAR-10

Date	22/04/2021
Described by	EEB & KG
Type	R
Location	MGA Zone 50 427567 mE; 6519563 mN 116.2376 E -31.456414 S
Veg Condition	Very Good
Soil	Sandy Loam
Rock Type	Laterite
Fire Age	3-5 yrs,5-10 yrs
Habitat	Undulating Low Hills
Vegetation	Mid to low *Eucalyptus marginata* and *Corymbia calophylla* woodland over *Adenanthos cygnorum* subsp. *cygnorum* and *Xanthorrhoea preissii* shrubland over low *Daviesia preissii* and *Hibbertia hypericoides* subsp. *hypericoides* shrubland.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Adenanthos cygnorum subsp. *cygnorum*					
Banksia dallanneyi subsp. *sylvestris*					
Banksia grandis					
Banksia squarrosa subsp. *squarrosa*					
Corymbia calophylla					
Daviesia preissii				HAR52-01	
Eucalyptus marginata					
Hibbertia huegelii					
Hibbertia hypericoides subsp. *hypericoides*					
Hibbertia lasiopus				HAR62-02	
Petrophile striata					
Stylidium diuroides				HAR59-01	
Synaphea sp. Indet					
Xanthorrhoea preissii					

Julimar Project Site HAR-11

Date	22/04/2021
Described by	EEB & KG
Type	R
Location	MGA Zone 50
	427102 mE; 6519541 mN
	116.2327 E -31.456582 S
Veg Condition	Very Good
Soil	Sandy Loam
Rock Type	Laterite
Fire Age	3-5 yrs
Habitat	Undulating Low Hills
Vegetation	*Eucalyptus marginata* and *Corymbia calophylla* low open woodland over *Banksia sessilis* and *Xanthorrhoea preissii* mid to tall open shrubland over *Hibbertia hypericoides* subsp. *hypericoides* and *Styphelia retrorsa* low shrubs.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Banksia dallanneyi subsp. *sylvestris*					
Banksia sessilis					
Corymbia calophylla					
Drosera ?*sewelliae*				HAR61-02	
Eucalyptus marginata					
Hakea lissocarpha					
Hibbertia hypericoides subsp. *hypericoides*					
Hibbertia lasiopus				HAR62-02	
Lepidosperma pubisquameum				HAR11-02	
Stylidium diuroides				HAR59-01	
Styphelia epacridis				HAR11-01	
Styphelia retrorsa				HAR39-02	
Synaphea sp. Indet					
Xanthorrhoea preissii					

Julimar Project Site HAR-12

Date	22/04/2021			
Described by	EEB & KG			
Type	R			
Location	MGA Zone 50			
	426537	mE;	6519509	mN
	116.2267	E	-31.456835	S
Veg Condition	Excellent			
Soil	Loamy Sand			
Rock Type	Laterite			
Fire Age	5-10 yrs,>10 yrs			
Habitat	Undulating Low Hills			
Vegetation	Mid to low *Eucalyptus marginata* and *Corymbia calophylla* woodland over tall to mid *Banksia squarrosa* subsp. *squarrosa* and *Xanthorrhoea preissii* shrubland over low *Hibbertia hypericoides* subsp. *hypericoides* shrubland.			

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Banksia sessilis					
Banksia squarrosa subsp. *squarrosa*					
Corymbia calophylla					
Eucalyptus marginata					
Grevillea synapheae subsp. *synapheae*				HAR62-01	
Hakea prostrata					
Hibbertia hypericoides subsp. *hypericoides*					
Hibbertia semipilosa					
Jacksonia sternbergiana					
Macrozamia riedlei					
Phyllanthus calycinus					
Styphelia retrorsa				HAR61-01	
Xanthorrhoea preissii					

Julimar Project Site HAR-13

Date	22/04/2021
Described by	EEB & KG
Type	R
Location	MGA Zone 50 426471 mE; 6518844 mN 116.2260 E -31.462832 S
Veg Condition	Very Good
Soil	Loam
Rock Type	Laterite
Fire Age	1-3 yrs
Habitat	Undulating Low Hills
Vegetation	*Eucalyptus marginata* and *Corymbia calophylla* low open woodland over *Xanthorrhoea preissii* mid to tall shrubs over *Hibbertia hypericoides* subsp. *hypericoides* and *Banksia dallanneyi* subsp. *sylvestris* low shrubland.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Banksia dallanneyi subsp. *sylvestris*					
Corymbia calophylla					
Eucalyptus marginata					
Hibbertia huegelii					
Hibbertia hypericoides subsp. *hypericoides*					
Hibbertia lasiopus					
Patersonia sp. Indet					
Synaphea sp. Indet					
Xanthorrhoea preissii					

Julimar Project Site HAR-14

Date	13/05/2021
Described by	CW & HE
Type	R
Location	MGA Zone 50
	427155 mE; 6518850 mN
	116.2332 E -31.462820 S
Veg Condition	Excellent
Soil	Sandy Loam
Rock Type	Laterite
Fire Age	1-3 yrs
Habitat	Undulating Low Hills
Vegetation	Open *Eucalyptus marginata* and *Corymbia calophylla* mid woodland over tall open shrubland of *Banksia sessilis* and *Xanthorrhoea preissii* over low open shrubland of *Styphelia retrorsa*, *Daviesia preissii* and *Banksia dallanneyi* subsp. *sylvestris*.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Banksia dallanneyi subsp. *sylvestris*					
Banksia sessilis					
Conostylis setigera subsp. *setigera*					
Corymbia calophylla					
Daviesia preissii				HAR14-01	
Eucalyptus marginata					
Grevillea synapheae subsp. *synapheae*				CWSCOPP02	
Hibbertia huegelii					
Hibbertia hypericoides subsp. *hypericoides*					
Hibbertia lasiopus				HAR36-07	
Lomandra sericea				HAR63-02	
Stylidium sp. Indet					
Styphelia retrorsa				HAR39-02	
Styphelia tenuiflora				BAU03-02	
Xanthorrhoea preissii					

Julimar Project Site HAR-16

Date	7/05/2021
Described by	EEB & CW
Type	R
Location	MGA Zone 50
	428183 mE; 6518745 mN
	116.2440 E -31.463831 S
Veg Condition	Excellent
Soil	Sandy Loam
Rock Type	Laterite
Fire Age	1-3 yrs
Habitat	Undulating Low Hills
Vegetation	Open *Eucalyptus marginata* and *Corymbia calophylla* woodland over *Banksia squarrosa* subsp. *squarrosa* and *Xanthorrhoea preissii* tall open shrubland over *Hibbertia hypericoides* subsp. *hypericoides*, *Styphelia tenuiflora* and *Banksia dallanneyi* subsp. *sylvestris* low shrubland.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Banksia bipinnatifida subsp. *bipinnatifida*				HAR07-02	
Banksia dallanneyi subsp. *sylvestris*					
Banksia squarrosa subsp. *squarrosa*					
Bossiaea ornata					
Calytrix ?angulata				HAR16-01	
Conostylis setigera subsp. *setigera*					
Corymbia calophylla					
Drosera ?sewelliae				CWSCOPP01	
Eucalyptus marginata					
Gompholobium knightianum					
Grevillea synapheae subsp. *synapheae*				CWSCOPP02	
Hakea lissocarpha					
Hibbertia huegelii					
Hibbertia hypericoides subsp. *hypericoides*					
Hibbertia lasiopus				HAR36-07	
Laxmannia ?squarrosa				HAR16-02	
Lomandra caespitosa					
Lomandra hermaphrodita					
Stylidium eriopodum				CWSCOPP08	
Styphelia retrorsa				HAR39-02	
Styphelia tenuiflora				BAU03-02	
Xanthorrhoea preissii					

Julimar Project Site HAR-17

Date	7/05/2021
Described by	SC & DR
Type	R
Location	MGA Zone 50
	428593 mE; 6518543 mN
	116.2483 E -31.465678 S
Veg Condition	Excellent
Soil	Clayey Sand
Rock Type	Laterite
Fire Age	5-10 yrs
Habitat	Undulating Low Hills
Vegetation	Mid *Eucalyptus marginata* and *Corymbia calophylla* forest over tall *Banksia sessilis* shrubland over mid *Daviesia angulata* and *Xanthorrhoea preissii* shrubland over low *Melaleuca trichophylla*, *Styphelia retrorsa* and *Banksia sphaerocarpa* var. *pumilio* shrubland.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Banksia dallanneyi subsp. *sylvestris*					
Banksia sessilis					
Banksia sphaerocarpa var. *pumilio*				HAR36-04	
Corymbia calophylla					
Daviesia angulata					
Drosera ?sewelliae					
Eucalyptus marginata					
Leporella fimbriata					
Leptospermum erubescens					
Melaleuca trichophylla				HAR17-01	
Pyrorchis nigricans					
Styphelia retrorsa				HAR39-02	
Xanthorrhoea preissii					

Julimar Project Site HAR-18

Date	7/05/2021
Described by	SC & DR
Type	R
Location	MGA Zone 50
	428762 mE; 6518520 mN
	116.2501 E -31.465899 S
Veg Condition	Excellent
Soil	Clay Loam Sandy
Rock Type	Laterite
Fire Age	1-3 yrs
Habitat	Undulating Low Hills
Vegetation	Mid *Eucalyptus marginata* and *Corymbia calophylla* forest over tall open *Banksia squarrosa* subsp. *squarrosa* and *Banksia sessilis* shrubland over mid sparse *Xanthorrhoea preissii* over low open *Hibbertia hypericoides* subsp. *hypericoides*, *Hibbertia huegelii* and *Banksia dallanneyi* subsp. *sylvestris* shrubland.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Banksia dallanneyi subsp. *sylvestris*					
Banksia sessilis					
Banksia squarrosa subsp. *squarrosa*					
Corymbia calophylla					
Drosera ?sewelliae					
Eucalyptus marginata					
Hibbertia huegelii					
Hibbertia hypericoides subsp. *hypericoides*					
Hibbertia lasiopus					
Leptospermum erubescens					
Macrozamia riedlei					
Petrophile striata				SCHEOPP01	
Stythelia tenuiflora				BAU03-02	
Synaphea decorticans				HAR35-01	
Xanthorrhoea preissii					

Julimar Project Site HAR-19

Date	21/04/2021
Described by	EEB & KG
Type	R
Location	MGA Zone 50 426022 mE; 6518447 mN 116.2212 E -31.466380 S
Veg Condition	Very Good
Soil	Loamy Sand
Rock Type	Laterite
Fire Age	>10 yrs
Habitat	Undulating Low Hills
Vegetation	Mid to low *Corymbia calophylla* and *Eucalyptus marginata* woodland over mid *Adenanthos cygnorum* subsp. *cygnorum* shrubland.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Adenanthos cygnorum subsp. *cygnorum*					
Corymbia calophylla					
Daviesia preissii				HAR52-01	
Daviesia sp. Indet				HAR19-01	
Eucalyptus marginata					
Grevillea synapheae subsp. *synapheae*				HAR62-01	
Hakea lissocarpha					
Hibbertia huegelii					
Hibbertia semipilosa					
Hypocalymma sp. Indet					
Phyllanthus calycinus					
Xanthorrhoea preissii					

Julimar Project Site HAR-20

Date	21/04/2021
Described by	EEB & KG
Type	R
Location	MGA Zone 50
	426287 mE; 6518611 mN
	116.2240 E -31.464921 S
Veg Condition	Very Good
Soil	Sandy Loam
Rock Type	Laterite
Fire Age	1-3 yrs
Habitat	Undulating Low Hills
Vegetation	*Corymbia calophylla* and *Eucalyptus marginata* low open woodland over *Banksia sessilis* mid to tall shrubs over *Adenanthos cygnorum* subsp. *cygnorum* low shrubs.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Adenanthos cygnorum subsp. *cygnorum*					
Banksia sessilis					
Calytrix sp. Indet 2				HAR20-03	
Corymbia calophylla					
Eucalyptus marginata					
Hibbertia huegelii					
Hibbertia hypericoides subsp. *hypericoides*					
Nuytsia floribunda					
Verticordia densiflora var. *cespitosa*				HAR20-02	
Verticordia sp. Indet				HAR20-03	
Xanthorrhoea preissii					

Julimar Project Site HAR-21

Date	13/05/2021			
Described by	CW & HE			
Type	R			
Location	MGA Zone 50			
	426956	mE;	6518352	mN
	116.2311	E	-31.467297	S
Veg Condition	Excellent			
Soil	Sandy Loam			
Rock Type	Laterite			
Fire Age	1-3 yrs			
Habitat	Undulating Low Hills			
Vegetation	Open *Corymbia calophylla* and *Eucalyptus marginata* mid-tall woodland over open tall shrubland of *Xanthorrhoea preissii*, *Banksia squarrosa* subsp. *squarrosa* over open low shrubland of *Hibbertia hypericoides* subsp. *hypericoides*, *Styphelia retrorsa* and *Hakea lissocarpha*.			

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Banksia dallanneyi subsp. *sylvestris*					
Banksia squarrosa subsp. *squarrosa*					
Conostylis setigera subsp. *setigera*					
Corymbia calophylla					
Eucalyptus marginata					
Grevillea synapheae subsp. *synapheae*				CWSCOPP02	
Hakea lissocarpha					
Hibbertia huegelii					
Hibbertia hypericoides subsp. *hypericoides*					
Hibbertia lasiopus				HAR36-07	
Stylidium sp. Indet					
Styphelia macrocalyx				HAR71-02	
Styphelia retrorsa				HAR39-02	
Synaphea decorticans				HAR35-01	
Xanthorrhoea preissii					

Julimar Project Site HAR-22

Date	13/05/2021
Described by	KG & MvW
Type	R
Location	MGA Zone 50
	427693 mE; 6518363 mN
	116.2388 E -31.467242 S
Veg Condition	Excellent
Soil	Clay Loam
Rock Type	Laterite
Fire Age	3-5 yrs
Habitat	Undulating Low Hills
Vegetation	Low open *Eucalyptus marginata* and *Corymbia calophylla* woodland over tall open *Xanthorrhoea preissii* shrubland over low *Hibbertia hypericoides* subsp. *hypericoides* and *Hakea lissocarpha* shrubland.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Banksia dallanneyi subsp. *sylvestris*					
Conostylis setigera subsp. *setigera*					
Corymbia calophylla					
Daviesia preissii				HAR22-01	
Drosera ?*sewelliae*				HAR61-02	
Eucalyptus marginata					
Grevillea pilulifera				HAR22-02	
Grevillea synapheae subsp. *synapheae*				MvWKGopp1	
Hakea lissocarpha					
Hibbertia huegelii				HAR27-01	
Hibbertia hypericoides subsp. *hypericoides*					
Hibbertia lasiopus				HAR62-02	
Phyllanthus calycinus					
Synaphea sp. Indet					
Xanthorrhoea preissii					

Julimar Project Site HAR-23

Date	13/05/2021
Described by	KG & MvW
Type	R
Location	MGA Zone 50
	428211 mE; 6517867 mN
	116.2442 E -31.471750 S
Veg Condition	Excellent
Soil	Clay Loam
Rock Type	Laterite
Fire Age	5-10 yrs
Habitat	Undulating Low Hills
Vegetation	Mid to low *Eucalyptus marginata*, *Corymbia calophylla* and *Eucalyptus wandoo* woodland over tall to mid *Hakea undulata* and *Banksia sessilis* shrubland over low *Hibbertia hypericoides* subsp. *hypericoides* and *Daviesia preissii* shrubland.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Banksia bipinnatifida subsp. *bipinnatifida*				HAR23-01	
Banksia dallanneyi subsp. *sylvestris*					
Banksia sessilis					
Bossiaea ornata					
Conostylis setigera subsp. *setigera*					
Corymbia calophylla					
Daviesia preissii					
Eucalyptus marginata					
Eucalyptus wandoo					
Grevillea synapheae subsp. *synapheae*				HAR62-01	
Hakea undulata					
Hibbertia huegelii				HAR27-01	
Hibbertia hypericoides subsp. *hypericoides*					
Hibbertia lasiopus				HAR62-02	
Lepidosperma tenue				HAR22-02	
Lomandra sp. Indet					
Styphelia retrorsa				HAR39-02	
Styphelia tenuiflora				BAU03-02	

Julimar Project Site HAR-25

Date 13/05/2021
Described by CW & HE
Type R
Location MGA Zone 50
428214 mE; 6517182 mN
116.2442 E -31.477935 S
Veg Condition Excellent
Soil Loamy Sand
Rock Type Laterite
Fire Age 5-10 yrs
Habitat Drainage Area/ Floodplain
Vegetation Tall open *Corymbia calophylla* and *Eucalyptus accedens* woodland over open *Xanthorrhoea preissii* and *Trymalium odoratissimum* subsp. *odoratissimum* shrubland over a low open *Phyllanthus calycinus*, *Hakea lissocarpha* and *Hibbertia hypericoides* subsp. *hypericoides* shrubland.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Acacia pulchella					
Babingtonia camphorosmae					
Banksia bipinnatifida subsp. *bipinnatifida*					
Banksia dallanneyi subsp. *sylvestris*					
Corymbia calophylla					
Eucalyptus accedens					
Grevillea bipinnatifida subsp. *bipinnatifida*					
Hakea lissocarpha					
Hibbertia ?semipilosa					
Hibbertia hypericoides subsp. *hypericoides*					
Hypocalymma angustifolium					
Leptospermum erubescens					
Phyllanthus calycinus					
Trymalium odoratissimum subsp. *odoratissimum*					
Xanthorrhoea preissii					

Julimar Project Site HAR-26

Date	13/05/2021
Described by	CW & HE
Type	R
Location	MGA Zone 50
	427944 mE; 6516946 mN
	116.2414 E -31.480043 S
Veg Condition	Excellent
Soil	Sandy Clay Loam
Rock Type	Granite, Laterite
Fire Age	5-10 yrs
Habitat	Minor Drainage Line
Vegetation	*Corymbia calophylla* mid closed woodland with scattered *Eucalyptus wandoo* over tall closed shrubland of *Trymalium odoratissimum* subsp. *odoratissimum* and *Xanthorrhoea preissii* over *Bossiaea eriocarpa* and *Trymalium odoratissimum* subsp. *odoratissimum* low shrubland.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Acacia pulchella					
Bossiaea eriocarpa					
Corymbia calophylla					
Eucalyptus wandoo					
Hakea lissocarpha					
Hibbertia ?semipilosa					
Trymalium odoratissimum subsp. *odoratissimum*					
Xanthorrhoea preissii					

Julimar Project Site HAR-27

Date	13/05/2021			
Described by	KG & MvW			
Type	R			
Location	MGA Zone 50			
	427494	mE;	6517818	mN
	116.2367	E	-31.472153	S
Veg Condition	Excellent			
Soil	Clay Loam			
Rock Type	Laterite			
Fire Age	3-5 yrs			
Habitat	Undulating Low Hills			
Vegetation	Mid to low *Eucalyptus marginata* and *Corymbia calophylla* open woodland over mid *Xanthorrhoea preissii* shrubland over low *Hibbertia hypericoides* subsp. *hypericoides* shrubland.			

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Adenanthos cygnorum subsp. *cygnorum*					
Banksia squarrosa subsp. *squarrosa*					
Corymbia calophylla					
Eucalyptus marginata					
Hakea lissocarpha					
Hibbertia huegelii				HAR27-01	
Hibbertia hypericoides subsp. *hypericoides*					
Hibbertia lasiopus				HAR62-02	
Lomandra sp. Indet					
Macrozamia riedlei					
Styphelia retrorsa				HAR39-02	
Synaphea sp. Indet					
Xanthorrhoea preissii					

Julimar Project Site HAR-28

Date	22/04/2021
Described by	EEB & KG
Type	R
Location	MGA Zone 50
	426262 mE; 6517988 mN
	116.2237 E -31.470534 S
Veg Condition	Very Good
Soil	Sandy Loam
Rock Type	Laterite
Fire Age	3-5 yrs
Habitat	Undulating Low Hills
Vegetation	*Eucalyptus marginata* low open woodland over *Banksia squarrosa* subsp. *squarrosa* tall sparse shrubland with *Adenanthos cygnorum* subsp. *cygnorum* and *Banksia sessilis* over *Banksia sphaerocarpa* var. ?*pumilio* and *Daviesia preissii* low shrubland.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Adenanthos cygnorum subsp. *cygnorum*					
Banksia dallanneyi subsp. *sylvestris*					
Banksia sessilis					
Banksia sphaerocarpa var. ?*pumilio*				HAR33-01	
Banksia squarrosa subsp. *squarrosa*					
Daviesia preissii				HAR52-01	
Drosera ?*sewelliae*				HAR61-02	
Eucalyptus marginata					
Hakea lissocarpha					
Hibbertia hypericoides subsp. *hypericoides*					
Hibbertia lasiopus				HAR62-02	
Patersonia sp. Indet					
Petrophile striata					
Xanthorrhoea preissii					

Julimar Project Site HAR-29

Date	22/04/2021
Described by	EEB & KG
Type	R
Location	MGA Zone 50 426445 mE; 6517623 mN 116.2256 E -31.473846 S
Veg Condition	Very Good
Soil	Loam
Rock Type	Laterite
Fire Age	3-5 yrs
Habitat	Undulating Low Hills
Vegetation	*Eucalyptus marginata* and *Corymbia calophylla* low open woodland over *Xanthorrhoea preissii* tall sparse shrubland over *Styphelia retrorsa* low shrubland.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Acacia saligna					
Adenanthos cygnorum subsp. *cygnorum*					
Banksia dallanneyi subsp. *sylvestris*					
Banksia squarrosa subsp. *squarrosa*					
Corymbia calophylla					
Eucalyptus marginata					
Grevillea synapheae subsp. *synapheae*					
Hibbertia semipilosa					
Macrozamia riedlei					
Styphelia retrorsa				HAR61-01	
Synaphea sp. Indet					
Xanthorrhoea preissii					

Julimar Project Site HAR-30

Date	22/04/2021
Described by	EEB & KG
Type	R
Location	MGA Zone 50 426008 mE; 6517519 mN 116.2210 E -31.474754 S
Veg Condition	Excellent
Soil	Sandy Loam
Rock Type	Laterite
Fire Age	3-5 yrs,5-10 yrs
Habitat	Undulating Low Hills
Vegetation	Mid to low *Eucalyptus marginata* woodland over tall to mid *Banksia squarrosa* subsp. *squarrosa* and *Xanthorrhoea preissii* shrubland over low *Hibbertia hypericoides* subsp. *hypericoides* shrubland.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Banksia dallanneyi subsp. *sylvestris*					
Banksia squarrosa subsp. *squarrosa*					
Corymbia calophylla					
Drosera ?*sewelliae*				HAR61-02	
Eucalyptus marginata					
Grevillea synapheae subsp. *synapheae*				HAR62-01	
Hakea lissocarpha					
Hibbertia huegelii					
Hibbertia hypericoides subsp. *hypericoides*					
Hibbertia lasiopus				HAR62-02	
Xanthorrhoea preissii					

Julimar Project Site HAR-31

Date	22/04/2021
Described by	EEB & KG
Type	R
Location	MGA Zone 50 425757 mE; 6517701 mN 116.2184 E -31.473097 S
Veg Condition	Good
Soil	Loamy Sand
Rock Type	Laterite
Fire Age	<1 yr,1-3 yrs
Habitat	Undulating Low Hills
Vegetation	*Eucalyptus marginata* low open woodland over *Adenanthos cygnorum* subsp. *cygnorum* and *Banksia squarrosa* subsp. *squarrosa* mid to tall open shrubland over *Hibbertia hypericoides* subsp. *hypericoides* low

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Adenanthos cygnorum subsp. *cygnorum*					
Banksia squarrosa subsp. *squarrosa*					
Drosera ?sewelliae				HAR61-02	
Eucalyptus marginata					
Hibbertia huegelii					
Hibbertia hypericoides subsp. *hypericoides*					
Nuytsia floribunda					
Xanthorrhoea preissii					

Julimar Project Site HAR-32

Date	13/05/2021			
Described by	KG & MvW			
Type	R			
Location	MGA Zone 50			
	425503	mE;	6517472	mN
	116.2157	E	-31.475146	S
Veg Condition	Excellent			
Soil	Sandy Loam			
Rock Type	Laterite			
Fire Age	3-5 yrs			
Habitat	Undulating Low Hills			
Vegetation	Low *Eucalyptus marginata* and *Corymbia calophylla* open woodland over tall to mid *Banksia squarrosa* subsp. *squarrosa* and *Xanthorrhoea preissii* shrubland over low *Hibbertia hypericoides* subsp. *hypericoides* shrubland.			

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Banksia squarrosa subsp. *squarrosa*					
Corymbia calophylla					
Drosera ?sewelliae				HAR61-02	
Eucalyptus marginata					
Hibbertia huegelii					
Hibbertia hypericoides subsp. *hypericoides*					
Hibbertia lasiopus				HAR62-02	
Lechenaultia ?biloba				HAR32-01	
Patersonia occidentalis					
Styphelia retrorsa				HAR39-02	
Styphelia tenuiflora				BAU03-02	
Xanthorrhoea preissii					

Julimar Project Site HAR-33

Date	21/04/2021
Described by	EEB & KG
Type	R
Location	MGA Zone 50
	425614 mE; 6517128 mN
	116.2168 E -31.478252 S
Veg Condition	Very Good
Soil	Sandy Loam
Rock Type	Laterite
Fire Age	1-3 yrs
Habitat	Undulating Low Hills
Vegetation	*Eucalyptus marginata* mid to low open woodland over mid *Xanthorrhoea preissii* sparse shrubs over resprouts.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Banksia dallanneyi subsp. *sylvestris*				HAR36-03	
Banksia sphaerocarpa var. *?pumilio*				HAR33-01	
Eucalyptus marginata					
Hibbertia huegelii					
Hibbertia lasiopus				HAR62-02	
Styphelia retrorsa				HAR39-02	
Xanthorrhoea preissii					

Julimar Project Site HAR-34

Date	13/05/2021
Described by	KG, CW, HE & MvW
Type	R
Location	MGA Zone 50 425929 mE; 6516958 mN 116.2201 E -31.479808 S
Veg Condition	Very Good
Soil	Sandy Loam
Rock Type	Laterite
Fire Age	1-3 yrs
Habitat	Undulating Low Hills
Vegetation	Mid open *Corymbia calophylla* and *Eucalyptus marginata* woodland over tall shrubland of *Banksia sessilis*, *Banksia squarrosa* subsp. *squarrosa* and *Xanthorrhoea preissii* over low open shrubland of *Hibbertia hypericoides* subsp. *hypericoides*, *Hakea lissocarpha* and *Petrophile striata*.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Banksia dallanneyi subsp. *sylvestris*					
Banksia sessilis					
Banksia squarrosa subsp. *squarrosa*					
Corymbia calophylla					
Drosera ?*sewelliae*				CWSCopp01	
Eucalyptus marginata					
Hakea lissocarpha					
Hibbertia huegelii					
Hibbertia hypericoides subsp. *hypericoides*					
Hibbertia lasiopus				HAR36-07	
Hypocalymma angustifolium					
Lomandra sp. Indet					
Petrophile striata				HAR90-01	
Stylidium sp. Indet					
Styphelia retrorsa				HAR39-02	
Styphelia tenuiflora				BAU03-02	
Xanthorrhoea preissii					

Julimar Project Site HAR-36

Date	20/04/2021
Described by	SC & CW
Type	R
Location	MGA Zone 50 427248 mE; 6516438 mN 116.2340 E -31.484585 S
Veg Condition	Excellent
Soil	Loamy Sand
Rock Type	Laterite
Fire Age	3-5 yrs
Habitat	Undulating Low Hills
Vegetation	Mid *Eucalyptus marginata* and *Corymbia calophylla* forest over tall scattered *Banksia squarrosa* subsp. *squarrosa* and *Banksia sessilis* shrubs over mid scattered *Xanthorrhoea preissii* shrubs over low scattered *Banksia sphaerocarpa* var. *pumilio* and *Hibbertia huegelii* shrubs.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
?Fabaceae sp. Indet				HAR36-06	
Banksia dallanneyi subsp. *sylvestris*				HAR36-03	
Banksia sessilis					
Banksia sphaerocarpa var. *pumilio*				HAR36-04	
Banksia squarrosa subsp. *squarrosa*					
Conostylis setigera subsp. *setigera*					
Corymbia calophylla					
Drosera ?sewelliae					
Eucalyptus marginata					
Hakea lissocarpha					
Hibbertia huegelii					
Hibbertia lasiopus				HAR36-07	
Lepidosperma pubisquameum				HAR36-02	
Neurachne alopecuroidea					
Stylidium diuroides				HAR36-01	
Styphelia propinqua				HAR36-05	
Xanthorrhoea preissii					

Julimar Project Site HAR-37

Date	20/04/2021
Described by	SC & CW
Type	R
Location	MGA Zone 50 427720 mE; 6516597 mN 116.2390 E -31.483181 S
Veg Condition	Excellent
Soil	Clay Loam Sandy
Rock Type	Laterite
Fire Age	3-5 yrs
Habitat	Gully
Vegetation	Mid *Eucalyptus wandoo* forest over tall scattered *Trymalium odoratissimum* subsp. *odoratissimum* shrubs over mid scattered *Xanthorrhoea preissii* and *Gastrolobium calycinum* shrubs over low scattered shrubs.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Eucalyptus wandoo					
Gastrolobium calycinum				HAR37-05	
Grevillea pilulifera				HAR37-01	
Hakea lissocarpha					
Hibbertia ?semipilosa				HAR70-01	
Malvaceae sp. Indet				HAR37-03	
Orthrosanthus laxus var. *gramineus*				HAR37-04	
Phyllanthus calycinus					
Trymalium odoratissimum subsp. *odoratissimum*				HAR37-02	
Xanthorrhoea preissii					

Julimar Project Site HAR-38

Date	20/04/2021
Described by	SC & CW
Type	R
Location	MGA Zone 50
	427498 mE; 6515651 mN
	116.2366 E -31.491699 S
Veg Condition	Excellent
Soil	Sandy Loam
Rock Type	Laterite
Fire Age	3-5 yrs
Habitat	Undulating Low Hills
Vegetation	*Eucalyptus marginata* and *Corymbia calophylla* mid forest over tall shrubland of *Banksia squarrosa* subsp. *squarrosa* and *Xanthorrhoea preissii* over low open shrubland of *Hibbertia hypericoides* subsp. *hypericoides*, *Hakea lissocarpha* and *Hibbertia lasiopus*.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Banksia dallanneyi subsp. *sylvestris*					
Banksia squarrosa subsp. *squarrosa*					
Bossiaea ornata					
Conostylis setigera subsp. *setigera*					
Corymbia calophylla					
Eucalyptus marginata					
Hakea lissocarpha					
Hibbertia huegelii					
Hibbertia hypericoides subsp. *hypericoides*					
Hibbertia lasiopus				HAR36-07	
Phyllanthus calycinus					
Xanthorrhoea preissii					

Julimar Project Site HAR-39

Date	20/04/2021
Described by	SC & CW
Type	R
Location	MGA Zone 50
	427309 mE; 6515257 mN
	116.2345 E -31.495241 S
Veg Condition	Excellent
Soil	Sandy Loam
Rock Type	Laterite
Fire Age	>10 yrs
Habitat	Stony Plain
Vegetation	Closed tall shrubland of *Banksia squarrosa* subsp. *squarrosa*, *Allocasuarina huegeliana*, and *Leptospermum erubescens* over low shrubland of *Banksia sphaerocarpa* var. *pumilio*.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Allocasuarina huegeliana				HAR39-01	
Banksia sphaerocarpa var. *pumilio*				HAR36-04	
Banksia squarrosa subsp. *squarrosa*					
Calytrix sp. Indet 1				HAR39-03	
Conospermum densiflorum subsp. *unicephalatum*				HAR39-04	
Corymbia calophylla					
Drosera ?*sewelliae*					
Leptospermum erubescens				CWSCopp06	
Styphelia retrorsa				HAR39-02	
Xanthorrhoea preissii					

Julimar Project Site HAR-40

Date	13/05/2021
Described by	KG & MvW
Type	R
Location	MGA Zone 50 426683 mE; 6515736 mN 116.2280 E -31.490883 S
Veg Condition	Good
Soil	Clay Loam
Rock Type	Laterite
Fire Age	1-3 yrs,3-5 yrs
Habitat	Undulating Low Hills
Vegetation	Low *Eucalyptus marginata* open woodland over mid *Xanthorrhoea preissii* shrubland over low *Hibbertia huegelii* and *Hibbertia hypericoides* subsp. *hypericoides* shrubland.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Banksia squarrosa subsp. *squarrosa*					
Eucalyptus marginata					
Hibbertia huegelii					
Hibbertia hypericoides subsp. *hypericoides*					
Xanthorrhoea preissii					

Julimar Project Site HAR-42

Date	21/04/2021			
Described by	EEB			
Type	R			
Location	MGA Zone 50			
	425894	mE;	6515795	mN
	116.2197	E	-31.490299	S
Veg Condition	Very Good			
Soil	Sandy Loam			
Rock Type	Laterite			
Fire Age	1-3 yrs,3-5 yrs			
Habitat	Undulating Low Hills			
Vegetation	Low open *Eucalyptus marginata* and *Corymbia calophylla* (resprouting) woodland over tall open *Xanthorrhoea preissii* shrubs.			

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Banksia dallanneyi subsp. *sylvestris*				HAR36-03	
Banksia squarrosa subsp. *squarrosa*					
Corymbia calophylla					
Eucalyptus marginata					
Hibbertia hypericoides subsp. *hypericoides*					
Macrozamia riedlei					
Styphelia retrorsa				HAR39-02	
Xanthorrhoea preissii					

Julimar Project Site HAR-45

Date	22/04/2021
Described by	SC & HE
Type	R
Location	MGA Zone 50
	425159 mE; 6516160 mN
	116.2120 E -31.486961 S
Veg Condition	Excellent
Soil	Loamy Sand
Rock Type	Laterite
Fire Age	>10 yrs
Habitat	Footslope
Vegetation	Tall closed *Banksia squarrosa* subsp. *squarrosa* shrubland over low *Calothamnus quadrifidus* subsp. *quadrifidus*, *Calytrix* sp. Indet 2 and *Hibbertia hypericoides* subsp. *hypericoides* shrubland.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Babingtonia camphorosmae					
Banksia sphaerocarpa var. *pumilio*				HAR36-04	
Banksia squarrosa subsp. *squarrosa*					
Calothamnus quadrifidus subsp. *quadrifidus*				HAR67-01	
Calytrix sp. Indet 2				HAR54-01	
Hibbertia hypericoides subsp. *hypericoides*					
Styphelia retrorsa				HAR39-02	

Julimar Project Site HAR-47

Date	22/04/2021			
Described by	KG			
Type	R			
Location	MGA Zone 50			
	425142	mE;	6515539	mN
	116.2118	E	-31.492563	S
Veg Condition	Excellent			
Soil	Sandy Loam			
Rock Type	Laterite			
Fire Age	3-5 yrs,5-10 yrs			
Habitat	Undulating Low Hills			
Vegetation	Mid to low *Eucalyptus marginata* woodland with scattered *Corymbia calophylla* trees over mid *Adenanthos cygnorum* subsp. *cygnorum* shrubland over low *Beaufortia eriocephala* shrubland.			

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Adenanthos cygnorum subsp. *cygnorum*					
Banksia dallanneyi subsp. *sylvestris*				HAR36-03	
Banksia sphaerocarpa var. *?pumilio*				HAR33-01	
Beaufortia eriocephala				HAR47-01	
Corymbia calophylla					
Eucalyptus marginata					
Hibbertia huegelii					
Hibbertia lasiopus					
Petrophile striata					
Styphelia retrorsa				HAR61-01	
Xanthorrhoea preissii					

Julimar Project Site HAR-48

Date	13/05/2021			
Described by	CW & HE			
Type	R			
Location	MGA Zone	50		
	424760	mE;	6515246	mN
	116.2077	E	-31.495180	S
Veg Condition	Excellent			
Soil	Sand			
Rock Type	Laterite			
Fire Age	5-10 yrs			
Habitat	Undulating Low Hills			
Vegetation	Low to mid *Eucalyptus wandoo* and *Corymbia calophylla* open woodland over mid *Xanthorrhoea preissii, Hakea varia* and *Leptospermum erubescens* shrubland over low open *Babingtonia camphorosmae* and *Styphelia retrorsa* shrubland.			

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Adenanthos cygnorum subsp. *cygnorum*					
Babingtonia camphorosmae					
Banksia dallanneyi subsp. *sylvestris*					
Banksia squarrosa subsp. *squarrosa*					
Calothamnus lateralis					
Corymbia calophylla					
Eucalyptus wandoo					
Grevillea bipinnatifida subsp. *bipinnatifida*					
Hakea prostrata					
Hakea varia				Har48-01	
Hypocalymma angustifolium					
Lepidosperma tenue				HAR71-03	
Leptospermum erubescens					
Styphelia retrorsa				HAR39-02	
Xanthorrhoea preissii					

Julimar Project Site HAR-49

Date	22/04/2021
Described by	EEB & KG
Type	R
Location	MGA Zone 50
	425549 mE; 6515174 mN
	116.2160 E -31.495878 S
Veg Condition	Excellent
Soil	Loamy Sand
Rock Type	Laterite
Fire Age	3-5 yrs,5-10 yrs
Habitat	Undulating Low Hills
Vegetation	*Eucalyptus marginata* and *Corymbia calophylla* mid to low open woodland over *Xanthorrhoea preissii* and *Acacia celastrifolia* mid to tall shrubs over *Leucopogon pulchellus* low shrubland.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Acacia celastrifolia				HAR49-01	
Banksia dallanneyi subsp. *sylvestris*					
Banksia grandis					
Banksia sessilis					
Conostylis setigera subsp. *setigera*					
Corymbia calophylla					
Eucalyptus marginata					
Hibbertia lasiopus					
Hibbertia semipilosa					
Leucopogon pulchellus				HAR49-02	
Petrophile striata					
Styphelia retrorsa				HAR39-02	
Xanthorrhoea preissii					

Julimar Project Site HAR-51

Date	21/04/2021			
Described by	EEB & KG			
Type	R			
Location	MGA Zone 50			
	426988	mE;	6514659	mN
	116.2311	E	-31.500615	S
Veg Condition	Excellent			
Soil	Sandy Loam			
Rock Type	Laterite			
Fire Age	>10 yrs			
Habitat	Undulating Low Hills			
Vegetation	*Eucalyptus marginata* mid to low open woodland over *Banksia squarrosa* subsp. *squarrosa* mid to tall sparse shrubland over *Xanthorrhoea preissii* mid shrubs over *Hibbertia hypericoides* subsp. *hypericoides* and *Styphelia retrorsa* low open shrubland.			

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Banksia dallanneyi subsp. *sylvestris*					
Banksia squarrosa subsp. *squarrosa*					
Corymbia calophylla					
Eucalyptus marginata					
Hakea lissocarpha					
Hibbertia hypericoides subsp. *hypericoides*					
Hibbertia lasiopus				HAR62-02	
Kunzea praestans				HAR51-01	
Pimelea sp. Indet					
Styphelia retrorsa				HAR39-02	
Xanthorrhoea preissii					

Julimar Project Site HAR-52

Date	21/04/2021			
Described by	EEB & KG			
Type	R			
Location	MGA Zone 50			
	426021	mE;	6514760	mN
	116.2209	E	-31.499647	S
Veg Condition	Excellent			
Soil	Sandy Loam			
Rock Type	Laterite			
Fire Age	3-5 yrs			
Habitat	Undulating Low Hills			
Vegetation	*Eucalyptus marginata* and *Corymbia calophylla* mid to low open woodland over *Xanthorrhoea preissii*, *Banksia squarrosa* subsp. *squarrosa* and *Banksia sessilis* mid tall shrubs over *Daviesia preissii* low shrubs.			

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Banksia dallanneyi subsp. *sylvestris*					
Banksia sessilis					
Banksia squarrosa subsp. *squarrosa*					
Conostylis aculeata					
Corymbia calophylla					
Daviesia preissii				HAR52-01	
Eucalyptus marginata					
Hibbertia hypericoides subsp. *hypericoides*					
Hibbertia lasiopus				HAR62-02	
Petrophile striata					
Stylidium sp. Indet					
Styphelia retrorsa				HAR39-02	
Xanthorrhoea preissii					

Julimar Project Site HAR-53

Date	21/04/2021
Described by	CW & HE
Type	R
Location	MGA Zone 50
	425261 mE; 6514873 mN
	116.2130 E -31.498572 S
Veg Condition	Excellent
Soil	Sandy Clay Loam
Rock Type	Laterite
Fire Age	>10 yrs
Habitat	Sandy/ Stony Plain
Vegetation	Open tall *Eucalyptus marginata* woodland over tall closed *Banksia squarrosa* subsp. *squarrosa* and *Banksia sessilis* shrubland over dense *Hibbertia hypericoides* subsp. *hypericoides* and *Leucopogon pulchellus* shrubland.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Banksia dallanneyi subsp. *sylvestris*					
Banksia grandis					
Banksia sessilis					
Banksia sphaerocarpa var. *pumilio*				HAR36-04	
Banksia squarrosa subsp. *squarrosa*					
Calytrix sp. Indet 3					
Conostylis ?setigera				HAR63-01	
Eucalyptus marginata					
Grevillea pilulifera				HAR37-01	
Grevillea synapheae subsp. *synapheae*				CWSCOPP02	
Hibbertia hypericoides subsp. *hypericoides*					
Hibbertia lasiopus				HAR36-07	
Leucopogon pulchellus				HAR-53-01	
Lomandra sericea				HAR-63-02	
Styphelia retrorsa				HAR39-02	
Xanthorrhoea gracilis					
Xanthorrhoea preissii					

Julimar Project Site HAR-54

Date	21/04/2021
Described by	CW & HE
Type	R
Location	MGA Zone 50
	424775 mE; 6514891 mN
	116.2078 E -31.498378 S
Veg Condition	Excellent
Soil	Clayey Sand
Rock Type	Laterite
Fire Age	>10 yrs
Habitat	Sand Plain
Vegetation	Sparse *Corymbia calophylla* and *Eucalyptus marginata* trees over closed tall shrubland of *Banksia sessilis*, *Banksia squarrosa* subsp. *squarrosa* and *Adenanthos cygnorum* subsp. *cygnorum*, over low shrubland of *Leucopogon pulchellus*, *Babingtonia camphorosmae* and *Styphelia retrorsa*.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Adenanthos cygnorum subsp. *cygnorum*					
Amyema miquelii				CWHEOPP03	
Babingtonia camphorosmae					
Banksia sessilis					
Banksia squarrosa subsp. *squarrosa*					
Calytrix sp. Indet 2				HAR54-01	
Corymbia calophylla					
Eucalyptus marginata					
Hibbertia hibbertioides var. *hibbertioides*				CWHWopp08	
Hibbertia hypericoides subsp. *hypericoides*					
Leucopogon pulchellus				HAR-53-01	
Lomandra ?caespitosa				HAR-55-01	
Styphelia retrorsa				HAR39-02	
**Ursinia anthemoides*					

Julimar Project Site HAR-55

Date	21/04/2021
Described by	CW & HE
Type	R
Location	MGA Zone 50
	424869 mE; 6514614 mN
	116.2088 E -31.500887 S
Veg Condition	Excellent
Soil	Sand
Rock Type	Laterite
Fire Age	>10 yrs
Habitat	Sandy/ Stony Plain
Vegetation	Tall open *Corymbia calophylla* and *Eucalyptus marginata* woodland over a tall scattered *Banksia sessilis* and *Xanthorrhoea preissii* shrubland over a *Bossiaea eriocarpa* and *Hibbertia hypericoides* subsp. *hypericoides* and *Phyllanthus calycinus* shrubland.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Adenanthos cygnorum subsp. *cygnorum*					
**Aira caryophyllea*					
Babingtonia camphorosmae					
Banksia dallanneyi subsp. *sylvestris*					
Banksia sessilis					
Bossiaea eriocarpa					
Comesperma calymega				HAR-55-02	
Corymbia calophylla					
Eucalyptus marginata					
Grevillea pilulifera				HAR37-01	
Haemodorum sp. Indet					
Hibbertia hibbertioides var. *hibbertioides*				CWHWopp08	
Hibbertia huegelii					
Hibbertia hypericoides subsp. *hypericoides*					
Lomandra ?caespitosa				HAR-55-01	
Phyllanthus calycinus					
Styphelia retrorsa				HAR39-02	
Xanthorrhoea preissii					

Julimar Project Site HAR-56

Date	21/04/2021
Described by	CW & HE
Type	R
Location	MGA Zone 50
	424468 mE; 6514454 mN
	116.2046 E -31.502307 S
Veg Condition	Excellent
Soil	Clayey Sand
Rock Type	Laterite
Fire Age	>10 yrs
Habitat	Sandy/ Stony Plain
Vegetation	Tall open *Eucalyptus marginata* and *Corymbia calophylla* woodland over tall scattered *Banksia squarrosa* subsp. *squarrosa* and *Xanthorrhoea preissii* over low shrubland of *Hibbertia hypericoides* subsp. *hypericoides*, *Styphelia retrorsa* and *Synaphea decorticans*.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Amyema miquelii				CWHEopp03	
Banksia bipinnatifida subsp. *bipinnatifida*					
Banksia squarrosa subsp. *squarrosa*					
Corymbia calophylla					
Eucalyptus marginata					
Hakea lissocarpha					
Hibbertia ?semipilosa				HAR70-01	
Hibbertia hypericoides subsp. *hypericoides*					
Hibbertia lasiopus				HAR36-07	
Lepidosperma tenue				HAR56-01	
Phyllanthus calycinus					
Styphelia retrorsa				HAR39-02	
Synaphea decorticans				HAR35-01	
Xanthorrhoea preissii					

Julimar Project Site HAR-57

Date	21/04/2021
Described by	CW & HE
Type	R
Location	MGA Zone 50 425348 mE; 6514304 mN 116.2138 E -31.503711 S
Veg Condition	Excellent
Soil	Sandy Loam
Rock Type	None
Fire Age	5-10 yrs
Habitat	Undulating Low Hills
Vegetation	Tall open woodland of *Eucalyptus accedens*, *Eucalyptus wandoo* and *Eucalyptus marginata* over tall scattered shrubland of *Xanthorrhoea preissii*, *Banksia squarrosa* subsp. *squarrosa* and *Banksia sessilis* over low open shrubland of *Hibbertia hypericoides* subsp. *hypericoides*, *Banksia dallanneyi* subsp. *sylvestris* and *Hakea lissocarpha*.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Banksia bipinnatifida subsp. *bipinnatifida*					
Banksia dallanneyi subsp. *sylvestris*					
Banksia sessilis					
Banksia squarrosa subsp. *squarrosa*					
Conostylis ?setigera				HAR63-01	
Eucalyptus accedens				CWHWopp05	
Eucalyptus marginata					
Eucalyptus wandoo					
Hakea lissocarpha					
Hibbertia hypericoides subsp. *hypericoides*					
Hibbertia lasiopus				HAR36-07	
Lomandra hermaphrodita					
Lomandra sericea				HAR63-02	
Lomandra sp. Indet					
Orthrosanthus laxus var. *laxus*				HAR70-02	
Styphelia oblongifolia				HAR57-02	
Styphelia pallida				HAR57-01	
Xanthorrhoea preissii					

Julimar Project Site HAR-59

Date	21/04/2021
Described by	EEB & KG
Type	R
Location	MGA Zone 50 426917 mE; 6514108 mN 116.2303 E -31.505583 S
Veg Condition	Excellent
Soil	Loamy Sand
Rock Type	Laterite
Fire Age	>10 yrs
Habitat	Undulating Low Hills
Vegetation	Mid to low *Eucalyptus marginata* and *Corymbia calophylla* woodland over tall to mid *Banksia squarrosa* subsp. *squarrosa* and *Xanthorrhoea preissii* shrubland over low *Hibbertia hypericoides* subsp. *hypericoides* and *Styphelia retrorsa* shrubland.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Banksia dallanneyi subsp. *sylvestris*					
Banksia squarrosa subsp. *squarrosa*					
Conostylis setigera subsp. *setigera*					
Corymbia calophylla					
Eucalyptus marginata					
Hakea lissocarpha					
Hibbertia huegelii					
Hibbertia hypericoides subsp. *hypericoides*					
Hibbertia lasiopus				HAR62-02	
Stylidium diuroides				HAR59-01	
Styphelia retrorsa				HAR39-02	
Xanthorrhoea preissii					

Julimar Project Site HAR-60

Date	21/04/2021
Described by	EEB & KG
Type	R
Location	MGA Zone 50 427112 mE; 6513797 mN 116.2324 E -31.508406 S
Veg Condition	Very Good
Soil	Sandy Loam
Rock Type	Laterite
Fire Age	>10 yrs
Habitat	Undulating Low Hills
Vegetation	*Eucalyptus wandoo* and *Eucalyptus marginata* mid to low open woodland over *Xanthorrhoea preissii* and *Banksia squarrosa* subsp. *squarrosa* mid shrubs over *Hibbertia hypericoides* subsp. *hypericoides* low shrubs.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Banksia sessilis					
Banksia squarrosa subsp. *squarrosa*					
Corymbia calophylla					
Eucalyptus marginata					
Eucalyptus wandoo					
Grevillea bipinnatifida subsp. *bipinnatifida*					
Hakea lissocarpha					
Hibbertia ?semipilosa					
Hibbertia hypericoides subsp. *hypericoides*					
Hibbertia lasiopus				HAR62-02	
Lepidosperma pubisquameum					
Phyllanthus calycinus					
Styphelia retrorsa				HAR39-02	
Xanthorrhoea preissii					

Julimar Project Site HAR-61

Date	21/04/2021
Described by	EEB & KG
Type	R
Location	MGA Zone 50 426401 mE; 6513865 mN 116.2249 E -31.507747 S
Veg Condition	Excellent
Soil	Loamy Sand
Rock Type	Laterite
Fire Age	5-10 yrs, >10 yrs
Habitat	Undulating Low Hills
Vegetation	Mid to low *Eucalyptus marginata* and *Eucalyptus wandoo* woodland over tall to mid *Xanthorrhoea preissii* and *Banksia squarrosa* subsp. *squarrosa* shrubland over low *Hibbertia hypericoides* subsp. *hypericoides* and *Styphelia retrorsa* shrubland.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Banksia dallanneyi subsp. *sylvestris*					
Banksia squarrosa subsp. *squarrosa*					
Conostylis ?setigera					
Corymbia calophylla					
Desmocladus ?asper					
Drosera ?sewelliae				HAR61-02	
Eucalyptus marginata					
Eucalyptus wandoo					
Hakea lissocarpha					
Hibbertia huegelii					
Hibbertia hypericoides subsp. *hypericoides*					
Stylidium ?brunonianum					
Styphelia retrorsa				HAR61-01	
Xanthorrhoea preissii					

Julimar Project Site HAR-62

Date	21/04/2021
Described by	EEB & KG
Type	R
Location	MGA Zone 50
	425928 mE; 6513801 mN
	116.2199 E -31.508287 S
Veg Condition	Very Good
Soil	Loamy Sand
Rock Type	Laterite
Fire Age	5-10 yrs,>10 yrs
Habitat	Undulating Low Hills
Vegetation	*Eucalyptus marginata* mid to low open woodland over *Banksia squarrosa* subsp. *squarrosa* and *Xanthorrhoea preissii* mid to tall open shrubland over *Hibbertia hypericoides* subsp. *hypericoides* and *Styphelia retrorsa* low sparse shrubs.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Banksia dallanneyi subsp. *sylvestris*					
Banksia squarrosa subsp. *squarrosa*					
Corymbia calophylla					
Eucalyptus marginata					
Eucalyptus wandoo					
Grevillea synapheae subsp. *synapheae*				HAR62-01	
Hakea lissocarpha					
Hibbertia hypericoides subsp. *hypericoides*					
Hibbertia lasiopus				62-02	
Stylidium ?brunonianum					
Styphelia retrorsa				HAR39-02	
Xanthorrhoea preissii					

Julimar Project Site HAR-63

Date	21/04/2021
Described by	CW & HE
Type	R
Location	MGA Zone 50
	425056 mE; 6514047 mN
	116.2107 E -31.506018 S
Veg Condition	Excellent
Soil	Sandy Clay Loam
Rock Type	Laterite
Fire Age	>10 yrs
Habitat	Sandy/ Stony Plain
Vegetation	Tall open *Eucalyptus wandoo* woodland over mid scattered *Xanthorrhoea preissii* shrubland over a low sparse *Hakea lissocarpha*, *Banksia bipinnatifida* subsp. *bipinnatifida* and *Hibbertia hypericoides* subsp. *hypericoides* shrubland.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Banksia bipinnatifida subsp. *bipinnatifida*					
Banksia dallanneyi subsp. *sylvestris*					
Conostylis ?setigera				HAR-63-01	
Eucalyptus wandoo					
Hakea lissocarpha					
Hibbertia ?semipilosa				HAR70-01	
Hibbertia hypericoides subsp. *hypericoides*					
Hibbertia lasiopus				HAR36-07	
Lomandra sericea				HAR-63-02	
Orthrosanthus laxus var. *laxus*				HAR70-02	
Styphelia propinqua				HAR36-05	
Xanthorrhoea preissii					

Julimar Project Site HAR-64

Date	21/04/2021			
Described by	CW & HE			
Type	R			
Location	MGA Zone 50			
	425036	mE;	6513846	mN
	116.2105	E	-31.507824	S
Veg Condition	Excellent			
Soil	Sandy Clay Loam			
Rock Type	Laterite			
Fire Age	5-10 yrs, >10 yrs			
Habitat	Sandy/ Stony Plain			
Vegetation	Tall open woodland of *Eucalyptus marginata* and *Corymbia calophylla* over a tall *Banksia squarrosa* subsp. *squarrosa* and *Xanthorrhoea preissii* shrubland over a low *Hibbertia hypericoides* subsp. *hypericoides*, *Styphelia retrorsa* and *Banksia dallanneyi* subsp. *sylvestris* shrubland.			

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Banksia dallanneyi subsp. *sylvestris*					
Banksia squarrosa subsp. *squarrosa*					
Corymbia calophylla					
Eucalyptus marginata					
Grevillea synapheae subsp. *synapheae*				CWSCOPP02	
Hakea lissocarpha					
Hibbertia hypericoides subsp. *hypericoides*					
Hibbertia lasiopus				HAR36-07	
Lomandra sp. Indet					
Stylidium hispidum				HAR-64-01	
Styphelia retrorsa				HAR39-02	
Synaphea decorticans				HAR35-01	
**Ursinia anthemoides*					
Xanthorrhoea preissii					

Julimar Project Site HAR-65

Date	21/04/2021			
Described by	SC & CW			
Type	R			
Location	MGA Zone 50			
	424780	mE;	6514013	mN
	116.2078	E	-31.506303	S
Veg Condition	Excellent			
Soil	Sand			
Rock Type	None			
Fire Age	>10 yrs			
Habitat	Sand Plain			
Vegetation	Scattered tall *Corymbia calophylla* over tall open shrubland of *Hakea prostrata*, *Jacksonia sternbergiana* and *Banksia sessilis* over low open shrubland of *Hypocalymma angustifolium*, *Hibbertia hypericoides* subsp. *hypericoides* and *Phyllanthus calycinus*.			

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Amyema miquelii				CWHEOPP03	
Banksia sessilis					
Bossiaea eriocarpa					
Corymbia calophylla					
Hakea prostrata					
Hibbertia hypericoides subsp. *hypericoides*					
Hypocalymma angustifolium					
Jacksonia sternbergiana					
Lomandra sp. Indet					
Macrozamia riedlei					
Orthrosanthus laxus var. *laxus*				HAR70-02	
Phyllanthus calycinus					
Styphelia retrorsa				HAR39-02	
**Ursinia anthemoides*					

Julimar Project Site HAR-66

Date	21/04/2021
Described by	CW & HE
Type	R
Location	MGA Zone 50
	424265 mE; 6513788 mN
	116.2024 E -31.508298 S
Veg Condition	Excellent
Soil	Clay Loam Sandy
Rock Type	Laterite
Fire Age	>10 yrs
Habitat	Sandy/ Stony Plain
Vegetation	Open *Eucalyptus marginata*, *Corymbia calophylla* and *Eucalyptus wandoo* woodland, over mid open *Xanthorrhoea preissii* shrubland over low *Hakea lissocarpha*, *Hibbertia hypericoides* subsp. *hypericoides* and *Hibbertia* ?*semipilosa* shrubland.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Banksia dallanneyi subsp. *sylvestris*					
Bossiaea eriocarpa					
Corymbia calophylla					
Eucalyptus marginata					
Eucalyptus wandoo					
Gompholobium marginatum					
Hakea lissocarpha					
Hibbertia ?*semipilosa*				HAR70-01	
Hibbertia hypericoides subsp. *hypericoides*					
Hypocalymma angustifolium					
Lomandra sp. Indet					
Orthrosanthus laxus var. *laxus*				HAR70-02	
Phyllanthus calycinus					
Styphelia retrorsa				HAR39-02	
Xanthorrhoea preissii					

Julimar Project Site HAR-67

Date	22/04/2021
Described by	SC & HE
Type	R
Location	MGA Zone 50
	425393 mE; 6515901 mN
	116.2144 E -31.489307 S
Veg Condition	Excellent
Soil	Sandy Clay Loam
Rock Type	Laterite
Fire Age	>10 yrs
Habitat	Undulating Low Hills
Vegetation	Tall scattered *Xanthorrhoea preissii* shrubs over low *Banksia fraseri* var. *fraseri*, *Calothamnus quadrifidus* subsp. *quadrifidus* and *Hibbertia hypericoides* subsp. *hypericoides* shrubland.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Babingtonia camphorosmae					
Banksia fraseri var. *fraseri*				HAR67-02	
Calothamnus quadrifidus subsp. *quadrifidus*				HAR67-01	
Calytrix sp. Indet 3					
Hakea incrassata				HAR67-03	
Hakea undulata					
Hibbertia hypericoides subsp. *hypericoides*					
Lepidosperma sp. Indet					
Melaleuca incana				HAR67-04	
Xanthorrhoea preissii					

Julimar Project Site HAR-70

Date	20/04/2021
Described by	SC & CW
Type	R
Location	MGA Zone 50
	427500 mE; 6516594 mN
	116.2366 E -31.483194 S
Veg Condition	Excellent
Soil	Loamy Sand
Rock Type	Laterite
Fire Age	3-5 yrs
Habitat	Undulating Low Hills
Vegetation	Mid *Eucalyptus wandoo* and occasional *Eucalyptus marginata* and *Corymbia calophylla* forest over tall scattered *Banksia squarrosa* subsp. *squarrosa* and *Trymalium odoratissimum* subsp. *odoratissimum* shrubs over mid scattered *Xanthorrhoea preissii* shrubs over low sparse *Hibbertia hypericoides* subsp. *hypericoides*, *Hakea lissocarpha* and *Hibbertia lasiopus* shrubs.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Banksia bipinnatifida subsp. *bipinnatifida*					
Banksia dallanneyi subsp. *sylvestris*					
Banksia squarrosa subsp. *squarrosa*					
Corymbia calophylla					
Eucalyptus marginata					
Eucalyptus wandoo					
Hakea lissocarpha					
Hibbertia ?semipilosa				HAR70-01	
Hibbertia hypericoides subsp. *hypericoides*					
Hibbertia lasiopus					
Orthrosanthus laxus var. *laxus*				HAR70-02	
Trymalium odoratissimum subsp. *odoratissimum*				CWSCOPP04	
Xanthorrhoea preissii					

Julimar Project Site HAR-71

Date	20/04/2021
Described by	SC & CW
Type	R
Location	MGA Zone 50
	428191 mE; 6516242 mN
	116.2439 E -31.486414 S
Veg Condition	Excellent
Soil	Sand
Rock Type	None
Fire Age	5-10 yrs
Habitat	Sandy/ Stony Plain
Vegetation	*Jacksonia sternbergiana* and *Banksia sessilis* tall open shrubland over mid-low shrubland of *Daviesia angulata* and *Hibbertia hypericoides* subsp. *hypericoides*.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Babingtonia camphorosmae				HAR71-01	
Banksia sessilis					
Daviesia angulata				CWSCopp04	
Desmocladus asper					
Hibbertia hypericoides subsp. *hypericoides*					
Jacksonia sternbergiana					
Lepidosperma tenue				HAR71-03	
Styphelia macrocalyx				HAR71-02	
Xanthorrhoea preissii					

Julimar Project Site HAR-72

Date	20/04/2021
Described by	SC & CW
Type	R
Location	MGA Zone 50
	427752 mE; 6516242 mN
	116.2393 E -31.486388 S
Veg Condition	Excellent
Soil	Sand
Rock Type	None
Fire Age	5-10 yrs,>10 yrs
Habitat	Sandy/ Stony Plain
Vegetation	Low open *Eucalyptus marginata* and *Corymbia calophylla* woodland over open tall shrubland of *Allocasuarina humilis*, *Xanthorrhoea preissii* and *Banksia squarrosa* subsp. *squarrosa* over low open shrubland of *Patersonia occidentalis*, *Hibbertia hypericoides* subsp. *hypericoides* and *Banksia dallanneyi* subsp. *sylvestris*.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Allocasuarina humilis					
Babingtonia camphorosmae					
Banksia dallanneyi subsp. *sylvestris*				HAR36-03	
Banksia squarrosa subsp. *squarrosa*					
Corymbia calophylla					
Eucalyptus marginata					
Hibbertia hypericoides subsp. *hypericoides*					
Laxmannia squarrosa				CWSCopp07	
Lepidosperma aff. *drummondii*				CWSCopp09	
Patersonia occidentalis					
Stylidium eriopodum				CWSCopp08	
Xanthorrhoea preissii					

Julimar Project Site HAR-90

Date	13/05/2021
Described by	CW & HE
Type	R
Location	MGA Zone 50
	426812 mE; 6516255 mN
	116.2294 E -31.486204 S
Veg Condition	Excellent
Soil	Sandy Loam
Rock Type	Laterite
Fire Age	1-3 yrs
Habitat	Undulating Low Hills
Vegetation	Open mid *Eucalyptus marginata* and *Corymbia calophylla* woodland over tall open shrubland of *Xanthorrhoea preissii* and *Banksia squarrosa* subsp. *squarrosa* over low sparse *Hibbertia hypericoides* subsp. *hypericoides*, *Banksia dallanneyi* subsp. *sylvestris* and *Hibbertia lasiopus*.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Banksia dallanneyi subsp. *sylvestris*					
Banksia squarrosa subsp. *squarrosa*					
Conostylis setigera subsp. *setigera*					
Corymbia calophylla					
Drosera ?sewelliae				CWSCOPP01	
Eucalyptus marginata					
Grevillea synapheae subsp. *synapheae*					
Hakea lissocarpha					
Hibbertia commutata					
Hibbertia huegelii					
Hibbertia hypericoides subsp. *hypericoides*					
Hibbertia lasiopus				HAR36-07	
Petrophile striata				HAR90-01	
Styphelia propinqua				HAR36-05	
Xanthorrhoea preissii					

Julimar Project   Site   Opps

Date
Described by
Type
Location   MGA Zone
mE;   mN
E   S
Veg Condition
Soil
Rock Type
Fire Age
Habitat
Vegetation
Notes

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Acacia drummondii subsp. *elegans*				EBCWopp-01	
Acacia sp. Indet					
Allocasuarina humilis				CWSCopp06	
Amyema miquelii				CWHEopp03	
Banksia grandis					
Bossiaea aquifolium subsp. *aquifolium*					
Bossiaea eriocarpa					
Bossiaea ornata				SCDRopp02	
Conostylis setigera subsp. *setigera*				SCDRopp03	
Daviesia angulata				CWSCopp04	
Drosera ?*sewelliae*					
Drosera ?*sewelliae*					
Drosera ?*sewelliae*					
Drosera ?*sewelliae*					
Drosera ?*sewelliae*					
Drosera ?*sewelliae*					
Drosera ?*sewelliae*					
Drosera ?*sewelliae*					
Drosera ?*sewelliae*				CWSCopp01	
Drosera ?*sewelliae*					
Drosera ?*sewelliae*					
Drosera ?*sewelliae*					
Drosera ?*sewelliae*					
Drosera ?*sewelliae*					
Drosera ?*sewelliae*					
Drosera ?*sewelliae*					
Drosera ?*sewelliae*					
Drosera ?*sewelliae*					
Drosera ?*sewelliae*					
Drosera ?*sewelliae*					
Drosera ?*sewelliae*					
Drosera ?*sewelliae*					
Drosera ?*sewelliae*					
Drosera ?*sewelliae*					
Drosera ?*sewelliae*					
Drosera ?*sewelliae*					
Drosera ?*sewelliae*					
Drosera ?*sewelliae*					
Drosera ?*sewelliae*					
Drosera ?*sewelliae*					
Drosera ?*sewelliae*					
Drosera ?*sewelliae*					

Drosera ?*sewelliae*		
Drosera ?*sewelliae*		
Drosera ?*sewelliae*		
Drosera ?*sewelliae*		
Drosera ?*sewelliae*		
Drosera ?*sewelliae*		
Drosera ?*sewelliae*		
Drosera ?*sewelliae*		
Drosera ?*sewelliae*		
Drosera erythrorhiza	SCDRopp05	
Drosera sewelliae	CWSCopp11	
Drosera sewelliae		
Eriochilus dilatatus		
Eucalyptus accedens	CWHWopp05	
Eucalyptus drummondii	CWSCopp10	
Eucalyptus wandoo		
Grevillea bipinnatifida subsp. *bipinnatifida*		
Grevillea synapheae subsp. *synapheae*	CWSCopp02	
Grevillea synapheae subsp. *synapheae*	Mvwkgopp1	
Hakea prostrata		
Hakea prostrata		
Hakea trifurcata		
Hakea trifurcata		
Hemigenia wandooana	HWCWopp10	
Hibbertia hibbertioides var. *hibbertioides*	CWHW-opp08	
Hibbertia hibbertioides var. *hibbertioides*		
Jacksonia furcellata		
Jacksonia sternbergiana		
Kennedia prostrata		
Laxmannia squarrosa	CWSCopp07	
Lepidosperma aff. *drummondii*	SCHEopp02	
Lepidosperma aff. *drummondii*	CWSCopp09	
Leporella fimbriata		
Leptospermum erubescens	CWSCopp06	
Leucopogon sp. Newdegate (M. Hislop 3585)	SCDRopp04	
Melaleuca trichophylla		
Nuytsia floribunda		
Nuytsia floribunda		
Olax scalariformis		
Persoonia angustiflora	SCHEopp03	
Persoonia elliptica		
Persoonia elliptica		
Persoonia elliptica		
Petrophile striata	SCHEopp01	
Phyllanthus calycinus		
Pimelea argentea	SCDRopp01	farm weed
Pimelea sp. Indet	CWHWopp02	
**Solanum nigrum*		
Stirlingia latifolia		
Stylidium eriopodum	CWSCopp08	
Stylidium hispidum	CWHWopp01	
Synaphea decorticans	HAR35-01	
Synaphea sp. Udumung (A.S. George 17058)	HWopp01	
Synaphea sp. Udumung (A.S. George 17058)	Hwopp01	
Synaphea sp. Udumung (A.S. George 17058)		
Synaphea sp. Udumung (A.S. George 17058)		
Trymalium odoratissimum subsp. *odoratissimum*	CWSCopp03	
Xanthorrhoea gracilis		

This page has been left blank intentionally

Appendix 4 Targeted Flora Survey of the Hartog and Baudin Targets (Biologic 2021a)

Hartog and Baudin targets – Chalice Julimar Project

Targeted Flora Survey

Biologic Environmental Survey

Report to Chalice Mining Ltd

October 2021

Document Status				
Revision No.	Author	Review / Approved for Issue	Approved for Issue to	
			Name	Date
1	C. Whyte	C. van den Bergh	M. Hobson & S. Carney	06/10/2021
2	C. Whyte	C. van den Bergh	M. Hobson & S. Carney	08/10/2021

TABLE OF CONTENTS

Executive Summary **1**

1 Introduction **2**

1.1 Background **2**

1.2 Objectives **2**

1.3 Biophysical Environment **3**

1.4 Legislation & Compliance **3**

2 Methods **6**

2.1 Survey Type, Timing & Conditions **6**

2.2 Survey Personnel & Licensing **6**

2.3 Field Survey **7**

2.3.1 Pre-mobilisation 7

2.3.2 Targeted Flora Assessment 7

2.3.3 Nomenclature & Specimen Identification 8

2.4 Limitation and Constraints **12**

3 Results **13**

3.1 Desktop Assessment **13**

3.2 Significant Flora **13**

Conospermum densiflorum subsp. *unicephalatum* (T) 13

Drosera sewelliae (P2) 16

Cyanicula ixioides subsp. *candida* (P2) 17

Acacia drummondii subsp. *affinis* (P3) 18

Cyanicula ixioides subsp. *ixioides* (P4) 19

3.3 Review of Likelihood of Occurrence **24**

4 Conclusion **25**

5 References **26**

LIST OF FIGURES

Figure 1.1: Study Area and regional location 4

Figure 1.2: Study Area 5

Figure 2.1: Rainfall and temperature for the Study Area (stations Julimar Forest 9268 and Northam 10111, respectively; BoM, 2021) 6

Figure 2.2: Flora targeted traverses 9

Figure 3.1: Significant flora observed in the Study Area 21

LIST OF TABLES

Table 2.1: Project Team & Licences 7

Table 2.2: Survey limitations and constraints 12

Table 3.1: Summary of known records for significant flora observed in the Study Area (Biologic, 2021; Patten & Broun, 2004; WAH, 1998-) 13

LIST OF PLATES

Plate 3.1: *Conospermum densiflorum* subsp. *unicephalatum* (T) observed during the field survey (Biologic photos) 15

Plate 3.2: *Conospermum densiflorum* subsp. *unicephalatum* (T) habitat within the survey area (Biologic photos) 15

Plate 3.3: *Drosera sewelliae* (P2) observed during the field survey (Biologic photo) 17

Plate 3.4: *Cyanicula ixioides* subsp. *candida* (P2) observed during the field survey (Biologic photos) 18

Plate 3.5: *Acacia drummondii* subsp. *affinis* (P3) observed during the field survey (Biologic photo) ... 19

Plate 3.6: *Cyanicula ixioides* subsp. *ixioides* (P4) observed during the field survey (Biologic photos) 20

APPENDICES

Appendix A: Pre and post-field likelihood assessment 27

EXECUTIVE SUMMARY

Chalice are undertaking exploration activities for the Julimar Project, located approximately 70 km northeast of Perth, in the Shire of Toodyay in Western Australia. Chalice are looking to continue their exploration activities within the Julimar State Forest, and as such, further biological surveys are required to build upon existing baseline information. Biologic was commissioned by Chalice to conduct a targeted flora and vegetation assessment of 72 proposed drill sites and associated access routes within the Hartog and Baudin targets, totalling approximately 63 ha (the Study Area). The overall objective of this survey was to identify and mark the location of threatened and priority flora within the Study Area, utilising the results of Biologic (2021) Hartog and Baudin reconnaissance flora and vegetation survey as the basis.

The targeted flora survey was conducted over four days from 7 – 10 September 2021. The entire Study Area was intensively traversed by five botanists focusing on a total of 38 target species. Higher than average winter rainfall preceded the survey and a high proportion of the flora was flowering at the time of survey. There were no substantial limitations or constraints to the survey.

A total of five threatened and priority flora taxa were found within the Study Area:

- 1,358 individuals from 59 point locations of *Conospermum densiflorum* subsp. *unicephalatum* (T);
- 5,153 individuals from 321 point locations of *Drosera sewelliae* (P2);
- 116 individuals from 32 point locations of *Acacia drummondii* subsp. *affinis* (P3);
- One individual of *Cyanicula ixioides* subsp. *candida* (P2); and
- One individual of *Cyanicula ixioides* subsp. *ixioides* (P4).

The *Conospermum densiflorum* subsp. *unicephalatum* (T) populations found by Biologic within the Julimar State Forest represent a substantial range extension to the south. The current survey has increased the number of known populations and considerably increased the number of individuals to more than 2,500.

1 INTRODUCTION

1.1 Background

Chalice Mining Limited (Chalice) are exploring the Julimar Exploration Project (hereafter referred to as the project), located approximately 70 kilometres (km) northeast of Perth, in the Shire of Toodyay in Western Australia (WA) (Figure 1.1). The project is located on exploration tenements E70/5118 and E70/5119 which overlay Julimar State Forest (JSF) and private farmland (Figure 1.1). Exploration activities within the Department of Biodiversity, Conservation and Attractions (DBCA) managed JSF are strictly governed by the approved Stage 1 Conservation Management Plan (CMP). The purpose of these activities is to screen the entire Julimar exploration corridor for potential mineralisation and reduce the overall area of focus by identifying specific target areas within the Julimar State Forest for future exploration.

To date, flora assessments undertaken for the Chalice Mining Julimar Exploration Project include:

- Desktop assessment of flora and fauna values of E70/5118 and E70/5119 (Mattiske, 2019);
- Gonneville reconnaissance and targeted flora assessment E70/5118 (Biologic, 2020); and
- Hartog and Baudin reconnaissance flora and vegetation survey E70/5119 (Biologic, 2021).

Chalice are looking to continue their exploration activities within the Julimar State Forest, and as such, further biological surveys are required to build upon this existing baseline information. Biologic Environmental Survey (Biologic) was commissioned by Chalice to conduct a targeted flora survey of 72 proposed drill sites and access tracks, totalling approximately 63 ha (the Study Area; Figure 1.2). 48 of these sites are off existing tracks, and the remaining 24 are on existing access tracks. Results of the targeted survey will be used to inform drill program planning, Native Vegetation Clearing Permit and Programme of Work applications and finalisation of the CMP Stage 2. The Study Area falls within the Hartog and Baudin targets which were subject to a reconnaissance flora and vegetation survey in Autumn 2021 (Biologic, 2021). The reconnaissance survey determined that none of the mapped vegetation types represented any known significant vegetation (Threatened or Priority Ecological Communities), and as such, vegetation was not required to be assessed as part of the targeted flora survey.

1.2 Objectives

The overall objective of this survey was to identify and mark the location of threatened and priority flora within the Study Area, utilising the results of Biologic (2021) Hartog and Baudin reconnaissance flora and vegetation survey as the basis. This was achieved through the following scope of works:

- Reviewing existing literature to inform the survey approach;
- Undertaking a targeted survey within the proposed drill sites (and associated buffers) to identify individuals and extent of any significant flora populations; and
- Preparing and submitting a final report and associated spatial data of the survey findings.

1.3 Biophysical Environment

The survey area is located within the Northern Jarrah Forest Interim Biogeographic Regionalisation for Australia (IBRA) subregion. The Northern Jarrah Forest subregion is characterised by jarrah – marri forest on laterite gravels in the west, with bullich (*Eucalyptus megacarpa*) and blackbutt (*Eucalyptus patens*) in the valleys, grading to wandoo – marri woodlands on clayey soils in the east, with powder bark (*Eucalyptus accedens*) on breakaways (Williams & Mitchell, 2001). There are extensive, but localised, sand sheets with *Banksia* low woodlands, and heath is found on granite rocks and as a common understory of forests and woodlands in the north and east (Williams & Mitchell, 2001). Most of the diversity in the communities occurs on lower slopes or near granite soils where there are rapid changes in site conditions (Williams & Mitchell, 2001).

The climate of the region is classified by cool wet winters, and warm, relatively dry summers. Average annual rainfall for the Northern Jarrah Forest subregion is from 1300 millimetres (mm) on the scarp, to approximately 700 mm in the east and north.

1.4 Legislation & Compliance

Conservation significant flora and vegetation is protected at a state and federal level and legislated by the following parliamentary acts:

- State *Biodiversity Conservation Act 2016* (BC Act);
- State *Environmental Protection Act 1986* (EP Act); and
- Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The Environmental Protection Authority (EPA) outline guidance for biological surveys in Western Australia. All aspects of botanical assessments at Biologic are compliant with the following technical guidance statements at the level of Environmental Impact Assessment (EIA):

- EPA Technical Guidance for Flora and Vegetation Surveys for EIA (EPA, 2016b);
- Environmental Factor Guidelines for flora and vegetation (EPA, 2016a); and
- Draft Survey Guidelines for Australia's threatened orchids. Guidelines for detecting orchids listed as 'Threatened' under the *Environment Protection and Biodiversity Conservation Act 1999* (DoE, 2014)

.

420000 425000 430000 435000

6525000 6520000 6515000 6510000

Perth

Julimar State Forest

E 7005119

Dewars Pool - Bindoon Rd

Munyerring Spring Rd

SHIRE OF CHITTERING

Timberden Dr

Nerranine Dr

Julimar Rd

Keating Rd

Jenjoda Rd

Rd No. 14748

E 7005118

SHIRE OF TOODYAY

Howard Rd

Parkland Dr

Beach Rd

Plunkett Rd

Davis Rd

Valley Rd

Chittering

Unknown Rd

Moondyne Nature Reserve

Avon Valley National Park

Cobbler Pool Rd

Legend

- Study Area
- Local Government Authority
- Live Mining Tenement
- Local Road

DBCA Managed Land

- National Park
- Nature Reserve
- Section 5(1)(g) Reserve
- State Forest

IBRA Region

- Jarrah Forest
- Swan Coastal Plain

IBRA Subregion

- Dandaragan Plateau
- Northern Jarrah Forest
- Perth

0 1 2 3 Km

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 08/10/2021

N

biologic Environmental Survey

Scale: 1:70,000

BOLGART
GINGIN
BINDOON
BEJOORDING
WEST TOODYAY
MUCHEA
TOODYAY

CHALICE MINING LTD

Hartog and Baudin targets - Chalice Julimar Project. Targeted Flora Survey

Figure 1.1: Study Area and regional location

425000

430000

6520000

6515000

Julimar Rd

Plunkett Rd

Legend

Study Area

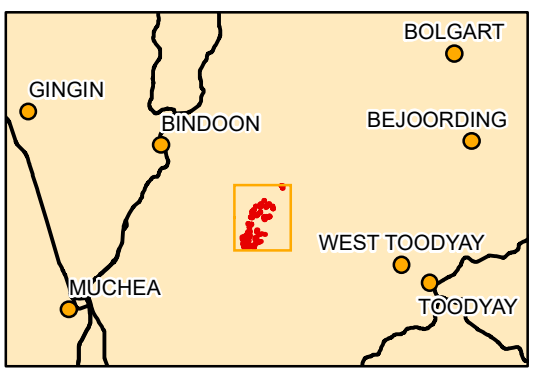
Local Road

0 500 1,000 Meters

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 08/10/2021

N

Scale: 1:27,000



CHALICE MINING LTD

Hartog and Baudin targets - Chalice Julimar Project. Targeted Flora Survey

Figure 1.2: Study Area

2 METHODS

2.1 Survey Type, Timing & Conditions

The field survey was conducted over four days from 7 – 10 September 2021. Winter rainfall in the months preceding the survey was well above average, although this was mainly due to record-breaking July rainfall (i.e. 382.4 mm June-August compared with the LTA of 263 mm) (Figure 2.1). Favourable conditions leading up to the September survey indicate the survey was of adequate seasonal timing for early-spring flowering taxa. Temperatures experienced during the field survey (16.0°C – to 27.6°C, Station 10111 Northam) were consistent with the long term average for the area (20.5°C; BoM, 2021).

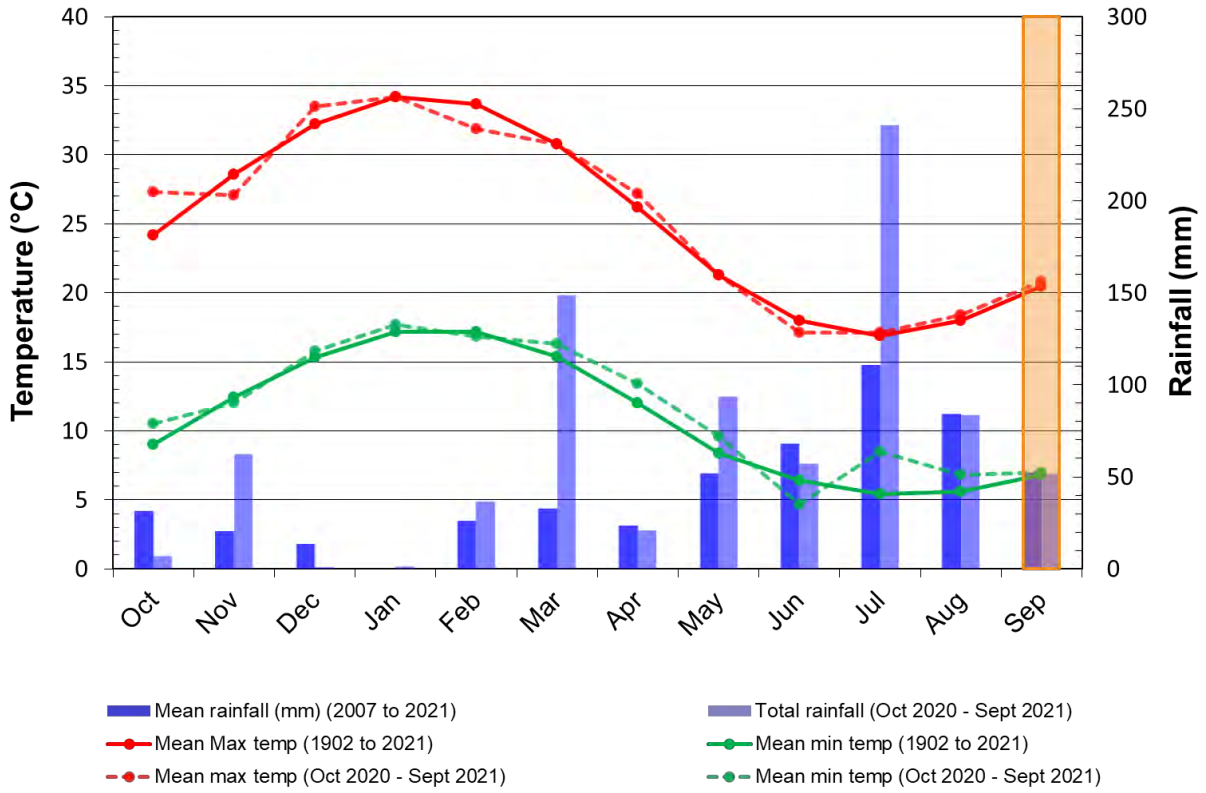


Figure 2.1: Rainfall and temperature for the Study Area (stations Julimar Forest 9268 and Northam 10111, respectively; BoM, 2021)

2.2 Survey Personnel & Licensing

The field survey was undertaken by five Biologic botanists over sixteen person days. Senior Botanist Carmel Winton led the field survey with the support of Senior Botanist Joel Chick, Senior Consultant Botanist Ben Eckermann, Botanist Clare Whyte and Graduate Botanist Darcy Reith. Biologic has a well-established and experienced biological survey team with the team lead having over five years' experience in botanical surveys in south-west Western Australia. Joel has extensive survey experience in the Jarrah Forest bioregion, and Clare and Darcy have recent survey experience in the JSF as part of the Biologic (2021) reconnaissance survey. Ben and Darcy have green card dieback training, which

is a requirement of the CMP. All personnel were fully inducted to site and held the current and relevant licencing (Table 2.1).

Table 2.1: Project Team & Licences

Biologic Personnel	Project Involvement	Licencing	Experience
Carmel Winton	Botanical project lead, field survey	FB62000134 TFL 134B-2021	7 years
Ben Eckermann	Field survey, team lead	FB62000262 TFL 181-1920	15+ years
Clare Whyte	Field survey, team lead, reporting	FB62000274	3.5 years
Joel Chick	Field survey	FB62000273 TFL 38-2021	14 years
Darcy Reith	Field survey	FB62000359	2 years

2.3 Field Survey

2.3.1 Pre-mobilisation

A desktop assessment, comprising of a literature review and database searches, was completed as part of the reconnaissance survey of the Hartog and Baudin targets (Biologic, 2021). The post-survey likelihood from the reconnaissance survey was reviewed and used to compile a list of significant flora to target within the proposed drill sites and access routes (Appendix A). Flora taxa that were confirmed, highly likely, likely or possible to occur within the Study Area were targeted. Species that were considered unlikely or highly unlikely to occur prior to the reconnaissance survey were not targeted unless individuals were observed while traversing the Study Area.

2.3.2 Targeted Flora Assessment

Field personnel familiarised themselves with photographs, reference samples and descriptions of the target taxa prior to mobilisation. An understanding of which significant flora were expected to occur in which locations was established based on aerial photography, location of known records, potential habitat and knowledge of the area and plants. This was reviewed each day in the field or when starting a new area. Aerial imagery, known locations and botanical references were available and utilised during the field assessment.

Comprehensive parallel targeted traverses were conducted throughout each proposed drill site (Figure 2.2). A 50 m wide area was surveyed for each drill site and access track. The spacing of traverses varied from 5 to 15 m, depending on the vegetation structure, habitat and species being targeted. Approximately 115 km of targeted traverses were completed throughout all 72 proposed drill sites. Several additional targeted traverses leading to off-track drill sites were conducted during the field survey; these have been incorporated into the Study Area (and figures). However, these traverses were generally narrower than 50 m wide.

Upon encountering potentially significant taxa, a GPS coordinate of the individual was taken when occurring in isolation, or a central GPS coordinate was taken for a small population (central coordinate with an approximate 10 m radius). Information collected at each location comprised:

- Number of individuals, for a small population, or an estimate for large populations;
- Notes of vegetation habitat;
- Notes on reproductive status of individuals e.g. sterile, flowering, fruiting, dead; and
- Coordinates of either each plant (if few) or the extent of the population (if many) using a GPS.

Threatened and Priority Flora Report Forms will be provided to the Parks and Wildlife Division (Parks and Wildlife) of DBCA, as required under the flora collecting permits. Conservation significant flora specimens will be vouchered with the Western Australian Herbarium (WAH), where required and appropriate.

2.3.3 Nomenclature & Specimen Identification

Flora nomenclature used in this report is consistent with the Western Australian Herbarium's plant census, provided on Florabase (WAH, 1998). All species are current at the time of report preparation.

Specimens were identified by Dr Rachel Meissner and Senior Botanist Sam Coultas supported by the Biologic botanical team using the appropriate taxonomic keys, and Western Australian reference herbarium. Significant flora specimens will be submitted to the Western Australian Herbarium for formal identification by taxonomic experts; however, it is not envisaged that the identifications will change.

426000

428000

6520000

6518000

Legend

- Study Area
- Local Road
- Traverse

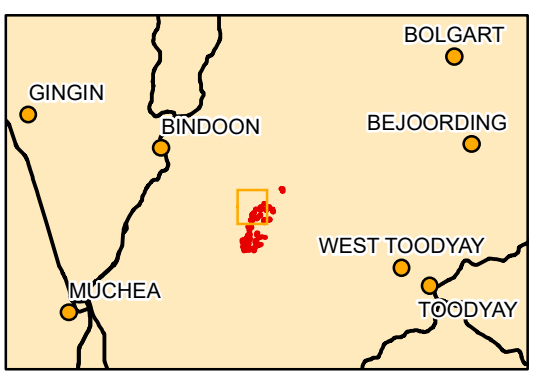
0 200 400 600 Meters

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 08/10/2021

N

biologic Environmental Survey

Scale: 1:14,000



CHALICE MINING LTD

Hartog and Baudin targets - Chalice Julimar Project. Targeted Flora Survey

Figure 3.2a: Flora targeted traverses

428000

430000

6520000

6518000

Legend

- Study Area
- Local Road
- Traverse

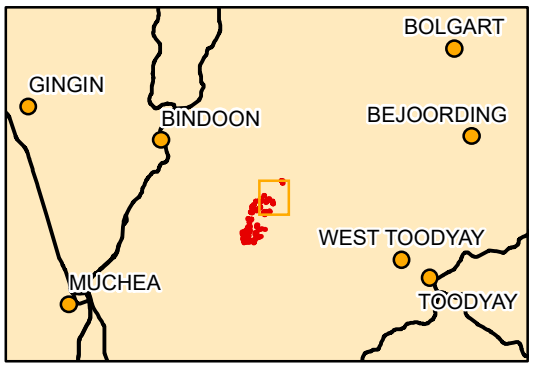
0 200 400 600 Meters

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 08/10/2021

N

biologic Environmental Survey

Scale: 1:14,000



CHALICE MINING LTD

Hartog and Baudin targets - Chalice Julimar Project. Targeted Flora Survey

Figure 3.2b: Flora targeted traverses

426000

428000

6516000

6514000

Julimar Rd

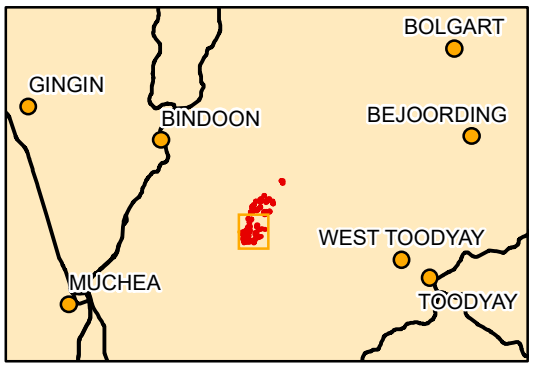
Plunkett Rd

Legend

- Study Area
- Local Road
- Traverse

0 200 400 600 Meters

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 08/10/2021



N

biologic Environmental Survey

Scale: 1:14,000

CHALICE MINING LTD

Hartog and Baudin targets - Chalice Julimar Project. Targeted Flora Survey

Figure 3.2c: Flora targeted traverses

2.4 Limitation and Constraints

Any aspects presenting limitations or constraints for the Study Area are discussed in Table 2.2.

Table 2.2: Survey limitations and constraints

Potential Limitation	Constraint	Comment
Availability of contextual information and data at a regional & local scale	No	The Jarrah Forest bioregion has been subjected to numerous biological surveys, and a sufficient amount of contextual work was available to complete the assessment, including within the Julimar State Forest.
Competency/experience of the survey team, including experience in the bioregion surveyed	No	The survey team was led by senior botanist Carmel Winton who has over seven years' experience as a botanist in Western Australia, supported by senior botanists Joel Chick and Ben Eckermann who have the minimum five years' experience within the Jarrah Forest bioregion. Botanists Clare Whyte and Darcy Reith have recent botanical experience within the Julimar State Forest.
Proportion of flora recorded/collected and any identification issues	No	As this was a targeted survey it was not necessary to collect all flora. One specimen, a *Paracaleana* sp., could only be identified down to genus level due to the flower not being open. However, there are no significant *Paracaleana* known to occur in the area.
Appropriate area fully surveyed (effort & extent)	No	The entire Study Area was intensively surveyed at intervals between 5 m and 15 m. When a significant taxon was encountered, botanists searched a 20 m radius focusing on that one taxon, including outside of the Study Area where appropriate.
Access restrictions within the Study Area	No	Tracks were in good condition at the time of the survey and the entire Study Area was accessible.
Survey timing, weather and seasonality	No	The targeted survey was conducted during spring, which is the recommended survey timing for the South-West (EPA, 2016b). Winter rainfall prior to the field survey had created favourable growing conditions, and a high proportion of the flora was flowering at the time of the survey. Flora species that flower in late spring may not have been as visible. Two target species remain Possible to occur within the Study Area due to not being in flower at the time of the field survey.
Disturbance that may have affected results, e.g. fire, flood	No	Some sections of the Study Area were fire affected (i.e., last burnt 1-3 years ago), but this did not affect the survey results.

3 RESULTS

3.1 Desktop Assessment

Six significant flora species have previously been confirmed to occur within the Hartog and Baudin targets; *Conospermum densiflorum* subsp. *unicephalatum* (T), *Drosera sewelliae* (P2), *Beaufortia eriocephala* (P3), *Lasiopetalum caroliae* (P3), *Persoonia sulcata* (P4) and *Synaphea grandis* (P4) (Biologic, 2021; DBCA, 2021; Western Australian Herbarium, 1998–). An existing DBCA record for *Drosera sewelliae* (P2) was located within the Study Area, at a drill site adjacent to Julimar Road. A further eleven species were considered likely (1) or possible (10) to occur. Most of these taxa were annual/ perennial herbs or small shrubs that may have been overlooked during the reconnaissance survey (WAH, 1998-). The full list of target species is presented in Appendix A.

3.2 Significant Flora

Five significant flora taxa were identified during the targeted field survey. A summarised view of the results is presented in Table 3.1. Populations recorded through the Atlas of Living Australia (ALA) and the TPFL database were not included. Biologic had access to the DBCA (2021) Threatened and Priority Flora (TPFL) records from the reconnaissance database searches, although there were no local (< 10 km) TPFL records for any of the five significant taxa recorded in the Study Area. It is possible that there are additional regional records within the DBCAs TPFL database. The total number of individuals is for all WAH records and Biologic records combined. Specific population information was not available for all WAH records, with ambiguous terms such as 'several hundred' or 2-5 being used. Therefore a conservative approach was taken in estimating the total number of individuals.

Table 3.1: Summary of known records for significant flora observed in the Study Area (Biologic, 2021; Patten & Broun, 2004; WAH, 1998-)

Significant taxon	Number of regional records (outside of 10 km)^	Number of local records (within 10 km)*	Number of individuals found by Biologic#	Total number of individuals
Conospermum densiflorum subsp. *unicephalatum* (T)	16	0	1,359	≥2,540
Drosera sewelliae (P2)	8	3	6,704	≥6,896
Cyanicula ixioides subsp. *candida* (P2)	7	0	1	≥315
Acacia drummondii subsp. *affinis* (P3)	34	3	116	≥197
Cyanicula ixioides subsp. *ixioides* (P4)	26	2	1	≥267

^Includes WAH records more than 10 km away from Hartog and Baudin targets (excluding the number of local records).
*Includes WAH records provided by DBCA database searches within the 10 km search radius. # This includes both inside and outside of the current Study Area.

Conospermum densiflorum subsp. *unicephalatum* (T)

Conospermum densiflorum subsp. *unicephalatum* (T) is a much-branched shrub growing to 0.6 m high. It's stems, foliage and crowded leaves 3 to 4 cm long, are covered in white, spreading hairs (Brown *et al.*, 1998). It has a singular globular head-like inflorescence held on a leafless scape with cream/ white

and blue flowers from September to November (Brown *et al.*, 1998; WAH, 1998-). It differs from the closely related *Conospermum densiflorum* subsp. *densiflorum* in having a single head of flowers on each flowering stem, rather than several heads forming a compact corymb inflorescence (Brown *et al.*, 1998). *Conospermum densiflorum* subsp. *unicephalatum* (T) grows on clay in low-lying areas as well as in lateritic gravel (Patten & Broun, 2004; WAH, 1998-). This taxon appears to be a disturbance opportunist, as populations have been noted as occurring in areas that have been disturbed for gravel extraction (Brown *et al.*, 1998).

Conospermum densiflorum subsp. *unicephalatum* is listed as Endangered at both the state (BC Act) and federal levels (EPBC Act). There are currently 16 WAH records for this taxon with the closest record being 33.3 km north of the Study Area (WAH, 1998-). This threatened taxon is distributed from Wannamal north to Coomberdale. An additional record also exists within the Moore River National Park vouchered with the NSW Herbarium (ALA, 2021). The total number of individuals for the 16 WAH records is at least 432 (WAH, 1998-). The use of ambiguous terminology like 'frequent' or '50+' for some records, however, makes it difficult to determine an accurate total number of individuals for these locations. At the time of publication, the 2004 interim recovery plan documented a total of 295 adult and 886 juvenile plants (Patten & Broun, 2004). Additional records of *Conospermum densiflorum* subsp. *unicephalatum* may also be available through DBCAs threatened and priority flora database.

A total of 1,358 *Conospermum densiflorum* subsp. *unicephalatum* (T) individuals from 59 point locations were found during the current survey. These records fell within four distinct populations; three were within proposed access routes and the fourth was along a stretch of existing gravel track (Figure 3.1). Each population contained healthy mature individuals, abundant seedlings and juveniles, as well as a number of dead/ senescent mature plant. A portion of plants were in full flower or early flower/ bud, but over half of each population was sterile or with old inflorescence stems and/ or old flowers (Plate 3.1). The populations were often occurring in association with old tracks and it is likely that the high number of seedlings was due to this soil disturbance. *Conospermum densiflorum* subsp. *unicephalatum* generally occurred in shrubland/ heath surrounded by *Eucalyptus marginata* and *Corymbia calophylla* woodland/ forest (Plate 3.2). Associated shrub and understorey species included *Banksia squarrosa* subsp. *squarrosa*, *Adenanthos cygnorum* subsp. *cygnorum*, *Xanthorrhoea preissii*, *Macrozamia riedlei*, *Daviesia* sp., *Calytrix sylvana*, *Styphelia* spp., *Hibbertia hypericoides*, *Banksia dallanneyi* subsp. *sylvestris*, and *Grevillea synaphea* subsp. *synaphea*.

The *Conospermum densiflorum* subsp. *unicephalatum* (T) populations within the Julimar State Forest represent a substantial range extension to the south, especially given the existing restricted distribution for the taxon. An additional record of *Conospermum densiflorum* subsp. *unicephalatum* was found during the previous reconnaissance survey, however only one individual was observed (Biologic, 2021). The current survey has increased the number of known populations and considerably increased the number of individuals to more than 2,500.

Plate 3.1: *Conospermum densiflorum* subsp. *unicephalatum* (T) observed during the field survey (Biologic photos)

Plate 3.2: *Conospermum densiflorum* subsp. *unicephalatum* (T) habitat within the survey area (Biologic photos)

Drosera sewelliae (P2)

Drosera sewelliae (P2) is a small, rosetted carnivorous perennial herb with orange flowers. There are several other pygmy *Drosera* known from the Northern Jarrah Forest subregion, most of which require flowers for confident identification. *Drosera sewelliae* has the largest flowers of the Pygmy Drosera group and is differentiated from closely related species by globose stigmas at the end of each style (Grieve, 1998). It generally occurs on lateritic soils in Jarrah and Marri woodland, (WAH, 1998-). This taxon has eleven herbarium records, all of which are located within 25 km of the Study Area, including two records which occur inside the Hartog target (WAH, 1998-).

A total of 5,153 *Drosera sewelliae* (P2) individuals from 321 point locations were found during the current survey (Figure 3.1). Most individuals recorded during the survey were sterile, although a small number of flowering plants were observed and confirmed via photos. Photos clearly show the five globose stigmas that characterise this taxon (Plate 3.3). It is highly likely that all records found are *Drosera sewelliae* (P2). Suitable habitat for this taxon was on sandy loams or sands with lateritic pebbles and occasionally in areas with lateritic outcropping. Preferred topography was undulating low hills, flats, slopes, and plateaus; no individuals were recorded from drainage lines, clay or granite outcropping. *Drosera sewelliae* (P2) was more common north of Julimar road where repeated prescribed burns had created open habitat with much reduced leaf litter. Some individuals had a diameter of less than 5 mm and were well camouflaged by the backdrop of similarly sized pebbles, however they usually occurred alongside larger individuals which were more readily observable. *Drosera sewelliae* (P2) occurred in *Eucalyptus marginata* and *Corymbia calophylla* woodland/ open forest with associated understorey species *Banksia squarrosa* subsp. *squarrosa*, *Adenanthos cygnorum* subsp. *cygnorum*, *Xanthorrhoea preissii* and *Macrozamia riedlei*.

Drosera sewelliae (P2) was very common in the Study Area and throughout the broader Hartog area. The eleven WAH records for this taxon comprise of at least 192 individuals; therefore along with the 1,551 individuals found as part of the Biologic (2021) reconnaissance survey, the total number of known individuals is now close to 7,000. Given the high numbers of individuals found and the widespread suitable habitat, it is likely that many more individuals exist throughout the Julimar State Forest. Preliminary information collected from additional surveys to the north of Hartog and Baudin suggests individuals extend well to the north within the State Forest.

Plate 3.3: *Drosera sewelliae* (P2) observed during the field survey (Biologic photo)

***Cyanicula ixioides* subsp. *candida* (P2)**

Cyanicula ixioides subsp. *candida* (P2) is a tuberous perennial orchid between 0.04 – 0.12 m high. It has a single basal leaf measuring 2-3 cm by 15-20 mm (Hoffman *et al.*, 2019). It produces pure white flowers between late August to October and is stimulated into flowering by summer fire (Hoffman *et al.*, 2019; WAH, 1998-). This orchid grows in mixed Jarrah and Wandoo forest in sand, laterite and gravel (Hoffman *et al.*, 2019; WAH, 1998-). The WAH currently holds seven specimens for this taxon, most of which are located between Bindoon and Mundaring State Forest. One of the WAH records is further south near Kojonup, as well as additional unverified ALA records around Williams and the Stirling Ranges (ALA, 2021; WAH, 1998-). DBCA only supplied significant flora records within 10 km for the Hartog reconnaissance survey and as the nearest record of *Cyanicula ixioides* subsp. *candida* (P2) is approximately 13.7 km northwest, it was not identified by the desktop assessment.

One *Cyanicula ixioides* subsp. *candida* (P2) individual was recorded during the targeted field survey (Figure 3.1). A thorough search was conducted surrounding this individual but no other flowering individuals or basal leaves were found. DoE (2014) survey guidelines for orchids recommend specimens only be taken if enough individuals are found, and as such, no specimen was taken for this location. Photos were taken to verify the identification (Plate 3.4). The individual was half closed at the time as is common with many orchid species. The leaf, indumentum, size and flower colour/ shape match the taxon, although photos will be further verified by an orchid taxonomist. *Cyanicula ixioides* subsp. *candida* (P2) was found south of Julimar road in open wandoo-marri-jarrah woodland over tall closed shrubland of *Banksia squarrosa* subsp. *squarrosa* and *Banksia sessilis* over low shrubland of *Hibbertia hypericoides*.

Plate 3.4: *Cyanicula ixioides* subsp. *candida* (P2) observed during the field survey (Biologic photos)

***Acacia drummondii* subsp. *affinis* (P3)**

Acacia drummondii subsp. *affinis* (P3) is an erect shrub growing between 0.1 – 1 m in height (WAH, 1998-). It is differentiated from other subspecies by its' recurved to revolute pinnules covered in pubescent hairs (DBCA, 2020). *Acacia drummondii* subsp. *affinis* (P3) grows in laterite or sand over laterite, in jarrah (*Eucalyptus marginata*), jarrah-marri (*E. marginata* - *Corymbia calophylla*) and sometimes wandoo (*E. wandoo*) forest and woodland (DBCA, 2020). There are 37 specimens held at the WAH for this taxon, with most records distributed around Julimar State Forest and north towards Mogumber (WAH, 1998-). The closest known record to the Study Area is approximately 7.0 km northwest of the Baudin target.

A total of 116 *Acacia drummondii* subsp. *affinis* (P3) individuals from 32 point-locations were found during the current survey (Figure 3.1). Most individuals recorded were juveniles and the majority were not in flower. The specimen collected from the Study Area was flowering and had a cylindrical inflorescence typical for the taxon (Plate 3.5). Individuals were located in six of the proposed drill areas and were mainly scattered in small numbers (< 5). One drill area had been affected by recent fire which may have assisted in seedling recruitment; this location contained a total of 65 individuals many of which were juveniles. *Acacia drummondii* subsp. *affinis* (P3) was found growing on undulating low hills, slopes and flats in brown sandy loam with lateritic pebbles and occasional outcropping. Surrounding vegetation was jarrah-marri (*Eucalyptus marginata*/ *Corymbia calophylla*) or wandoo-jarrah (*Eucalyptus wandoo*/ *Eucalyptus marginata*) woodland over open shrubland of various associated species including *Hakea undulata*, *Xanthorrhoea preissii* and *Hibbertia hypericoides*.

Plate 3.5: *Acacia drummondii* subsp. *affinis* (P3) observed during the field survey (Biologic photo)

***Cyanicula ixioides* subsp. *ixioides* (P4)**

Cyanicula ixioides subsp. *ixioides* (P4) is a tuberous perennial orchid between 0.05-0.15 m in height. It has a broad and hairy basal leaf 3-4 cm by 2 cm (Hoffman *et al.*, 2019). It produces yellow flowers between August and October, however it only flowers subsequent to summer fires (Hoffman *et al.*, 2019; WAH, 1998-). This taxon occurs in lateritic soils in jarrah-marri or wandoo open woodland (WAH, 1998-). Twenty-eight specimens are held at the WAH, most of which are located between Gidgegannup, Toodyay and York. Two records exist within the Julimar State Forest, the closest being approximately 1 km southeast of the Baudin proposed drill pad.

One *Cyanicula ixioides* subsp. *ixioides* (P4) individual was recorded during the targeted field survey (Figure 3.1). A thorough search was conducted surrounding this individual but no other flowering individuals or basal leaves were found. DoE (2014) survey guidelines for orchids recommend specimens only be taken if enough individuals are found, and as such, no specimen was taken for this location. Photos were taken to verify the identification (Plate 3.6). *Cyanicula ixioides* subsp. *ixioides* (P4) was found on a lower slope in brown lateritic loam within open jarrah-marri woodland.

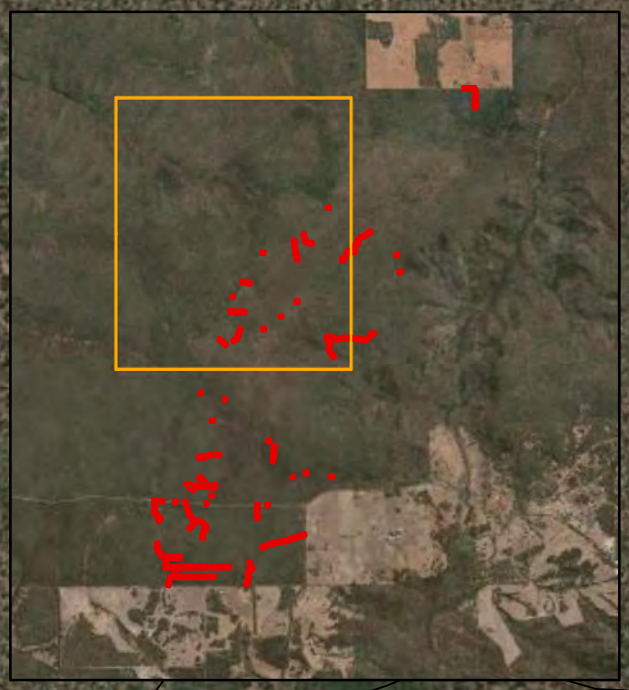
Plate 3.6: *Cyanicula ixioides* subsp. *ixioides* (P4) observed during the field survey (Biologic photos)

426000

428000

6520000

6518000



Legend

Study Area

Local Road

Taxon

Conospermum densiflorum subsp. *unicephalatum* - T

Drosera sewelliae - P2

Acacia drummondii subsp. *affinis* - P3

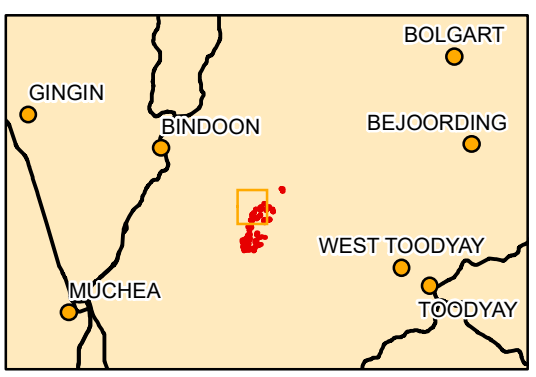
0 250 500 Meters

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 08/10/2021

N

biologic Environmental Survey

Scale: 1:14,000



CHALICE MINING LTD

Hartog and Baudin targets - Chalice Julimar Project. Targeted Flora Survey

Figure 4.1a: Significant flora observed in the Study Area

428000

430000

6520000

6518000

Legend

Study Area

Local Road

Taxon

Conospermum densiflorum subsp. *unicephalatum* - T

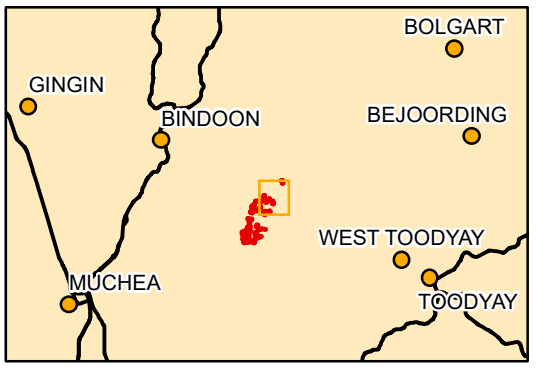
Drosera sewelliae - P2

Acacia drummondii subsp. *affinis* - P3

Cyanicula ixioides subsp. *ixioides* - P4

0 250 500 Meters

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 08/10/2021



N

biologic Environmental Survey

Scale: 1:14,000

CHALICE MINING LTD

Hartog and Baudin targets - Chalice Julimar Project. Targeted Flora Survey

Figure 4.1b: Significant flora observed in the Study Area

426000

428000

6516000

6514000

Julimar Rd

Plunkett Rd

Legend

Study Area

Local Road

Taxon

- *Conospermum densiflorum* subsp. *unicephalatum* - T
- *Cyanicula ixioides* subsp. *candida* - P2
- *Drosera sewelliae* - P2
- *Acacia drummondii* subsp. *affinis* - P3

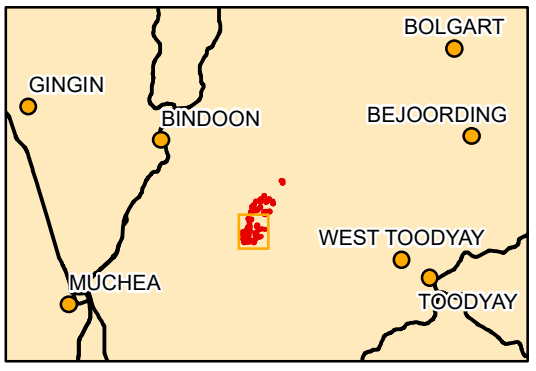
0 250 500 Meters

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 08/10/2021

N

biologic Environmental Survey

Scale: 1:14,000



CHALICE MINING LTD

Hartog and Baudin targets - Chalice Julimar Project. Targeted Flora Survey

Figure 4.1c: Significant flora observed in the Study Area

3.3 Review of Likelihood of Occurrence

Likelihood rankings for each target species were reviewed to assess the post-survey likelihood that they may still occur within the current Study Area (proposed drill sites) (Appendix A). The likelihood of occurrence for most of the target species was downgraded for the following reasons:

- Taxon was flowering at time of survey;
- Taxon was a perennial herb or shrub that would have been observable and identifiable without flowers or fruit; and/or
- Lack of suitable habitat within the Study Area

Two target taxa remain Possible to occur within the Study Area; *Millotia tenuifolia* var. *laevis* (P2) and *Verticordia citrella* (P2). A potential *Millotia* was found throughout several sections of the Study Area, however the flowers were too immature for identification and a specimen was not collected. The individuals observed may represent *Millotia tenuifolia* var. *laevis* (P2). This taxon appears to be distributed more closely to the Study Area than the other two *Millotia* species known from the Northern Jarrah Forest. The individuals observed may also potentially be a similar genus within the Asteraceae (daisy) family. A *Verticordia* specimen taken during the reconnaissance survey was unable to be identified due to lack of flowering material but shared affinities with *Verticordia citrella* (P2) (Biologic, 2021). This record was located within one of the drill sites south of Julimar Road. *Verticordia citrella* (P2) flowers from October to November (WAH, 1998-) and therefore would not have been flowering and identifiable at the time of the targeted survey.

Thelymitra stellata (T) does not flower during September and if present would have been an underground tuber and therefore not visible. Suitable habitat occurred in the Study Area for this taxon; however, most populations of *T. stellata* occur around Eneabba or Kelmscott, over 70 km away. Although there is a TPFL record approximately 8 km east of the Study Area, all but one WAH records are from further west on the Swan Coastal Plain or Lesueur Sandplain. Given this distribution, *T. stellata*'s likelihood of occurrence has been downgraded to Unlikely.

It should be noted that the review of likelihood was made only for the current Study Area and that the target species as well as other significant species may still be present throughout other areas of the Hartog and Baudin targets. Reasoning behind the change in likelihood for each target species is detailed in Appendix A.

4 CONCLUSION

A targeted flora and vegetation assessment was carried out from 7 – 10 September 2021 with the entire Study Area (all 72 proposed drill sites and access routes) being intensively traversed.

A total of five threatened and priority flora taxa were found within the Study Area:

- 1,358 individuals from 59 point locations of *Conospermum densiflorum* subsp. *unicephalatum* (T);
- 5,153 individuals from 321 point locations of *Drosera sewelliae* (P2);
- 116 individuals from 32 point locations of *Acacia drummondii* subsp. *affinis* (P3);
- One individual of *Cyanicula ixioides* subsp. *candida* (P2); and
- One individual of *Cyanicula ixioides* subsp. *ixioides* (P4).

The *Conospermum densiflorum* subsp. *unicephalatum* (T) populations found by Biologic within the Julimar State Forest represent a substantial range extension to the south. The current survey has increased the number of known populations and considerably increased the number of individuals to more than 2,500.

It is possible that two taxa that were targeted during the field survey, *Verticordia citrella* (P2) and *Millotia tenuifolia* var. *laevis* (P2), are present within the Study Area, due to the survey not being timed during their flowering period.

5 REFERENCES

ALA, Atlas of Living Australia. (2021). Atlas of Living Australia; Occurrence search (custom search). from ALA, Atlas of Living Australia http://www.ala.org.au/

Biologic. (2020). *Julimar exploration project: reconnaissance and targeted flora survey*.

Biologic. (2021). *Julimar exploration project reconnaissance and targeted flora survey*.

BoM, Bureau of Meteorology. (2021). Climate Data Online. Retrieved 2021, from Bureau of Meteorology http://www.bom.gov.au./climate/data/index.shtml

Brown, A., Thomson-Dans, C., & Marchant, N. (1998). *Westerm Australia's threatened flora*. Como, Western Australia: Department of Conservation and Land Management.

DBCA. (2020). Wattle: *Acacias* of Australia. Retrieved from https://apps.lucidcentral.org/wattle/text/intro/index.html

DBCA. (2021). Threatened and Priority Flora Database (custom search). Retrieved 2021, from Department of Biodiversity, Conservation and Attractions http://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/threatened-animals

DoE, Department of the Environment. (2014). *Draft Survey Guidelines for Australia's threatened orchids. Guidelines for detecting orchids listed as 'Threatened' under the Environment Protection and Biodiversity Conservation Act 1999*. Canberra: DoE,, Department of the Environment.

EPA. (2016a). *Environmental Factor Guideline: Flora and Vegetation*. Perth, Western Australia: Environmental Protection Authority.

EPA. (2016b). *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment*. Perth, Western Australia: Environmental Protection Authority.

Grieve, B. J. (1998). *How to know Western Australian wildflowers, a key to the extratropical regions of Western Australia, Part II* (2nd ed.). Nedlands: University of Western Australia Press.

Hoffman, N., Brown, A., & Brown, J. (2019). *Orchids of south-west Australia*. Nedlands: University of Western Australia Press.

Mattiske. (2019). *Assessment of potential flora, vegetation and fauna values - Julimar Project, Bindoon, WA*. Kalamunda, WA:

Patten, J., & Broun, G. (2004). *One-headed smokebush (COnospermum densiflorum subsp. unicephalatum): Interim recovery plan 2004-2009*. Wanneroo:

WAH, Western Australian Herbarium. (1998-). FloraBase-the Western Australian Flora. Retrieved January 2020, from WAH,, Western Australian Herbarium https://florabase.dpaw.wa.gov.au/

Western Australian Herbarium. (1998–). FloraBase—the Western Australian Flora. Retrieved from https://florabase.dpaw.wa.gov.au/

Williams, K., & Mitchell, D. (2001). *Jarrah Forest 1 (JF1 - Northern Jarrah Forest subregion)*.

Appendix A: Pre and post-field likelihood assessment

Taxon	Habit and habitat	Distance to nearest record	Reconnaissance survey likelihood (pre-survey)	Targeted survey likelihood (pre-survey)	Notes	Targeted survey likelihood (post-survey) within Study Area	Reasoning
Drosera sewelliae (P2)	Fibrous-rooted, rosetted perennial, herb, to 0.06 m high, to 0.025 m wide. Fl. orange, Oct. Laterite & silica sand soils.	Within	Confirmed	Confirmed within Study Area	Recorded during the reconnaissance survey. One DBCA record for this taxon occurs within one of the proposed drill sites, as well as several locations recorded within the Hartog and Baudin targets.	Confirmed within Study Area	n/a
Conospermum densiflorum subsp. *unicephalatum* (T)	Erect, much-branched shrub, 0.3-0.6 m high, inflorescence a spike. Fl. cream/white & blue, Sep to Nov. Clay soils. Low-lying areas.	Within	Unlikely	Confirmed within Hartog target	One location recorded during the reconnaissance survey.	Confirmed within Study Area	n/a
Beaufortia eriocephala (P3)	Erect, compact shrub, 0.3-0.6 m high. Fl. red, Sep to Nov. Lateritic sandy soils. Slopes.	Within	Not identified	Confirmed within Hartog target	One location recorded during the reconnaissance survey.	Unlikely	Taxon is a perennial shrub which would've been flowering at the time of survey.
Lasiopetalum caroliae (P3)	Low shrub, to 0.3 m high. Fl. pink/purple, Sep to Oct. Brown sandy loam clay over laterite. Slopes, drainage lines, hilltops, outcrops.	Within	Possible	Confirmed within Hartog target	Two locations recorded during the reconnaissance survey.	Unlikely	Taxon is a perennial shrub which would've been flowering at the time of survey.
Persoonia sulcata (P4)	Erect, spreading to decumbent shrub, 0.2-1 m high. Fl. yellow, Sep to Nov. Lateritic or granitic soils.	Within	Confirmed	Confirmed within Hartog target	One DBCA record - ground-truthed during reconnaissance survey and not recorded.	Unlikely	Taxon is a perennial shrub which would've been flowering at the time of survey.
Synaphea grandis (P4)	Tufted shrub, ca 0.3 m high. Fl. yellow, Oct to Nov. Laterite.	Within	Confirmed	Confirmed within Hartog target	Two DBCA records - ground-truthed during reconnaissance survey and not recorded.	Unlikely	This taxon does not flower in September so would've been less observable. None of the *Synaphea* observed during the field survey matched the description or herbarium specimen for this taxon. Likelihood has been downgraded to Unlikely due to the adequate coverage of the Study Area.
Verticordia citrella (P2)	Erect, slender shrub, 0.3-1 m high. Fl. yellow, Oct to Nov. Gravelly loam or sand. Low-lying damp areas, swamps.	8.7 km SE	Possible	Likely	*Verticordia* sp. indet collected during reconnaissance survey has the potential to be this taxon. This specimen was found within one of the proposed drill sites.	Possible	This taxon does not flower in September so would've been less observable. No *Verticordia* were observed flowering within the Study Area.
Thelymitra stellata (T)	Tuberous, perennial, herb, 0.15-0.25 m high. Fl. yellow & brown, Oct to Nov. Sand, gravel, lateritic loam.	8.3 km E	Possible	Possible	Taxon is either annual, small or inconspicuous. Suitable habitat found during reconnaissance survey.	Unlikely	This taxon does not flower during September, however most WAH records are further west in different bioregions and thus likelihood was downgraded to Unlikely.
Androcalva fragifolia (P1)	Prostrate shrub 5cm high up to 3m wide, with hairy stems. Fl. White-pink, Oct to Feb. Laterite, loamy sand or sandy clay on flats, slopes, road verges.	14.7 km NNE	Possible	Possible		Unlikely	Taxon is a perennial shrub which would've been observed if present.
Conostylis caricina subsp. *elachys* (P1)	Rhizomatous, tufted perennial, grass-like or herb, 0.05-0.1 m high. Fl. cream-yellow, Jul to Aug. Gravel, clayey loam, sand. Found in heathland with mallee *Eucalyptus drummondii*, wandoo woodland.	11.2 km NNE	Possible	Possible		Unlikely	Taxon does not flower in September, however there was no suitable habitat present
Stylidium vinosum (P1)	Perennial herb, 0.08-0.2 m high. Fl. white with pink/red throat markings, Sept-Nov. Grey/white sands over laterite. Slopes, flats.	3.5 km E	Possible	Possible		Unlikely	Taxon flowers in September, however none of the flowering *Stylidium* were considered analogous to this taxon.
Millotia tenuifolia var. *laevis* (P2)	Ascending to erect annual, herb, 0.02-0.1 m high. Fl. yellow, Sep to Oct. Granite or laterite soils.	10.7 km NW	Possible	Possible		Possible	?*Millotia* sp. was present but flowers were too immature for identification.

Taxon	Habit and habitat	Distance to nearest record	Reconnaissance survey likelihood (pre-survey)	Targeted survey likelihood (pre-survey)	Notes	Targeted survey likelihood (post-survey) within Study Area	Reasoning
Synaphea rangiferops (P2)	Shrub, ca 0.3 m high. Fl. yellow, Jul to Sep. Sandy loam, gravel.	13.7 km NW	Possible	Possible		Unlikely	Taxon is a perennial shrub which would've been observed if present.
Johnsonia inconspicua (P3)	Rhizomatous, tufted perennial, grass-like or herb, 0.1-0.3 m high, to 0.2 m wide. Fl. green-white/pink, Oct to Nov. White-grey or black sand. Low dunes, winter-wet flats.	3.4 km N	Possible	Possible		Highly Unlikely	No suitable habitat.
Tetratheca pilifera (P3)	Spreading shrub, 0.1-0.3 m high. Fl. purple, Aug to Oct. Gravelly soils.	3.4 km NE	Possible	Possible		Unlikely	Taxon is a perennial shrub which would've been flowering at the time of survey.
Chorizema ulotropis (P4)	Sprawling, open, semi-prostrate shrub, to 0.45 m high. Fl. orange-yellow, Jul to Sep. Moist to dry soils, white sand with gravel, laterite, granite. Outcrops, winter damp to dry areas, flats.	13.7 km NE	Possible	Possible		Unlikely	Taxon is a perennial shrub which would've been flowering at the time of survey.
Cyanicula ixioides subsp. *ixioides* (P4)	Tuberous, perennial, herb, 0.05-0.15 m high. Fl. yellow, Aug to Oct. Laterite, gravel.	3.2 km ENE	Possible	Possible		Confirmed within Study Area	n/a
Oxymyrrhine coronata (P4)	Erect, open shrub, 0.7-1.5 m high. Fl. pink/white, Dec. Brown/yellow gravel over laterite. Slopes, hilltops, flats.	1.4 km N	Highly Likely	Possible		Unlikely	Taxon is a large perennial shrub which would've been observed if present.
Grevillea bracteosa subsp. *bracteosa* (T)	Spindly shrub, 1-2 m high. Fl. Green or pink, Aug to Oct. Hilltops, flats, slopes, laterite clay-loam soils.	11.9 km NE	Possible	Unlikely	Taxon is a medium-large/ conspicuous shrub. Suitable habitat was found during reconnaissance survey.	Highly Unlikely	Taxon is a perennial shrub which would've been flowering at the time of survey.
Grevillea corrugata (T)	Shrub, 1.5-2.5 m high. Fl. white, Aug to Sep. Gravelly loam. Roadsides.	6.7 km W	Possible	Unlikely		Highly Unlikely	Taxon is a perennial shrub which would've been flowering at the time of survey.
Gastrolobium crispatum (P1)	Tall shrub, to 2.5 m high. Fl. yellow&orange&red, Sep to Oct. Yellow or brown sandy loam, red laterite soils. Steep gullies, slopes, ridges, breakaways.	5.1 km W	Possible	Unlikely		Highly Unlikely	Taxon is a perennial shrub which would've been flowering at the time of survey, marginal habitat.
Lechenaultia magnifica (P1)	Erect perennial, herb or shrub (subshrub), to 0.6 m high. Fl. White or blue, November. Brown, grey, yellow or white sand, brown sandy loam, laterite. Slopes and flats.	14.1 km NE	Possible	Unlikely		Unlikely	Taxon is a perennial shrub which is inconspicuous without flowers, likelihood remains unchanged.
Acacia browniana var. *glaucescens* (P2)	Multi-stemmed shrub, 0.2-0.5 m high, spreading by subterranean runners. Fl. yellow, Aug. Lateritic gravelly soils.	2.8 km ENE	Possible	Unlikely		Highly Unlikely	Taxon is a perennial shrub which would've been observed if present.
Gastrolobium nudum (P2)	Spreading, twiggy shrub, to 0.8 m high. Fl. orange&red, Feb. Red-brown clay, brown loam, gravel, laterite, granite. Flats, slopes, hilltops, ridges, valleys, breakaways.	10.0 km SSE	Possible	Unlikely		Highly Unlikely	Taxon is a perennial shrub which would've been observed if present.
Acacia drummondii subsp. *affinis* (P3)	Erect shrub, 0.3-1 m high. Fl. yellow, Jul to Aug. Lateritic gravelly soils.	7.0 km NW	Possible	Unlikely		Confirmed within Study Area	n/a
Acacia pulchella var. reflexa acuminate bracteole variant (R.J. Cumming 882) (P3)	Shrub, 0.3-1 m high. Fl. yellow, Jul to Sep. Sandy loam or sandy clay over laterite. Woodland.	12.5 km W	Possible	Unlikely		Highly Unlikely	Taxon is a perennial shrub which would've been observed if present.
Adenanthos cygnorum subsp. *chamaephyton* (P3)	Prostrate, mat-forming, non-lignotuberous shrub, to 0.3 m high. Fl. white-cream-pink-green/green, Jul or Sep to Dec or Jan. Grey sand, lateritic gravel.	11.3 km NE	Possible	Unlikely		Highly Unlikely	Taxon is a perennial shrub which would've been observed if present. This subspecies is easily distinguishable from the more common subspecies which was present in the Study Area.
Verticordia huegelii var. *tridens* (P3)	Shrub, 0.15-0.6 m high. Fl. green-yellow/red, Sep to Nov. Sandy or gravelly loam. Winter-wet areas, low hills.	14.6 km NNE	Possible	Unlikely		Highly Unlikely	Taxon is a perennial shrub which would've been flowering at the time of survey, marginal habitat.
Verticordia serrata var. *linearis* (P3)	Shrub, to 1 m high. Fl. other, Sep to Oct. White sand, gravel. Open woodland.	13.7 km SW	Possible	Unlikely		Highly Unlikely	Taxon is a perennial shrub which would've been flowering at the time of survey.

Taxon	Habit and habitat	Distance to nearest record	Reconnaissance survey likelihood (pre-survey)	Targeted survey likelihood (pre-survey)	Notes	Targeted survey likelihood (post-survey) within Study Area	Reasoning
Calothamnus pachystachyus (P4)	Erect, much-branched, often straggly shrub, (0.3-) 0.6-1.7 m high. Fl. red-brown-black, Aug to Oct. Lateritic soils, often gravelly. Ridges, road verges.	16.7 km NNE	Possible	Unlikely		Highly Unlikely	Taxon is a perennial shrub which would've been flowering at the time of survey.
Hemigenia platyphylla (P4)	Spreading shrub, 0.2-1.5 m high. Fl. blue-purple, Sep to Nov. Sandy & loamy soils. Granite rocks, slopes.	18.1 km NNE	Possible	Unlikely		Highly Unlikely	Taxon is a perennial shrub which would've been flowering at the time of survey.
Hibbertia miniata (P4)	Decumbent or erect shrub, 0.1-1 m high. Fl. orange/orange-red, Aug to Nov. Lateritic gravelly soils.	6.0 km E	Possible	Unlikely	Taxon is a medium-large shrub. Suitable habitat was found during reconnaissance survey.	Highly Unlikely	Taxon is a perennial shrub which would've been flowering at the time of survey.
Schoenus natans (P4)	Aquatic annual, grass-like or herb (sedge), 0.3 m high. Fl. brown, Oct. Winter-wet depressions.	0.6 km W	Highly Likely	Unlikely	Suitable habitat was found during reconnaissance survey (vegetation type W1); however this vegetation type does not occur within any of the proposed drill sites.	Highly Unlikely	No suitable habitat.
Schoenus capillifolius (P3)	Semi-aquatic tufted annual, grass-like or herb (sedge), 0.05 m high. Fl. green, Oct to Nov. Brown mud. Claypans.	11.6 km N	Possible	Unlikely		Highly Unlikely	No suitable habitat.
Stylidium longitubum (P4)	Erect annual (ephemeral), herb, 0.05-0.12 m high. Fl. pink, Oct to Dec. Sandy clay, clay. Seasonal wetlands.	10.9 km N	Possible	Unlikely		Highly Unlikely	No suitable habitat.
Grevillea curviloba (T)	Prostrate to erect shrub, 0.1-2.5 m high. Fl. white-cream, Aug to Oct. Grey sand, sandy loam. Winter-wet heath.	14.1 km E	Possible	Highly Unlikely	No suitable habitat present (winter-wet heath).	Highly Unlikely	No suitable habitat.
Eleocharis keigheryi (T)	Rhizomatous, clumped perennial, grass-like or herb (sedge), to 0.4 m high. Fl. green, Aug to Nov. Clay, sandy loam. Emergent in freshwater: creeks, claypans.	11.0 km N	Possible	Highly Unlikely	No surface water present.	Highly Unlikely	No suitable habitat.
Hydrocotyle lemnoides (P4)	Aquatic, floating annual, herb. Fl. purple, Aug to Oct. Swamps.	11.1 km N	Possible	Highly Unlikely		Highly Unlikely	No suitable habitat.
Cyanicula ixioides subsp. *candida* (P2)	Tuberous, perennial, herb, 0.04-0.12 m high. Fl. white, Aug to Oct. Sand, laterite, gravel.	13.7 km NW	Not identified	n/a	n/a	Confirmed within Study Area	n/a

Appendix 5 Basic and Targeted Vertebrate Fauna Survey (Western Wildlife 2021)

Julimar Nickel-Copper PGE Project: Hartog and Baudin Exploration Targets

Basic Vertebrate Fauna Survey and Targeted Mammal Survey 2021



Prepared for: Chalice Gold Mines Limited

Prepared by: Western Wildlife
8 Ridgeway Pl
Mahogany Creek WA 6072
Ph: 0427 510 934

June 2021

Executive Summary

Introduction

Chalice Gold Mines Limited (CGML) propose to conduct exploration drilling in the Hartog and Baudin's Exploration Targets at their Julimar Nickel-Copper PGE Project (Julimar Project). As these areas are located in Julimar State Forest, CGML commissioned Western Wildlife to carry out a basic vertebrate fauna survey and targeted conservation significant mammal survey of a study area that encompassed the two exploration target areas.

Methods

The fauna survey was undertaken in accordance with *Technical guidance: terrestrial vertebrate fauna surveys for environmental impact assessment* (EPA 2020) and relevant State and Federal Guidelines on surveying conservation significant fauna.

The field survey was carried out on the 14th April - 17th May 2021, and included:

- Fauna habitat identification.
- Camera trapping for conservation significant mammals at 20 sites.
- 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

Three fauna habitats were identified: Jarrah – Marri woodland, Wandoo woodland and Creek. The habitats in the study area are common in the Northern Jarrah Forest IBRA subregion. The key importance of the habitats present is twofold. Firstly, the study areas are part of Julimar State Forest, a large area of remnant native vegetation that has value in supporting a relatively intact ecosystem. Large habitat areas are less vulnerable to the impacts of habitat fragmentation and increase the likelihood of faunal populations persisting in the long-term. Secondly, the habitats provide 'habitat critical to the survival' of at least four EPBC Act-listed Threatened species.

The predicted faunal assemblage includes up to 16 frogs, 54 reptiles, 99 birds and 31 mammals (25 native and six introduced). The observed faunal assemblage included one frog, three reptiles, 39 birds and 12 mammals (eight native and four introduced), and this is unlikely to be complete. The faunal assemblage is likely to relatively intact and typical of woodlands in the region. A total of 15 vertebrate fauna species of conservation significance have the potential to occur in the study area:

Threatened species

Six threatened species potentially occur in the Study Area, of which two were recorded:

- Forest Red-tailed Black-cockatoo (*Calyptorhynchus latirostris banksii*) – EPBC Act (Vulnerable), BC Act (Vulnerable) - **Recorded**
- Carnaby's Black-cockatoo (*Calyptorhynchus latirostris*) – EPBC Act (Endangered), BC Act (Endangered) - **Recorded**
- Baudin's Black-cockatoo (*Calyptorhynchus baudinii*) – EPBC Act (Vulnerable), BC Act (Vulnerable)
- Chuditch (*Dasyurus geoffroii*) – EPBC Act (Vulnerable), BC Act (Vulnerable) – **Recorded**
- Woylie – EPBC Act (Endangered), BC Act (Critically Endangered) – **Recorded**
- Black-flanked Rocky-wallaby (*Petrogale lateralis lateralis*) – EPBC Act (Endangered), BC Act (Endangered)

All three black-cockatoo species are likely to be foraging visitors to the study area, with foraging by Carnaby's Cockatoo and the Forest Red-tailed Black-cockatoo recorded. Baudin's Cockatoo is on the northern limit of its range in the area and is likely to be an occasional visitor only. The woodlands represent high value foraging habitat as they contain favoured cockatoo food-plants such as Marri. The foraging habitat is likely to be important for supporting breeding birds. Both Carnaby's Cockatoo and the Forest Red-tailed Black-cockatoo are known to breed in the subregion, and potentially breed in the study area.

The Chuditch and Woylie were recorded in the study area and are likely to be breeding residents. The Black-flanked Rock-wallaby may disperse though the study area, although the likelihood is low as the habitats of the study area are unsuitable for this species.

Migratory species

One Migratory species potentially occurs in the study area:

- Fork-tailed Swift (*Apus pacificus*) – EPBC Act (Migratory), BC Act (Migratory)

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

Two Specially Protected species potentially occur in the study area:

- Peregrine Falcon (*Falco peregrinus*) – BC Act (Other Specially Protected)
- Brush-tailed Phascogale (*Phascogale tapoatafa*) – BC Act (Conservation Dependent)

The Peregrine Falcon is likely to occur as a foraging visitor, but the study area is unlikely to be important for this species as its population is large and secure, and its favoured breeding habitat is absent. The Brush-tailed Phascogale has been recorded at Julimar in the past and is likely to occur in all habitats.

Priority species

Five Priority species potentially occur in the study area, of which one was recorded:

- Dell's Ctenotus (*Ctenotus delli*) – Priority 4
- Barking Owl, southern (*Ninox connivens connivens*) – Priority 3
- Quenda (*Isoodon fusciventer*) – Priority 4
- Western Brush Wallaby (*Notamacropus irma*) – Priority 4 – **Recorded**
- Tammar Wallaby (*Notamacropus eugenii derbianus*) – Priority 4 – **Recorded**

The Western Brush Wallaby and Tammar Wallaby were recorded in the study area and are likely to be breeding residents using all habitats. Although not recorded on this survey, the Quenda is regularly recorded at Julimar and is likely to be a breeding resident favouring the creek habitat and woodland areas with dense understory. Dell's Ctenotus is likely to occur in the Jarrah – Marri woodland, as it is known to occur nearby. The Barking Owl is uncommonly recorded, but the habitats of the study area are suitable for this species.

Locally significant species

One locally significant species is likely to occur: the Carpet Python (*Morelia spilota imbricata*).

Invertebrates

This report is primarily concerned with vertebrate fauna, however, four invertebrates of conservation significance are known to occur in the vicinity of the study area. Of these, Carter's Freshwater Mussel (*Westralunio carteri*) and the Mortlock River Shield-backed Trapdoor Spider (*Idiosoma schoknechtorum*) are unlikely to occur. Two other spiders potentially occur in the Jarrah – Marri woodland with native understory: the Julimar Shield-backed Trapdoor Spider (*Idiosoma mcclementsorum*) and Inornate Trapdoor Spider (*Euoplos inornatus*).

Conclusion

The habitats of the study areas are likely to support a relatively intact faunal assemblage of up to 16 frogs, 54 reptiles, 99 birds and 31 mammals (25 native and six introduced). Up to 15 conservation significant vertebrate fauna of which six were recorded on this survey. Up to four conservation significant invertebrate fauna potentially occur. The key value of the fauna habitats are as a part of a large are of remnant native vegetation that supports a relatively intact ecosystem and their value as habitat to conservation significant fauna. The habitats of the study area provide habitat critical to the survival of at least four EPBC Act-listed Threatened species: the Woylie, Chuditch, Carnaby's Cockatoo and Forest Red-tailed Black-cockatoo. Critical habitat is essential to the long-term survival and recovery of a species.

Table of Contents

Executive Summary ..... **i**
1. Introduction **1**

1.1 The Study Area **1**
1.2 Regional Context **1**

1.2.1. Interim Biogeographic Regionalisation for Australia (IBRA) Region 3
1.2.2 Land Systems 3
1.2.3 Climate and Weather 3

2. Methods **6**

2.1 Overview **6**
2.2 Guidance Documents and Licencing **6**
2.3 Personnel **6**
2.4 Taxonomy and Nomenclature **6**
2.5 Habitat Mapping **7**
2.6 Literature Review **7**
2.7 Field Studies **7**

2.7.1 Basic Fauna Survey 7
2.7.2 Habitat Assessment 9
2.7.3 Targeted Conservation Significant Mammal Survey 11

2.8 Assessment of Conservation Significance **13**

2.8.1 Legislative Protection for Fauna 13
2.8.2 Levels of Conservation Significance in this Report 15

2.9 Likelihood of Occurrence **16**

3. Survey Limitations **16**
4. Fauna Habitats of the Study Area **18**

4.1 Jarrah – Marri Woodland **20**
4.2 Wandoo Woodland **22**
4.3 Creek **24**

5. Vertebrate Fauna of the Study Area **26**

5.1 Vertebrate Fauna Assemblage **26**

5.1.1 Amphibians 26
5.1.2 Reptiles 27
5.1.3 Birds 27
5.1.4 Mammals 27

5.2 Vertebrate Fauna of Conservation Significance **29**

5.2.1 Threatened Fauna 35
5.2.2 Migratory Fauna 41
5.2.3 Specially Protected Fauna 42
5.2.4 Priority Fauna 43
5.2.5 Locally Significant Fauna 45

5.3 Invertebrates of Conservation Significance 46

5.3.1 Threatened Invertebrates 46
5.3.2 Priority Invertebrates 46

6. Discussion 49

6.1 Vertebrate Fauna Assemblage 49
6.2 Conservation Significant Vertebrate Fauna 49
6.3 Conservation Significant Invertebrate Fauna 51
6.4 Important Habitats 51
6.5 Conclusion 52

7. References 53

Appendix 1. Habitat Assessment Sites. 56
Appendix 2. Frogs that Potentially Occur in the Study Area. 68
Appendix 3. Reptiles that Potentially Occur in the Study Area. 69
Appendix 4. Birds that Potentially Occur in the Study Area. 71
Appendix 5. Mammals that Potentially Occur in the Study Area. 75
Appendix 6. EPBC Protected Matters Search Tool Results. 77
Appendix 7. Fauna Recorded in the Study Area April - May 2021. 78

Tables, Figures & Plates

Table 1. Weather During the Field Survey (Pearce RAAF). 5
Table 2. Databases Used in the Preparation of this Report. 8
Table 3. Camera Trap Locations and Habitat. 11
Table 4. Fauna Survey Limitations. 17
Table 5. Fauna Habitats. 18
Table 6. Summary of Vertebrate Fauna Potentially Occurring in the Study Area 26
Table 7. Summary of Conservation Significant Vertebrate Fauna. 30

Figure 1. Julimar Project (Hartog and Baudin) - Regional Location. 2
Figure 2. Julimar Project (Hartog and Baudin) – Land Systems. 4
Figure 3. Climate Statistics, Pearce RAAF. 5
Figure 4. Julimar Project (Hartog and Baudin) – Transects and Habitat Assessments 10
Figure 5. Julimar Project (Hartog and Baudin) - Camera Trap Locations. 12
Figure 6. Julimar Project (Hartog and Baudin) - Fauna Habitats. 19
Figure 7. Julimar Project (Hartog and Baudin) - DBCA Records of Vertebrate Fauna. 33
Figure 8. Julimar Project (Hartog and Baudin) – Conservation Significant Fauna Recorded. 34
Figure 9. Julimar Nickel-Copper PGE Project – Confirmed Cockatoo Roosting and Breeding Sites. 39
Figure 10. Julimar Project (Hartog and Baudin) - DBCA Records of Invertebrate Fauna. 48

Plate 1. Jarrah - Marri woodland. 20
Plate 2. Jarrah - Marri woodland, recently burnt. 21
Plate 3. Jarrah - Marri woodland with a shrubby understory including Woollybush. 21
Plate 4. Jarrah – Marri woodland with *Banksia squarrosa* thicket. 22
Plate 5. Wandoo woodland. 23
Plate 6. Wandoo woodland with large hollow-bearing trees. 23
Plate 7. Powderbark Wandoo woodland on laterite rise..... 24
Plate 8. Creek with shrubby vegetation and a Jarrah – Marri – Wandoo canopy. 25
Plate 9. Minor creek with small channel and a Wandoo canopy..... 25
Plate 10. Brush-tailed Possum and Echidna Recorded on Camera Traps in the Study Area.. 28
Plate 11. Woylie Recorded on Camera Traps in the Study Area. 36
Plate 12. Chuditch Recorded on Camera Traps in the Study Area. 36
Plate 13. Marri nuts observed in the study area, chewed by Carnaby's Cockatoo. 38
Plate 14. Western Brush Wallabies Recorded on Camera Traps in the Study Area..... 44
Plate 15. Tammar Wallabies Recorded on Camera Traps in the Study Area. 45

1. Introduction

Chalice Gold Mines Limited (CGML) propose to conduct exploration drilling in the Hartog and Baudin's Exploration Targets at their Julimar Nickel-Copper PGE Project (Julimar Project). As these areas are located in Julimar State Forest, CGML commissioned Western Wildlife to carry out a basic vertebrate fauna survey and targeted conservation significant mammal survey of a study area that encompassed the two exploration target areas.

The aims of the fauna survey were to:

- Identify the fauna habitats present in the study area.
- 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 may occur in the study area.
- Conduct targeted camera trapping for the presence of conservation significant mammals.

This report details the findings of the fauna survey conducted in April - May 2021.

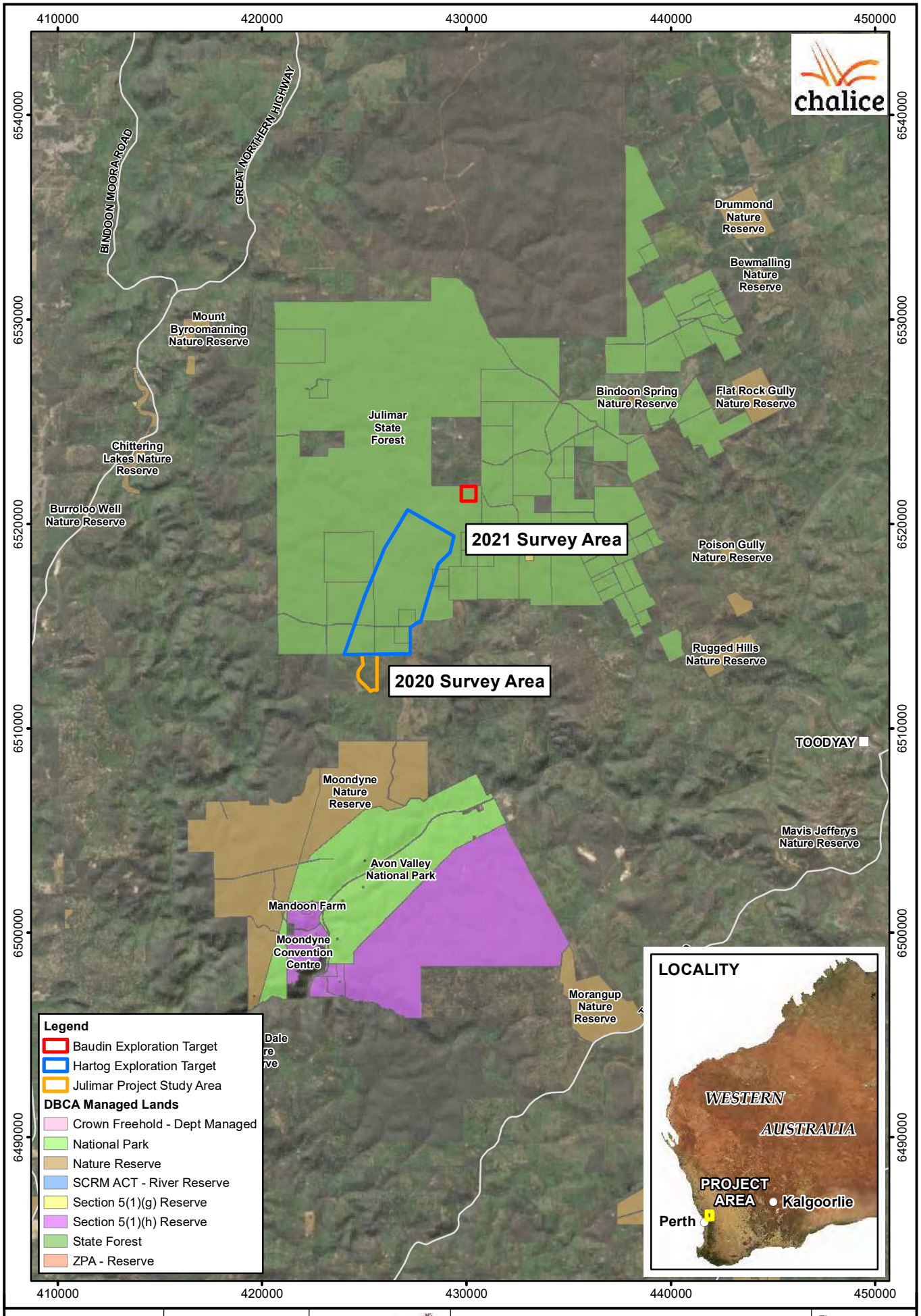
1.1 The Study Area

The study area consists of two parts: the Hartog (1,971.1ha) and Baudin (50.3ha) Exploration Targets. It is situated off Julimar Rd, Julimar, in the Shire of Toodyay. The entire study area is under native vegetation (Figure 1).

1.2 Regional Context

The study area is situated in Julimar State Forest (Figure 1). Julimar State Forest is a large area of Jarrah – Marri woodland on uplands, Wandoo woodlands in broad valleys and Powderbark Wandoo on lateritic breakaways (Johnson *et al*. 2006). Julimar is a translocation site for several conservation significant species, including the Chuditch (*Dasyurus geoffroii*), Woylie (*Bettongia penicillata ogilbyi*) and Tammar Wallaby (*Notamacropus eugenii derbianus*) (Johnson *et al*. 2006).

The study area is about 5km north of Moondyne Nature Reserve, which is contiguous with Avon Valley National Park. Avon Valley National Park is also a translocation site for threatened fauna.



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

CAD Ref: a2779Fa02_01 | A4

Date: June 2021 | Rev: A | Author: J. Wilcox

N 0 2 4 km

Scale: 1:250,000
MGA94 (Zone 50)

Western Wildlife

Julimar Project (Hartog and Baudin)
Regional Location

Figure: **1**

1.2.1. Interim Biogeographic Regionalisation for Australia (IBRA) Region

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 is the Northern Jarrah Forest subregion of the Jarrah Forest Bioregion according to IBRA (DoEE 2018). Occurring east of the Darling Scarp, this subregion supports Jarrah – Marri forests on lateritic soils, Wandoo – Marri woodlands on clayey soils and Powderbark Wandoo on breakaways. There are Banksia woodlands on sands in localized patches, and granites support heaths (Williams and Mitchell 2001).

Refugia identified in the subregion include release sites of the Noisy Scrub-bird (*Atrichornis clamosus*), populations of critical weight range mammals, freshwater wetlands, granite outcrops and Wandoo woodlands (such as Dryandra Woodland) that support the Numbat (*Myrmecobius fasciatus*), Woylie (*Bettongia penicillata ogilbyi*) and Tammar Wallaby (Williams and Mitchell 2001).

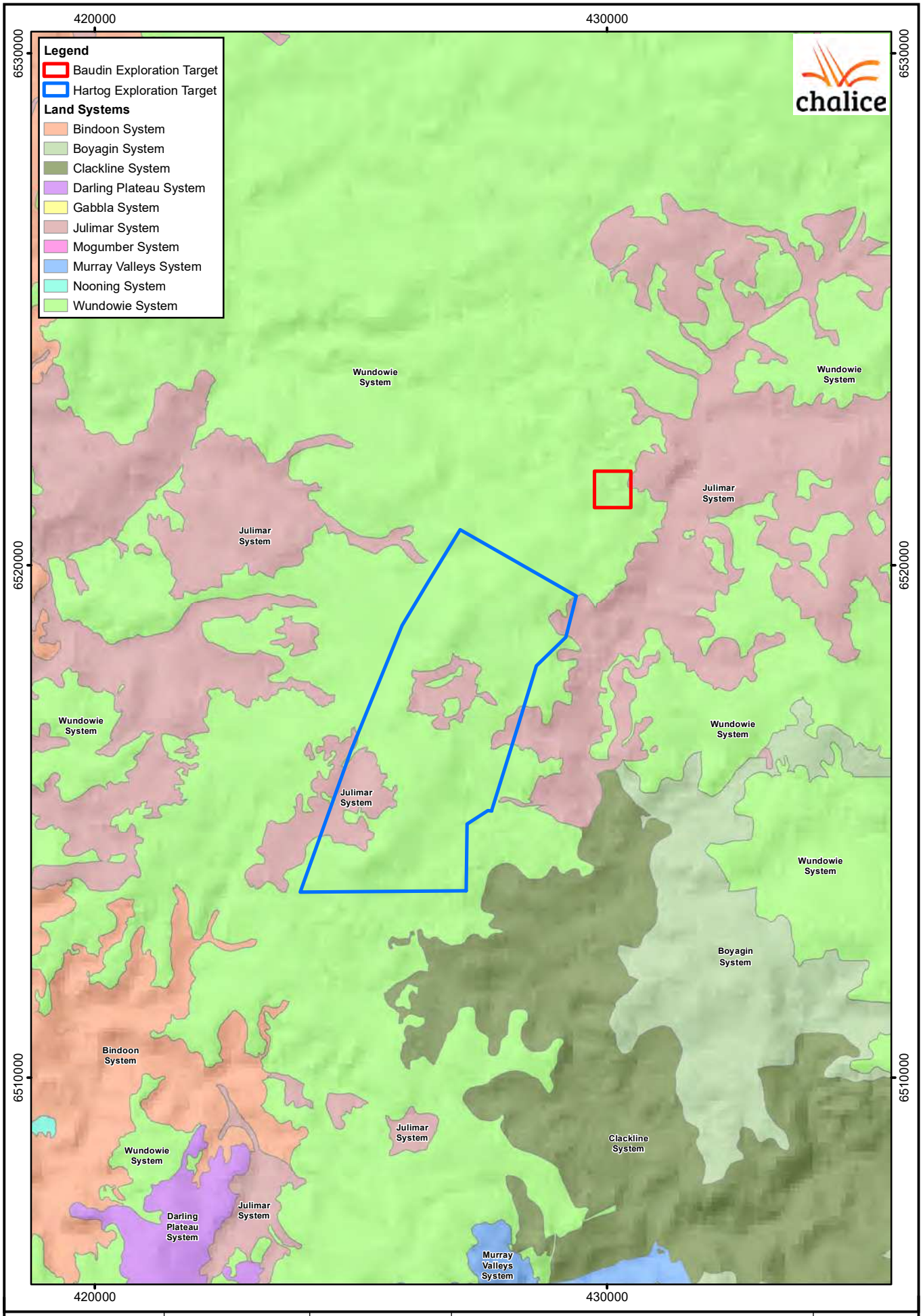
1.2.2 Land Systems

Land systems are broad descriptions of landform, geology and soils. The study area intersects two land systems (Figure 2). The land systems are characterised as follows:

- **Julimar:** Moderately dissected areas with gravelly slopes and ridges and minor rock outcrop on the eastern side of the Darling Plateau over weathered granite and granitic gneiss. Loamy gravel, shallow duplexes and pale deep sand common. Wandoo woodlands.
- **Wundowie**: Intact undulating lateritic terrain with minor rock outcrops in the north eastern Darling Range. "Buckshot" gravels, duricrust and some deep sands vegetated by Jarrah forest.

1.2.3 Climate and Weather

The monthly climate statistics for Pearce RAAF (Bureau of Meteorology Site 009053) are shown in Figure 3 (data after BOM 2021). Pearce RAAF is about 27km southwest of the study area. The climate is Mediterranean with cold, wet winters and hot, dry summers. The mean annual rainfall (1937 – 2021) is 673.5mm. The weather during the field survey was cool, mostly sunny with some light rain (Table 1).



Drawn: CAD Resources www.cadresources.com.au Tel: (08) 9246 3242	N 0 0.75 1.5 km Scale: 1:100,000 MGA94 (Zone 50)	Western Wildlife	Julimar Project (Hartog and Baudin) **Land Systems**	Figure: **2**
CAD Ref: a2779Fa02_02 A4				
Date: June 2021 Rev: A	Author: J. Wilcox			

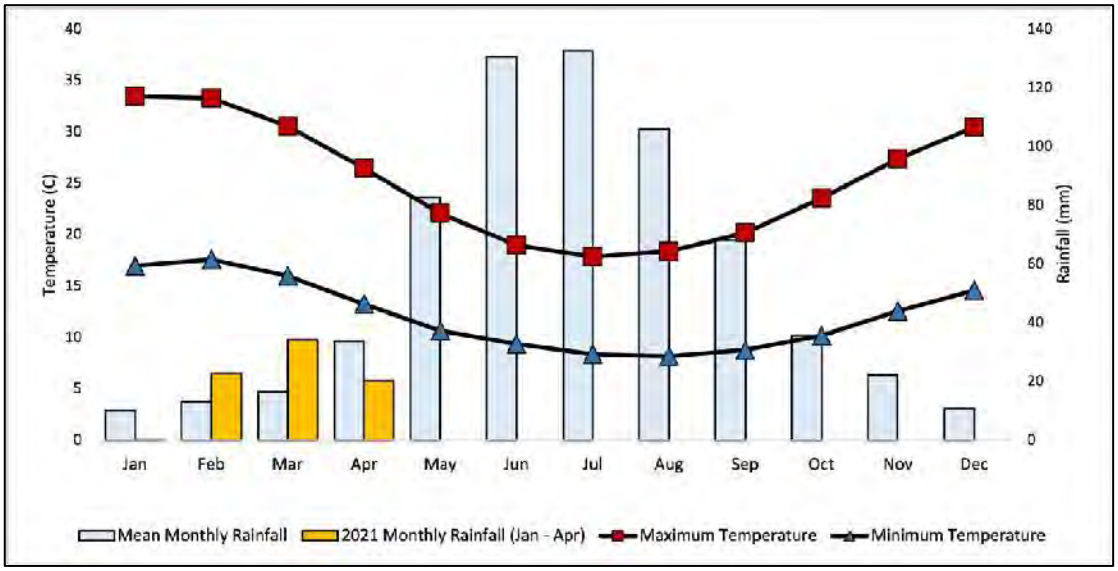


Figure 3. Climate Statistics, Pearce RAAF.

Table 1. Weather During the Field Survey (Pearce RAAF).

Field survey days shaded light green

Date	Minimum	Maximum	Rainfall
14/4/21	10.8	26.3	-
15/4/21	11.2	25.6	-
164/21	8.4	26.5	-
17/4/21	14.2	29.4	-
18/4/21	10.9	23.9	-
19/4/21	16.6	23.8	6.0
20/4/21	9.6	25.0	0.8
21/4/21	13.6	26.2	0.4
22/4/21	13.0	25.5	0.2
23/4/21	13.1	26.3	-
24/4/21	12.4	23.6	-
25/4/21	16.6	24.5	1.2
26/4/21	9.8	27.7	1.0
27/4/21	8.8	26.3	-
28/4/21	12.1	22.1	0.2
29/4/21	8.1	22.2	-
30/4/21	11.3	21.8	-

Date	Minimum	Maximum	Rainfall
01/5/21	13.0	24.9	-
02/5/21	14.5	28.8	-
03/5/21	14.4	32.0	-
04/5/21	14.5	26.1	-
05/5/21	15.6	24.6	2.4
06/5/21	11.6	17.3	8.6
07/5/21	10.3	19.2	2.8
08/5/21	11.8	19.6	4.2
09/5/21	4.5	20.2	-
10/5/21	7.1	26.2	-
11/5/21	3.9	23.3	-
12/5/21	9.0	29.7	-
13/5/21	15.2	29.8	-
14/5/21	8.6	25.0	-
15/5/21	5.3	22.4	-
16/5/21	10.0	23.5	-
17/5/21	10.1	20.3	-

2. Methods

2.1 Overview

This fauna survey included a search of available literature and databases (a 'desktop' study), and a field survey. The field survey comprised the following two components: a basic vertebrate fauna survey and a targeted conservation significant mammal survey. The field survey served to put the desk-top study into context, as well as allowing for the identification of fauna habitats and likely fauna assemblages of the site. The targeted surveys were designed to provide additional data on Threatened and Priority mammal species known to occur in Julimar State Forest.

2.2 Guidance Documents and Licencing

The fauna survey was conducted with reference to the following documents:

- Technical guidance: terrestrial vertebrate fauna surveys for environmental impact assessment (EPA 2020)
- Referral Guidelines for Three Threatened Black-Cockatoo Species (DSEWPaC 2012)
- Survey Guidelines for Australia's Threatened Mammals (DSEWPaC 2011)

The survey was undertaken under Fauna Taking (Biological Assessment) Licence BA27000274 and an Authorisation to Take or Disturb Threatened Species TFA 2020-0080.

2.3 Personnel

Ms Jenny Wilcox (*BSc.Biol./Env.Sci., Hons.Biol.*) from Western Wildlife carried out the field survey and prepared the report. Jenny Wilcox has 21 years' experience in carrying out fauna surveys in Western Australia, including in the Northern Jarrah Forest IBRA subregion.

2.4 Taxonomy and Nomenclature

Taxonomy and nomenclature for fauna species used in this report follow the Western Australian Museum checklists, updated in April 2020.

2.5 Habitat Mapping

Fauna habitat mapping was undertaken using observations made by fauna personnel in the field and interpretation of aerial photography. CAD Resources produced the maps from information provided by Western Wildlife. Key habitat elements were identified for each fauna habitat. Habitat elements include (but are not restricted to) caves, rocky crevices, tree hollows, fallen logs, accumulations of leaf litter, sources of water, and/or sandy soils suitable for burrowing.

2.6 Literature Review

Lists of fauna expected to occur in the study area were produced using information from several sources. These included publications that provide information on general patterns of distribution of frogs (Tyler *et al*. 2000), reptiles (Wilson and Swan 2017, Storr *et al*. 1983, 1990, 1999 and 2002), birds (Barrett *et al*. 2003; Johnstone and Storr 1998; Johnstone and Storr 2004) and mammals (Churchill 2007, Menkhorst and Knight 2004; Van Dyck and Strahan 2008).

The databases in Table 2 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 that the study area is outside the known range of the species as presented in the literature (i.e., erroneous records). These species are not included in lists of expected fauna.

A previous fauna survey for the Julimar Project was undertaken in 2020, on a 130.9ha area of farmland and remnant native vegetation adjacent to the southern boundary of the current study area (Figure 1). The survey included a basic fauna survey, a cockatoo habitat survey and camera trapping at 20 sites (Western Wildlife 2020). The fauna recorded on this survey are indicated in the listed of potential fauna in Appendices 2 – 5. No other fauna surveys undertaken within 20km of the study area could be found in the public domain.

2.7 Field Studies

2.7.1 Basic Fauna Survey

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 visited on the 19th April, 14th May and 17th May 2021. All vertebrate fauna encountered were recorded and notes were made on the fauna habitats present on the site.

Table 2. Databases Used in the Preparation of this Report.

Database	Type of records held on database	Area searched
Western Australian Museum Specimen Databases (DBCA 2007-)	Records of specimens held in the WA Museum. Includes historical data.	20km surrounding 31.473°S, 116.235°E.
Fauna Survey Returns Database (DBCA 2007-)	Records of fauna captured, observed or inferred from secondary evidence during fauna surveys.	20km surrounding 31.473°S, 116.235°E.
Birds Australia Atlas Database (DBCA 2007-)	Records of bird observations in Australia, 1998-2009.	20km surrounding 31.473°S, 116.235°E.
Birdata (DBCA 2007-)	Records of bird observations in Australia, 2010-2018.	20km surrounding 31.473°S, 116.235°E.
Quenda Community Survey Database (DBCA 2007-)	Survey of community sightings of Quenda.	20km surrounding 31.473°S, 116.235°E.
Faunafile (DBCA 2007-)	Records from DBCA's Western Shield Fauna Monitoring Database.	20km surrounding 31.473°S, 116.235°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.	20km surrounding 50J 425277 E, 6512798 N.
Black-cockatoo breeding sites (buffered to 2km) (Birdlife Australia 2019)	Sites where Black-Cockatoos (generally Carnaby's) are confirmed to be breeding. Breeding is inferred based on surveys which have recorded either birds entering/leaving the nest or the inside of the nest has been viewed with eggs or chicks. These records are of breeding attempts, but not necessarily of successful fledging. The first surveys were in 2003, with some nests surveyed a single time and others revisited once a year. Most records are in the peak breeding season of Carnaby's (September to January).	40km surrounding 50J 425277 E, 6512798 N.
Carnaby's Cockatoo confirmed breeding areas within the Swan Coastal Plain and Jarrah Forest IBRA Regions. (Glossop *et al*. 2011)	Confirmed breeding areas of the Carnaby's Black Cockatoo (CBC) within the Swan Coastal Plain and the Jarrah Forest IBRA regions. Confirmed sites are identified where chicks or eggs of CBC have been observed.	40km surrounding 50J 425277 E, 6512798 N.
Black-cockatoo roosting sites (buffered to 1km) (Birdlife Australia 2020)	Data from The Great Cocky Count which takes place annually in early to mid-April. This event records birds as they fly in to night roosts on a single day and has taken place since 2010. Three species are recorded: Carnaby's and Baudin's (white-tailed) and Forest Red-tailed Black-Cockatoos. In the Perth-Peel Coastal Plain all white-tailed are assumed to be Carnaby's. In other areas the roosts could include either species or both, so a generic 'white-tailed' term is used.	40km surrounding 50J 425277 E, 6512798 N.
Carnaby's Cockatoo confirmed roosting areas within the Swan Coastal Plain and Jarrah Forest IBRA Regions. (Glossop *et al*. 2011)	Describes the currently known and confirmed night roost areas for Carnaby's Black Cockatoo in the South - West of Western Australia.	40km surrounding 50J 425277 E, 6512798 N.
EPBC Protected Matters Search Tool	Records on matters protected under the EPBC Act, including threatened species.	5km surrounding 31.473°S, 116.235°E.

2.7.2 Habitat Assessment

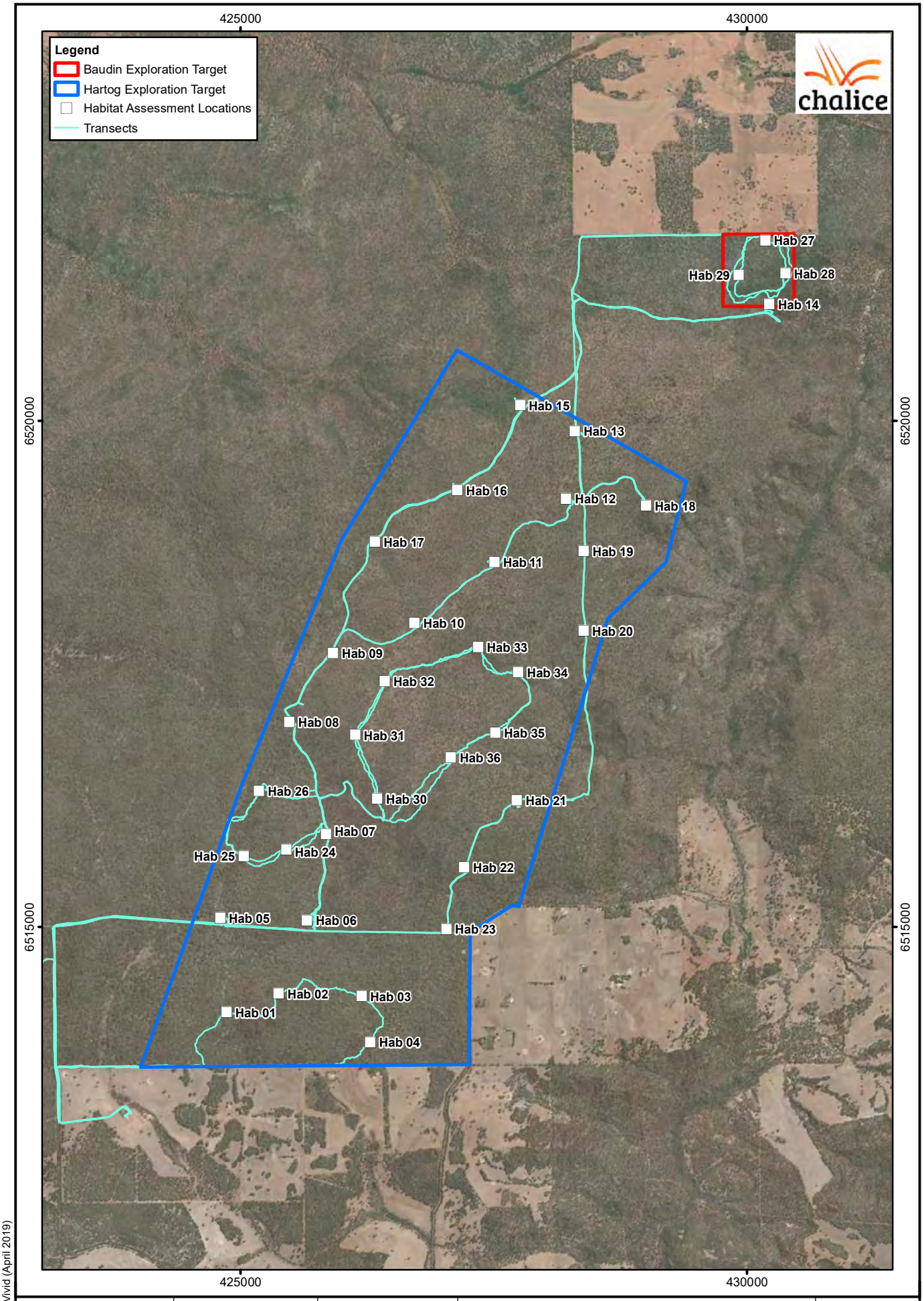
As part of the basic fauna survey, the study area was walked and habitats assessed for the potential to support conservation significant fauna. Habitat assessments were completed at 36 sites across the study area. The area traversed and the habitat assessment locations are shown in Figure 4. At each habitat assessment site, the following were recorded:

- GPS co-ordinate
- Habitat name
- Vegetation description
- Landform
- Evidence of fire
- Disturbance (e.g., weeds, clearing)
- Soil colour and type
- Rock type and presence of outcrops
- Important features that support fauna, such as:
    - Termite mounds
    - Logs and woody debris
    - Leaf litter accumulations
    - Tree hollows
    - Tree crevices or peeling bark
- Wetlands
- All fauna or evidence of fauna observed
- Representative photographs.

Although potential cockatoo habitat trees were not individually recorded, the habitats of the study area were examined for their potential to support one or more of the following species:

- Forest Red-tailed Black-cockatoo (*Calyptorhynchus banksii naso*)
- Carnaby's Cockatoo (*Calyptorhynchus latirostris*)
- Baudin's Cockatoo (*Calyptorhynchus baudinii*)

The study area was examined for the presence of vegetation types or plant species known to constitute cockatoo foraging habitat and any evidence of foraging such as chewed fruits or flowers.



Imagery: ESRI, Vivid (April 2019)

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

CAD Ref: a2779Fa02_03 | A4

Date: June 2021 | Rev: A | Author: J. Wilcox

N 0 400 800 m
Scale: 1:50,000
MGA94 (Zone 50)

Western Wildlife

Julimar Project (Hartog and Baudin)
Transects and Habitat Assessments

Figure: **4**

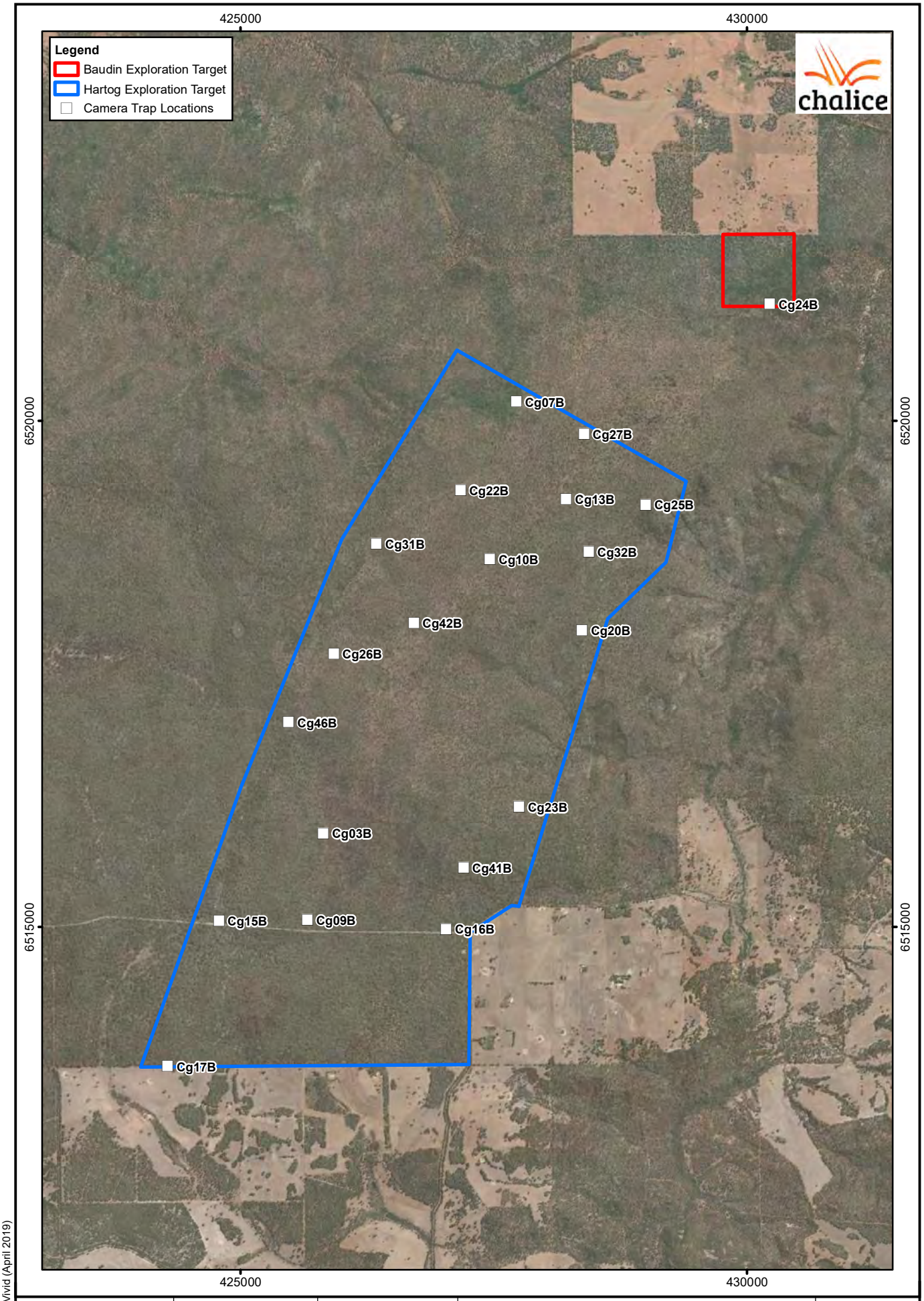
2.7.3 Targeted Conservation Significant Mammal Survey

A total of 20 camera traps were deployed across the study area with the purpose of detecting the presence of conservation significant mammals including the Chuditch (*Dasyurus geoffroii*), Woylie (*Bettongia penicillata ogilbyi*), Tammar Wallaby (*Notamacropus eugenii derbianus*), Western Brush Wallaby (*Notamacropus irma*), Brush-tailed Phascogale (*Phascogale tapoatafa*) and Quenda (*Isoodon fusciventer*) (Table 3, Figure 5).

Each camera trap was securely fastened to a tree, baited with a non-reward lure (a burley-oil-soaked sponge in a perforated PVC tube) placed in the line of sight of the camera and the lure secured to the ground with a tent peg. The cameras were left in situ for 24 nights between the 19th April and 14th May 2021, giving a total of 480 camera trap nights. The cameras were downloaded, and all fauna species recorded on each camera were identified to species level where possible.

Table 3. Camera Trap Locations and Habitat.

Camera code	Habitat	Zone	Easting	Northing
Cg03B	Jarrah – Marri woodland	50	425817	6515924
Cg09B	Jarrah – Marri woodland	50	425661	6515068
Cg10B	Jarrah – Marri woodland	50	427463	6518633
Cg13B	Jarrah – Marri woodland	50	428217	6519226
Cg15B	Wandoo woodland	50	424786	6515060
Cg16B	Jarrah – Marri woodland	50	427033	6514981
Cg17B	Jarrah – Marri woodland	50	424282	6513624
Cg20B	Jarrah – Marri woodland	50	428374	6517930
Cg22B	Jarrah – Marri woodland	50	427173	6519312
Cg23B	Jarrah – Marri woodland	50	427752	6516184
Cg24B	Wandoo – Marri woodland	50	430228	6521152
Cg25B	Wandoo – Jarrah – Marri woodland	50	429003	6519168
Cg26B	Jarrah – Marri woodland	50	425922	6517696
Cg27B	Jarrah – Marri woodland	50	428392	6519868
Cg31B	Jarrah – Marri woodland	50	426342	6518785
Cg32B	Jarrah – Marri woodland	50	428439	6518705
Cg41B	Jarrah – Marri woodland	50	427203	6515585
Cg42B	Jarrah – Marri woodland	50	426713	6518003
Cg46B	Jarrah – Marri woodland	50	425474	6517022
Cg07B	Jarrah – Marri woodland	50	427725	6520187



Imagery: ESRI, Vivid (April 2019)

Drawn: CAD Resources www.cadresources.com.au Tel: (08) 9246 3242	N 0 400 800 m Scale: 1:50,000 MGA94 (Zone 50)	Western Wildlife	Julimar Project (Hartog and Baudin) Camera Trap Locations	Figure: 5
CAD Ref: a2779Fa02_05 A4				
Date: June 2021 Rev: A	Author: J. Wilcox			

2.8 Assessment of Conservation Significance

2.8.1 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 have been produced by the federal Department of Agriculture, Water and the Environment (DAWE) in the form of Action Plans. 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), lizards and snakes (Chapple *et al*. 2019), 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

2.8.2 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 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.

2.9 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.

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 4.

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. The key limitation of this survey was with the identification of tree hollows, in that it is not possible to ascertain hollow depth from a ground-level survey.

Table 4. Fauna Survey Limitations.

Potential Limitation	Extent of limitation for the fauna survey	
Availability of data and information	Not limiting	The fauna of the southwest are relatively well-known, and there are many records on databases for the 20km surrounding the study area.
Competency/experience of the survey team, including experience in the bioregion surveyed	Not limiting	The survey was undertaken by Jenny Wilcox, who has more than 21 years' experience with fauna surveys in Western Australia. She has previously undertaken targeted surveys for Chuditch (e.g., at Forrestiana) and black-cockatoo habitat (e.g., at Collie, Mt Helena and Muchea). She has completed other surveys in the Northern Jarrah Forest subregion (e.g., in Chittering, Morangup, Beechina, Brigadoon, Red Hill, Mt Helena and Pickering Brook).
Scope of survey (e.g., faunal groups excluded from the survey)	Minor limitation	The level of survey undertaken 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 mammals were targeted with camera traps.
Timing, weather and season	Minor limitation	The survey was undertaken outside of the main September – January breeding season for Carnaby's Cockatoo and the Forest Red-tailed Black-cockatoo, so current nesting could not be reliably determined. This is in common with many surveys of this type and hence the approach of identifying all potential habitat trees. Heavy rain was experienced during the camera trapping period. Although this has the potential to wash away the bait, it did not appear to be limiting in this case as many of the target species were recorded.
Disturbance that may have affected the results	Not limiting	Some of the study area had been recently burnt, however, this was unlikely to impact the survey and unburnt habitat was also present.
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, and frogs that call in winter. Additional records were obtained from the camera trapping results.
The adequacy of the survey intensity and proportion of survey achieved (e.g., extent to which the area was surveyed)	Not limiting	The survey was completed with a moderate intensity. Within the survey period a representative proportion of the study area was surveyed (see Figure 4). The number of camera traps deployed was large for the size of the study area and were effective at detecting several of the target species.
Access problems	Not limiting	Within the survey period all areas were accessible on foot and/or by vehicle (see Figure 4).
Problems with data and analysis, including sampling biases	Not limiting	No complex analyses were undertaken, and no problems were noted.

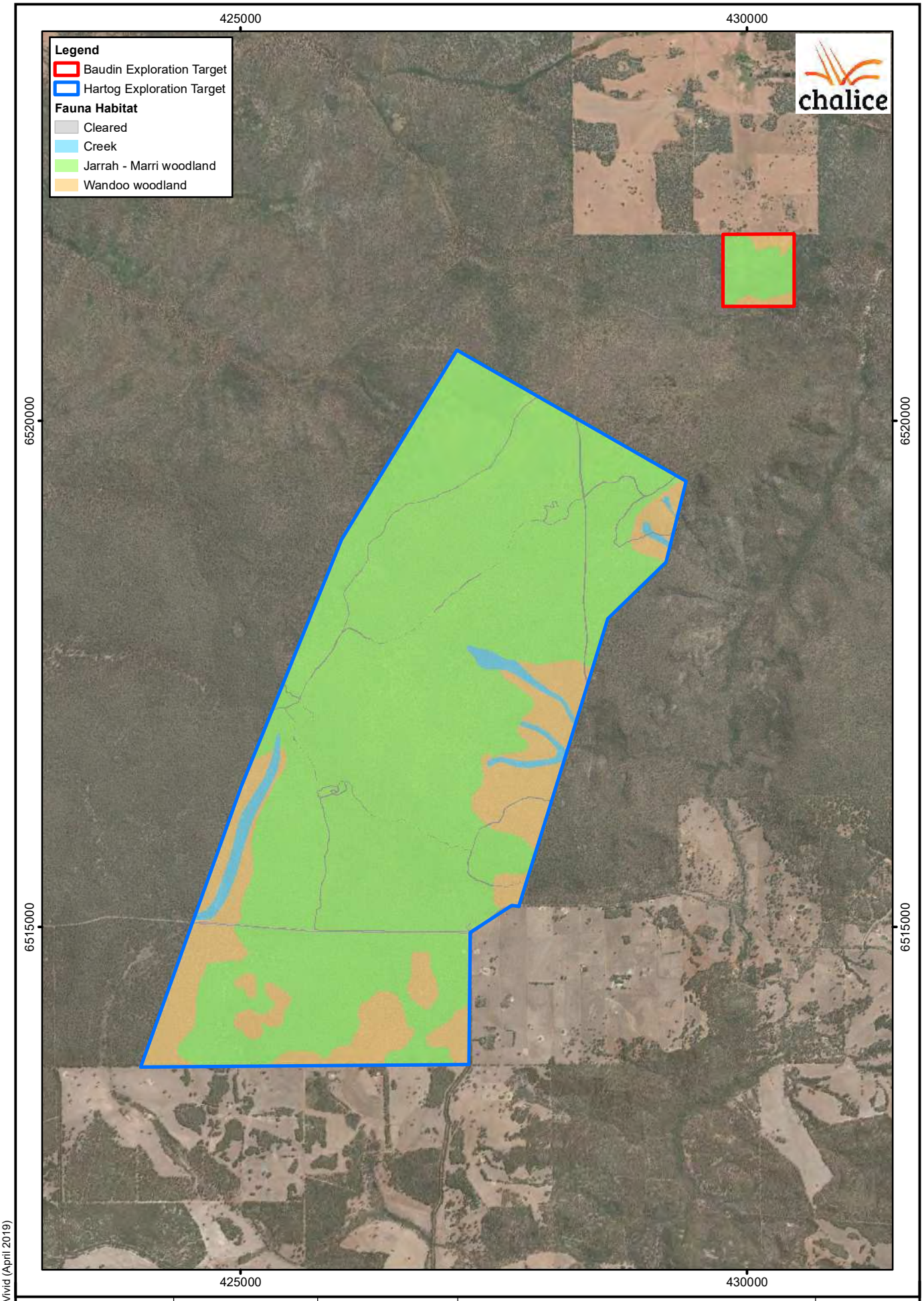
4. Fauna Habitats of the Study Area

Three broad fauna habitats were identified in the study area during the site visit: Jarrah – Marri Woodland, Wandoo Woodland and Creek (Table 5, Figure 6, Appendix 1). Each habitat is described below and presented in Figure 6. The habitats are common in Julimar State Forest. Less common habitat types, such as wetlands and granite outcrops, were absent.

Table 5. Fauna Habitats.

Habitat	Key Habitat Elements	Area (ha) – Hartog	Area (ha) – Baudin	Total Area (ha)
Jarrah – Marri woodland	• Trees with hollows and crevices provide shelter and breeding habitat for fauna. • Fallen logs provide shelter habitat. • Scattered surface rocks and small outcrops provide shelter for reptiles. • Patches of *Banksia sessilis* and/or *Banksia squarrosa* provide shelter and foraging habitat for nectar-feeding species. • Native understory provides habitat for terrestrial fauna.	1,603.6	38.5	1,642.1
Wandoo woodland	• Trees with hollows and crevices provide shelter and breeding habitat for fauna. • Fallen logs provide shelter habitat. • Scattered surface rocks and small outcrops provide shelter for reptiles. • Native understory provides habitat for terrestrial fauna.	311.5	11.8	323.3
Creek	• Shelter and breeding habitat for native frogs. • Emergent trees with hollows and crevices provide shelter and breeding habitat for fauna. • Dense stands of shrubs provide habitat for nesting birds.	43.2	-	43.2
Cleared (tracks, roads)	• Limited value to fauna.	12.8	-	12.8
	Total Area:	**1,971.1**	**50.3**	**2,021.4**

Overall, there is little disturbance to the habitats, except that from historical logging and current access tracks. There is some illegal rubbish dumping near tracks, which may also be sources of weeds or pathogens. Parts of the study area were recently burnt in 2019.



Imagery: ESRI, Vivid (April 2019)

Drawn: CAD Resources www.cadresources.com.au Tel: (08) 9246 3242	N 0 400 800 m Scale: 1:50,000 MGA94 (Zone 50)	Western Wildlife	Julimar Project (Hartog and Baudin)	Figure: 6
CAD Ref: a2779Fa02_06 A4			Fauna Habitats	
Date: June 2021 Rev: A	Author: J. Wilcox			

4.1 Jarrah – Marri Woodland

The Jarrah – Marri woodland occurs on the higher ground on lateritic sandy gravels with occasional surface rock outcropping (Plates 1 – 4). The canopy is mostly Marri (*Corymbia calophylla*) and Jarrah (*Eucalyptus marginata*), with occasional Wandoo (*Eucalyptus wandoo*). There are occasional patches of Bull Banksia (*Banksia grandis*) in the midstory. The understory vegetation is mostly of low mixed shrubs dominated by *Hibbertia hypericoides*, with Grasstrees (*Xanthorrhoea sp*.) and Zamia (*Macrozamia riedlei*). There are also extensive thickets of Parrotbush (*Banksia sessilis*) and/or Pingle (*Banksia squarrosa*).

Some of the larger trees contain hollows that are likely to be suitable for nesting and roosting fauna, and patches of Parrotbush, where present, are nesting habitat for birds. Fallen logs and woody debris provide shelter for ground-dwelling fauna.

Threatened fauna that are likely to be supported by this habitat include Carnaby's Cockatoo (*Calyptorhynchus latirostris*), Forest-Red-tailed Black-cockatoo (*Calyptorhynchus banksia naso*) and the Chuditch (*Dasyurus geoffroii*). Priority fauna that may occur are the Quenda (*Isoodon fusciventer*) and Brush-tailed Phascogale (*Phascogale tapoatafa*). These are further discussed in section 5.2.

Plate 1. Jarrah - Marri woodland.

Plate 2. Jarrah - Marri woodland, recently burnt.

Plate 3. Jarrah - Marri woodland with a shrubby understory including Woollybush.

Plate 4. Jarrah – Marri woodland with *Banksia squarrosa* thicket.

4.2 Wandoo Woodland

The Wandoo woodland occurs mainly on the lower slopes and valleys on pale clay-loams (Plates 5 – 6). The canopy is mostly Wandoo (*Eucalyptus wandoo*) with scattered Marri (*Corymbia calophylla*) and Jarrah (*Eucalyptus marginata*). On laterite rises there are woodlands of Powderbark Wandoo (*Eucalyptus accedens*) (Plate 7). The understory vegetation is often sparse but consists mixed low native shrubs with grasstrees (*Xanthorrhoea sp*.). Some of the larger trees contain hollows that may be suitable for nesting and roosting fauna. Fallen logs and woody debris provide shelter for ground-dwelling fauna.

Threatened fauna that are likely to be supported by this habitat include Carnaby's Cockatoo (*Calyptorhynchus latirostris*), Forest-Red-tailed Black-cockatoo (*Calyptorhynchus banksia naso*) and the Chuditch (*Dasyurus geoffroii*). Priority fauna that may occur are the Quenda (*Isoodon fusciventer*). These are further discussed in section 5.2.

Plate 5. Wandoo woodland.

Plate 6. Wandoo woodland with large hollow-bearing trees.

Plate 7. Powderbark Wandoo woodland on laterite rise.

4.3 Creek

The creek habitat consists of small seasonal or ephemeral channels (Plates 8 - 9). Some are open with little understory, and some have a shrubby understory. Some of the larger trees contain hollows that may be suitable for nesting and roosting fauna, and the patches of dense understory, where present, provide shelter for ground-dwelling fauna or nesting birds. The creek channels and adjacent seasonally wet areas provide damp habitats for native frog species.

Priority fauna likely to be supported by this habitat is the Quenda (*Isoodon fusciventer*). Threatened fauna, include Carnaby's Cockatoo (*Calyptorhynchus latirostris*), Forest-Red-tailed Black-cockatoo (*Calyptorhynchus banksia naso*) and the Chuditch (*Dasyurus geoffroii*) may also occur. These are further discussed in section 5.2.

Plate 8. Creek with shrubby vegetation and a Jarrah – Marri – Wandoo canopy.

Plate 9. Minor creek with small channel and a Wandoo canopy.

5. Vertebrate Fauna of the Study Area

5.1 Vertebrate Fauna Assemblage

The results of the literature review and field survey were combined to create a list of all the vertebrate fauna potentially occurring in the study area (Appendices 2 - 5). Indicated in the fauna lists are all the species observed during the fauna survey, those recorded previously on the Julimar Project and those recorded in the region as part of the literature review (see Table 2 for search areas). The results of the EPBC Act Protected Matters search are given in Appendix 6. All fauna recorded on this survey are listed in Appendix 7.

The potentially occurring vertebrate faunal assemblage is summarised in Table 6. The overall vertebrate faunal assemblage is likely to be relatively intact, as the study area is set within a relatively large are of native vegetation and the habitats are in good condition.

Table 6. Summary of Vertebrate Fauna Potentially Occurring in the Study Area.

Taxon	Total Species	Introduced Species	Conservation Significant Species				
			Threatened	Migratory	Specially Protected	DBCA Priority	Locally Significant
Amphibians	16	0	-	-	-	-	-
Reptiles	54	0	-	-	-	1	1
Birds	99	2	3	1	1	1	-
Mammals	33	6	3	-	1	3	-
Totals:	**202**	**8**	**6**	**1**	**2**	**5**	**1**

5.1.1 Amphibians

Up to 16 species of frog occur in the study area, of which one was recorded opportunistically during this survey and a further two species were recorded in the Julimar Project to the south of the current study area (Appendix 2). The creek habitat provides shelter and breeding habitat for frogs. Some frog species, such as the Slender Tree Frog (*Litoria adelaidensis*) and Motorbike Frog (*Litoria moorei*) require permanent water or permanently damp situations and are likely to be restricted to the creek habitat, if present. Burrowing species, such as the Moaning Frog (*Heleioporus eyrei*) and Banjo Frog (*Limnodynastes dorsalis*), breed around seasonal water but can range widely in terrestrial habitats during the non-breeding season. These species are also likely to be found in the Jarrah – Marri and Wandoo woodlands.

5.1.2 Reptiles

Up to 54 species of reptile potentially occur in the study area (Appendix 3). Only three species, were recorded during the field survey, but this is consistent with a basic fauna survey in the cooler months. Important habitat elements for reptiles include fallen timber, tree crevices and hollows, loose bark on trees, leaf litter, surface rocks and the loose sandy surface (for fossorial species).

The study area is likely to support an intact reptile assemblage. The reptile assemblage of each habitat is likely to be similar, with many species occurring across all habitats and only a few species restricted to a particular habitat. For example, the South-west Cool Skink (*Acritoscincus trilineatus*) is likely to favour the creek habitat but is also likely to range into adjacent areas of woodlands. The Reticulated Velvet Gecko (*Hesperoedura reticulata*) prefers the smooth-barked trees in the Wandoo woodland habitat but may also range into Jarrah-Marri woodland.

5.1.3 Birds

There are 99 species of bird that have the potential to occur in the study area, of which 39 were recorded during the field survey (Appendix 4). The bird assemblage is likely to be relatively intact, and most species are likely to occur in all habitats. A few species may favour one habitat, such as the Crested Shrike-tit (*Falcunculus frontatus*) and Rufous Treecreeper (*Climacteris rufus*), both of which prefer Wandoo woodlands.

Many birds are highly mobile and will move into and out of the study area on a daily or seasonal basis. For example, when flowering, the eucalypt canopy is likely to attract honeyeaters. Trees with hollows may support nesting parrots, pardalotes, kingfishers or owls. Small insectivores such as the Splendid Fairywren (*Malurus splendens*) are more sedentary and are likely to favour habitats with dense native understory, such as patches of Woollybush or *Banksia squarrosa* thickets in the Jarrah-Marri woodland. For wide-ranging species, such as many birds of prey, the study area would represent only a portion of a much larger home-range.

Although many waterbirds are known from the region, only those that nest in tree hollows (four species of duck) have been included in Appendix 4. The creek habitat may attract a few other common waterbird species from time to time but is unlikely to be important habitat for foraging or breeding waterbirds.

5.1.4 Mammals

There are 31 species of mammal that have the potential to occur in the study area, of which 25 are native and six introduced (Appendix 5). Twelve mammals (eight native and four introduced) were recorded during the field survey using camera traps. A dunnart (*Sminthopsis sp*.) was also observed on camera, but unable to be identified to species level as three species potentially occur.

The mammal assemblage of the study area is likely to be relatively intact, as the habitats are in good condition and situated in a large area of remnant forest. As Julimar State Forest has been a release site for translocated populations of conservation significant mammals, several species are present that are locally extinct in other parts of their natural range, including the Woylie (*Bettongia penicillata ogilbyi*), Chuditch (*Dasyurus geoffroii*) and Tammar Wallaby (*Notamacropus eugenii derbianus*). These species are further discussed in section 5.2.

A large proportion of the mammal species on the list in Appendix 5 are insectivorous bats. Bats may roost in crevices, loose bark or hollows in trees, foraging under the woodland canopy at night. The Common Brushtail Possum (*Trichosurus vulpecula*) was recorded on two of the 20 camera traps in the study area (Plate 10) and would also use tree hollows for shelter. The Echidna (*Tachyglossus aculeatus*) was common, observed on 15 of the 20 camera traps and likely to occur in all habitats.

Plate 10. Brush-tailed Possum and Echidna Recorded on Camera Traps in the Study Area.

Feral mammals recorded were the Cat (*Felis catus*), Fox (*Vulpes vulpes*), Rabbit (*Oryctolagus cuniculus*) and Pig (*Sus scrofa*). Of the 20 camera traps deployed, the Cat was recorded on two and the Fox was recorded on five. The remaining species were not recorded on cameras but were observed from their secondary signs such as diggings and scats.

5.2 Vertebrate Fauna of Conservation Significance

There are 15 vertebrate fauna of conservation significance that potentially occur in the study area: six Threatened, one Migratory, two Specially Protected, five Priority and one Locally Significant species. Each species is summarised in Table 7 and discussed in the sections below.

Conservation significant fauna recorded within 20km of the Survey Area on DBCA's Threatened and Priority Fauna Database are shown in Figure 7. Note that some of the points shown have been generalized by DBCA to protect the exact location of protected species. Records of conservation significant fauna made on this survey are shown in Figure 8. Figure 9 shows confirmed breeding and roosting sites for cockatoos (mainly Carnaby's) in the region surrounding the study area. Note that these sites are shown as buffered by 2 – 12km.

One recorded on DBCA's Threatened and Priority Fauna Database, the Woma (*Aspidites ramsayi*; Priority 1), was omitted from the list in Appendix 3 and the discussion below. This record is listed as uncertain, the habitats in the study area are unsuitable for this species and it is generally thought to be locally extinct.

A number of bird species occur on databases (Figure 7, Appendix 6) but would not occur in the study area as either their habitats are absent or they are locally extinct. These include migratory shorebirds such as the Australia Painted Snipe (*Rostratula australis*), Sharp-tailed Sandpiper (*Calidris acuminata*), Curlew Sandpiper (*Calidris ferruginea*), Pectoral Sandpiper (*Calidris melanotos*), Eastern Curlew (*Numenius madagascariensis*), Common Sandpiper (*Tringa hypoleucos*), Common Greenshank (*Tringa nebularia*) and Grey Wagtail (*Motacilla cinerea).* The Blue-billed Duck (*Oxyura australis*) requires deep waters which are absent from the study area and the Osprey (*Pandion haliaetus*) occurs primarily in coastal areas. Muir's Corella (*Cacatua pastinator pastinator*) may be an erroneous record, as this subspecies is only known from the southwest in the vicinity of Boyup Brook, Bridgetown and Rocky Gully. The Malleefowl is generally thought to be locally extinct in the area and there are no records of this species in the area on DBCA's Threatened and Priority Fauna Database (Figure 7). These species have been excluded from the list of potentially occurring birds in Appendix 4 and are not discussed further.

There is one mammal listed on DBCA's Threatened and Priority Fauna Database for the area that has been excluded from the list in Appendix 5 and the discussion below. The Bilby (*Macrotis lagotis*; Threatened) is known only from historical records and is locally extinct.

Table 7. Summary of Conservation Significant Vertebrate Fauna.

Key to status: Cr = Critically Endangered, En = Endangered, Vu = Vulnerable, Mi = Migratory, OS = Other Specially Protected, CD = Conservation Dependent, P1 – P4 = Priority 1 – 4, LS = Locally Significant.

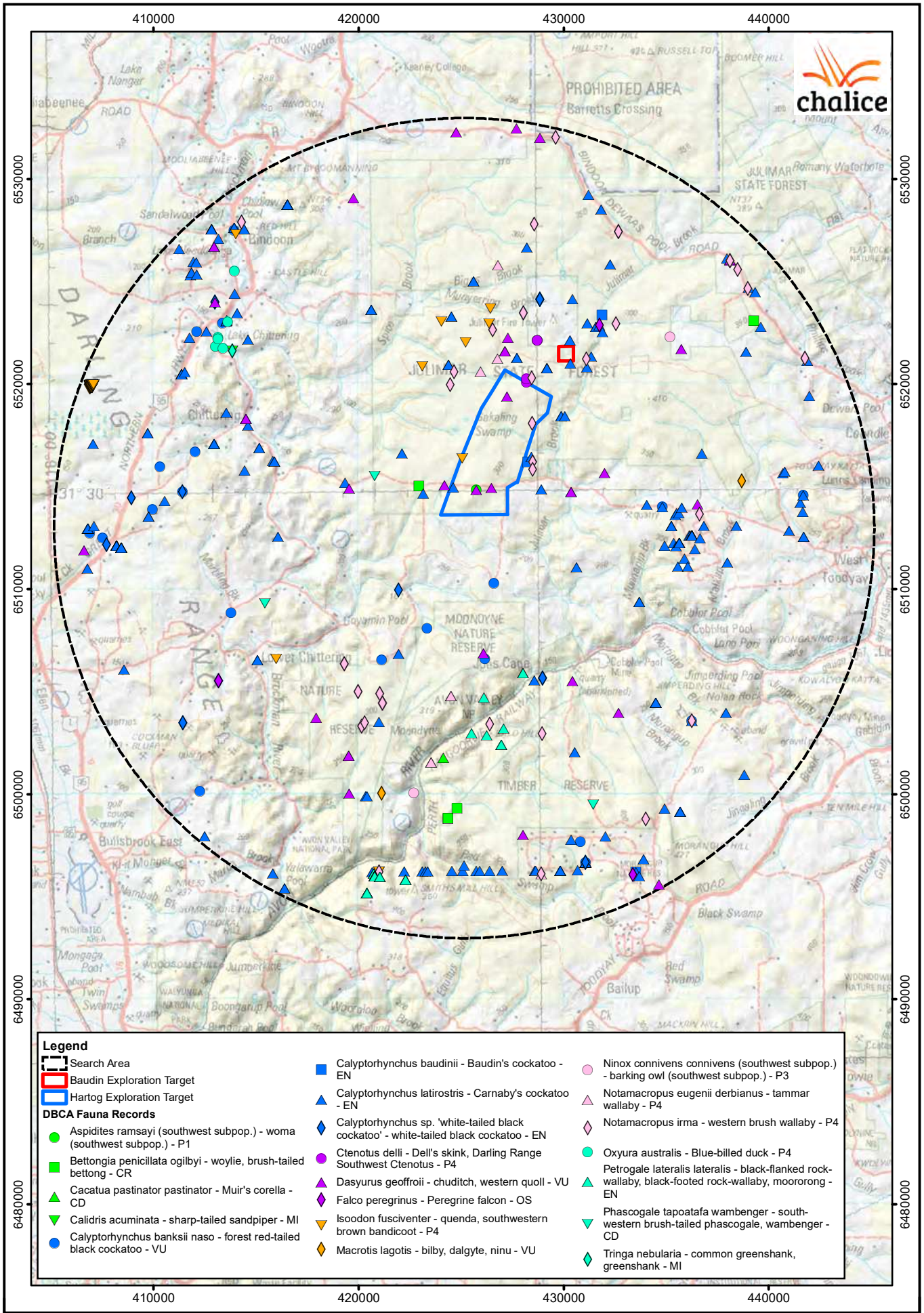
Species	Conservation Status				Records within 20km (DBCA 2020, see also Figure 7)	Likelihood of Occurrence	Potential habitat use in the Study Area
	EPBC Act	BC Act	DBCA Priority	Locally significant			
Threatened Species							
Calyptorhynchus banksii naso **Forest Red-tailed Black Cockatoo**	Vu	Vu	-	-	**Recorded on this survey, Apr-May 2021.** Foraging signs and birds heard. 20 nearby records (DBCA 2020). Records from Chittering (2006, 2007, 2015, 2017), Moondyne Nature Reserve (2017), Morangup (2015, 2017), Bindoon (2015) and Julimar (2013).	Known to occur	A resident or seasonal visitor, foraging in Jarrah – Marri woodland and possibly breeding in tree hollows in Jarrah, Marri or Wandoo.
Calyptorhynchus latirostris **Carnaby's Black-Cockatoo**	En	En	-	-	**Recorded on this survey, Apr-May 2021.** Foraging signs recorded. 298 nearby records (DBCA 2020). Records from Bindoon, Chittering, Morangup, Julimar, Dewars Pool, West Toodyay, Coondle and Avon Valley National Park.	Known to occur	A seasonal visitor, foraging in Jarrah – Marri woodland, *Banksia* thickets and possibly breeding in tree hollows in Jarrah, Marri or Wandoo.
Calyptorhynchus baudinii **Baudin's Black-Cockatoo**	Vu	Vu	-	-	3 records (DBCA 2020). 2 records in Julimar (2004, 2007), 1 in Morangup (1999).	Low	An uncommon winter visitor, foraging in Jarrah – Marri woodland.
Dasyurus geoffroii **Chuditch**	Vu	Vu	-	-	**Recorded on this survey, Apr-May 2021.** Recorded on several camera traps. 36 nearby records (DBCA 2020). Translocation records from Julimar (1992, 1993), other records from Julimar (2000, 2014), Moondyne (1984, 1989, 1990), Bindoon (1993, 2000, 2003, 2015), Morangup (2018), Avon Valley National Park (2011, 2012), Chittering (1973, 1985, 2016) and Dewars Pool (2000).	Known to occur	Likely to be a breeding resident occurring in all habitats, denning in hollow logs, rock piles and possibly tree hollows.
Bettongia penicilata ogilbyi **Woylie**	En	Cr	-	-	**Recorded on this survey, Apr-May 2021.** Recorded on camera traps. 5 records (DBCA 2020). Translocation records from Avon Valley National Park (2002, 2003), other records from Julimar (2019) and Dewars Pool (2015).	Known to occur	Likely to be a breeding resident occurring in all habitats.
Petrogale lateralis lateralis **Black-flanked Rock-wallaby**	En	En	-	-	42 records (DBCA 2020). Records of translocations to Avon Valley National Park (2001, 2002, 2010) and Paruna Sanctuary (2001, 2002, 2003), other records from Avon Valley National Park (2010 – 2017) and Moonyne (2014).	Very low	May disperse through the study area but unlikely to use any habitat in the study area.

Table 7. (cont.)

Species	Conservation Status				Records within 20km (DBCA 2020, see also Figure 7)	Likelihood of Occurrence	Potential habitat use in the Study Area
	EPBC Act	BC Act	DBCA Priority	Locally significant			
Migratory Species							
Apus pacificus **Fork-tailed Swift**	Mi	Mi	-	-	No records within 20km.	Moderate	May overfly study area but unlikely to use any habitat in the study area.
Specially Protected Fauna							
Falco peregrinus **Peregrine Falcon**	-	OS	-	-	3 records (DBCA 2020). Records from Lower Chittering (1980), Julimar (2000) and Morangup (2006).	Moderate	Possible foraging visitor over pasture, that may breed in tall trees in woodlands. The study area would be part of a much larger home-range for a single pair.
Phascogale tapoatafa **Brush-tailed Phascogale**	-	CD	-	-	3 records (DBCA 2020). Records from Lower Chittering (2005), Mortimer (1994) and Avon Valley National Park (2013).	High	Likely to be a breeding resident occurring in all habitats.
DBCA Priority Fauna							
Ninox connivens connivens **Barking Owl**	-	-	P3	-	2 records (DBCA 2020). Records from Avon Valley National Park (1994) and Julimar (1999).	Moderate	Possible breeding resident, breeding in large tree hollows. The study area would be part of a much larger home-range for a single pair.
Ctenotus delli **Dell's Ctenotus**	-	-	P4	-	5 records (DBCA 2020). Records from Julimar (1983, 1994, 1999).	High	Likely to be a breeding of Jarrah-Marri woodland.

Table 7. (cont.)

Species	Conservation Status				Records within 20km (DBCA 2020, see also Figure 7)	Likelihood of Occurrence	Potential habitat use in the Study Area
	EPBC Act	BC Act	DBCA Priority	Locally significant			
Isoodon fusciventer **Quenda**	-	-	P4	-	123 records (DBCA 2020). Records from Bindoon (2013), Lower Chittering (2005, 2012), Paruna Sanctuary (2000), Julimar (2006, 2011), Avon Valley National Park (2013) and Mortimer (1994).	High	Likely to be a breeding resident occurring in all habitats but favouring creek and woodlands with a dense understory.
Notamacropus eugenii derbianus **Tammar Wallaby**	-	-	P4	-	**Recorded on this survey, Apr-May 2021.** Recorded on camera traps. 34 records (DBCA 2020). Translocation records from Avon Valley National Park (2001, 2002, 2003) and Julimar (1998). Other records from Avon Valley National Park/Paruna Sanctuary (2010 – 2016), Morangup (2004) and Julimar (2004).	Known to occur	Likely to be a breeding resident occurring in all habitats.
Notamacropus irma **Western Brush Wallaby**	-	-	P4	-	**Recorded on this survey, Apr-May 2021.** Recorded on camera traps. 53 records (DBCA 2020). Records from Lower Chittering (2012), Dewars Pool (2000), Morangup (2004, 2012), Julimar (2000, 2004, 2006), Avon Valley National Park (2010, 2012, 2017), Bindoon Springs Nature Reserve (2000) and Moondyne (2010, 2012)	Known to occur	Likely to be a breeding resident occurring in all habitats.
Locally Significant Fauna							
Morelia spilota imbricata **Carpet Python**	-	-	-	LS	Recorded on the WA Museum Specimen Database (Appendix 3).	High	May occur in woodland habitats, sheltering in tree hollows, rock piles and hollow logs.



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

CAD Ref: a2779Fa02_07 | A4

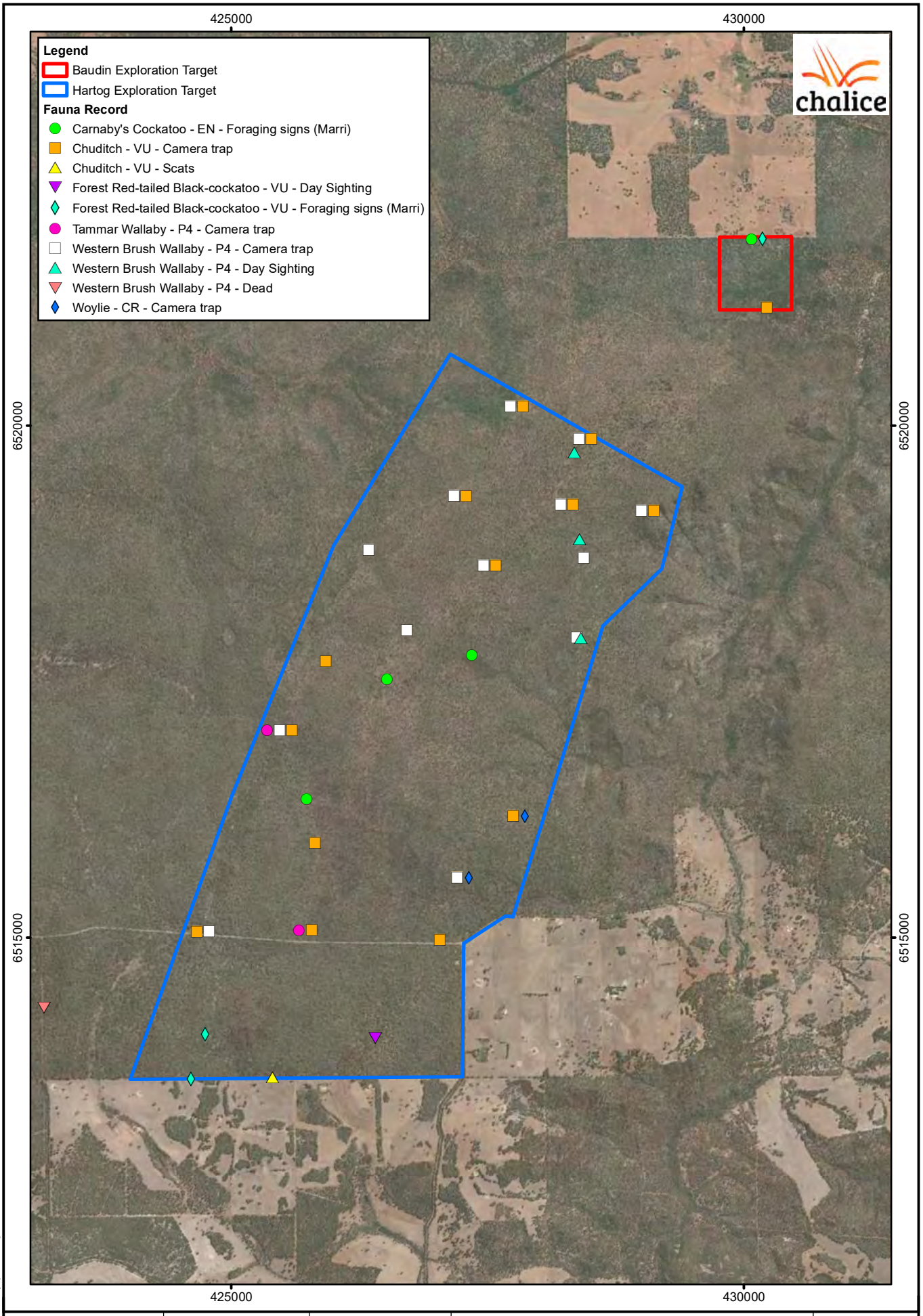
Date: June 2021 | Rev: A | Author: J. Wilcox

N 0 2 4 km
Scale: 1:250,000
MGA94 (Zone 50)

Western Wildlife

Julimar Project (Hartog and Baudin)
DBCA Records of Vertebrate Fauna

Figure: **7**



Imagery: ESRI, Vivid (April 2019)

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

CAD Ref: a2779Fa02_08 | A4

Date: June 2021 | Rev: A | Author: J. Wilcox

N 0 400 800 m
Scale: 1:50,000
MGA94 (Zone 50)

Western Wildlife

Julimar Project (Hartog and Baudin)
Conservation Significant Fauna Recorded

Figure: **8**

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 are likely to be important for their long-term conservation, particularly if the site supports a resident breeding population. An area of habitat that is essential to the conservation of a listed species can be considered 'habitat critical to the survival' of the species. Critical habitat is usually defined in recovery plans and is different for each species.

Six Threatened species potentially occur in the study area, of which four were recorded on this survey.

Woylie - *Bettongia penicillata ogilbyi*

The Woylie is listed as Endangered under the EPBC Act and Critically Endangered under the BC Act.

The Woylie was formerly widespread across much of Australia south of the tropics, but by 1970 was restricted to four subpopulations in Western Australia (TSSC 2018). Initial translocation efforts resulted in a population increase, but it suffered a catastrophic population decline between 2000 and 2010, dropping by about 90% (Woinarski *et al*. 2014). There are translocated populations at Julimar Forest, as well as nearby at Avon Valley National Park (about 8km south of the study area), although the latter is thought to have failed (Woinarski *et al*. 2014, TSSC 2018).

Key threats impacting this species are predation by feral cats and foxes, habitat loss and inappropriate fire regimes (TSSC 2018, Woinarski *et al*. 2014). Cats and foxes predate on young Woylies and appropriate fire regimes are required to maintain the dense protective cover of understory vegetation.

The Woylie used to inhabit a wide variety of habitats, but the remnant subpopulations occur in woodlands and heaths. During the day, this species rests in a concealed nest built over a small depression on the ground (TSSC 2018). Habitat critical to the survival of the species is considered to include tall eucalypt forests or woodlands, dense myrtaceous shrubland and proteaceous or mallee heath that either currently support Woylies or have the potential to support Woylies (Yeatman and Groom 2012).

There are five records of this species within 20km on DBCA's Threatened and Priority Fauna Database (Figure 7), ranging from 2002 to 2019. The 2019 record is from the corner of Julimar and Keating Rd, about 1.7km west of the study area. The Woylie was recorded on two of the 20 camera traps in the study area (Figure 8, Plate 11). This species potentially occurs throughout the study area.

Plate 11. Woylie Recorded on Camera Traps in the Study Area.

Chuditch – *Dasyurus geoffroii*

The Chuditch is listed as Vulnerable under the BC Act and EPBC Act.

The Chuditch used to occur across much of Australia but is now restricted to the southwest of Western Australia. It is vulnerable to predation by foxes and increases in areas where fox control is undertaken (Burbidge 2004). Although they used to occupy a variety of habitats, the majority of Chuditch now occur in the Jarrah forest with some wheatbelt populations in drier woodlands, heath and mallee shrublands (Van Dyck and Strahan 2008; Orrell and Morris 1994).

There are many records within 20km on DBCA's Threatened and Priority Database, including records from Julimar State Forest and Avon Valley National Park (Figure 7). Chuditch were reintroduced to Julimar State Forest in the 1990s and is now considered by DBCA to be one of the healthiest Chuditch populations in Western Australia. The Chuditch was recorded in the study area, on 17 of the 20 camera traps deployed (Figure 8, Plate 12). The Chuditch is likely to use all habitats in the study area, using hollow logs, rock crevices and possibly tree hollows as daytime shelter.

Plate 12. Chuditch Recorded on Camera Traps in the Study Area.

Black-flanked Rock-wallaby – *Petrogale lateralis lateralis*

The Black-flanked Rock-wallaby is listed as Endangered under the BC Act and EPBC Act.

The Black-flanked Rock-wallaby is endemic to Western Australia and currently confined to small patches of suitable habitat across the central and southern part of the State (TSSC 2016). It is known from translocated populations in Avon Valley National Park and Paruna Sanctuary, about 9km and 18km south of the study area respectively. Records from these populations are shown on Figure 7. This species inhabits rocky habitats including caves, scree and boulder piles, foraging in close proximity to shelter sites. As the study area lacks these rocky habitats, the Black-flanked Rock-wallaby is unlikely to occur, however, there is a small possibility that wallabies could disperse through the study area.

Carnaby's Cockatoo – *Calyptorhynchus latirostris*

Carnaby's Cockatoo is listed as Endangered under the BC Act and EPBC Act.

Carnaby's Cockatoo is endemic to the southwest of Western Australia, occurring mostly in the wheatbelt but also on the Swan Coastal Plain and wetter southwest (Johnstone and Storr 1998). The population size is estimated to be 40,000 birds (or possibly between 10,000 – 60,000) (Garnett *et al*. 2011). There are many records of this species within 20km on DBCA'S Threatened and Priority Fauna Database (Figure 7). The study area is within the Bindoon - Julimar Key Biodiversity Area (KBA), an area that supports at least 1% of the breeding population of Carnaby's Cockatoo, as well as providing foraging habitat (Birdlife International 2021a). There are many confirmed breeding sites in the region (Figure 9).

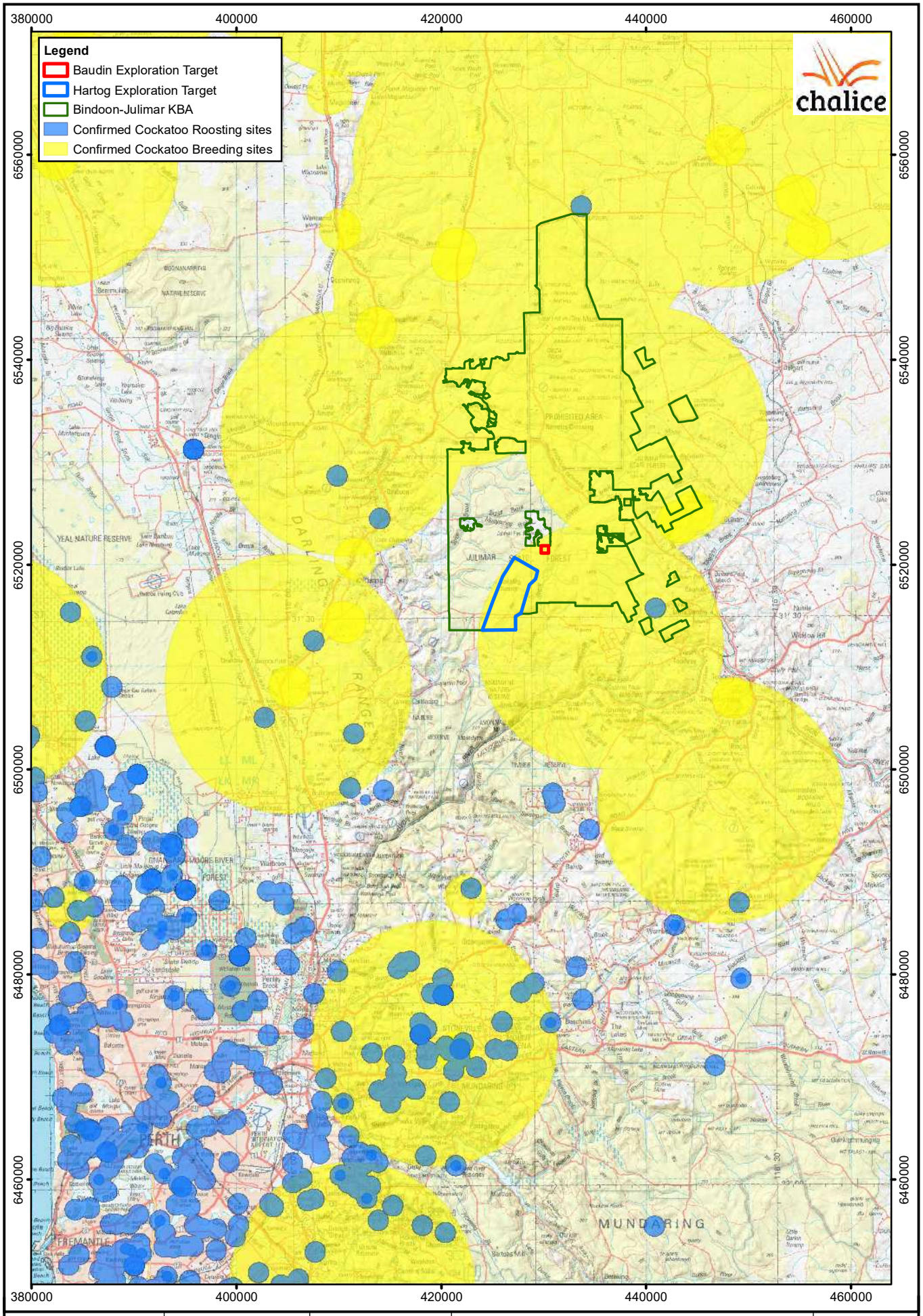
Typically, Carnaby's Cockatoo breeds in the wheatbelt region of Western Australia, nesting in large hollows in smooth-barked eucalypts such as the Salmon Gum (*Eucalyptus salmonophloia)* and Wandoo (*Eucalyptus wandoo*). However, it has started breeding in areas further west and south than its traditional breeding range, including areas in the Darling Range and on the Swan Coastal Plain (Johnstone *et. al*. 2005, Johnstone *et al*. 2011). Eggs are laid from early July to mid-October (Johnstone and Storr 1998).

Some of the Carnaby's Cockatoo population is resident (particularly in wetter areas) and some of the population moves west and south towards the coast after breeding (Johnstone and Storr 1998). Between February and September, large flocks of birds aggregate in feeding flocks on the northern Swan Coastal Plain (Johnstone *et al*. 2011). These birds are foraging mainly in heaths, *Banksia* woodlands and pine plantations, and can be in large numbers of up to 7,000 birds (Johnstone e*t al*. 2011). On the southern Swan Coastal Plain flocks are smaller (200 – 1,200 birds) and these birds forage on vegetation over a wide area (Johnstone *et al*. 2011). Vegetation on the Swan Coastal Plain and adjacent escarpment is an important resource, with 8,000 – 10,000 birds estimated to use the area during the non-breeding season (Burnham *et al*. 2010).

Carnaby's Black-Cockatoo forage on the seeds of a range of plant species, but are particularly attracted to proteaceous heaths, *Banksia* and *Eucalyptus* woodlands and pine plantations (Johnstone and Storr 1998). On the Swan Coastal Plain, important food plants include *Banksia attenuata*, *B. menziesii*, *B. grandis*, *B. ilicifolia*, *B. sessilis*, *B. prionotes*, Marri (*Corymbia calophylla*) and Jarrah (*Eucalyptus marginata*) (Shah 2006). In breeding areas, it is important to have sufficient foraging resources in close proximity to nest hollows (DSEWPaC 2012). Carnaby's Black-Cockatoo generally roosts in tall native or introduced eucalypts or pines in riparian habitats or near permanent water (DEE 2017, Burnham *et al*. 2010).

Evidence of Carnaby's Cockatoo foraging on Marri was recorded in the study area (Figure 8, Plate 13). All woodlands are foraging habitat for this species, particularly areas with dense thickets of Parrotbush (*Banksia sessilis*) or Pingle (*Banksia squarrosa*) in the understory (Figure 6, Table 5). It is possible that this species currently breeds in the study area, and it is known to breed nearby (Figure 9). No evidence of roosting was recorded.

Plate 13. Marri nuts observed in the study area, chewed by Carnaby's Cockatoo.



Drawn: CAD Resources www.cadresources.com.au Tel: (08) 9246 3242	N 0 4 8 km Scale: 1:500,000 MGA94 (Zone 50)	Western Wildlife	**Julimar Nickel-Copper PGE Project** **Confirmed Cockatoo Roosting and Breeding Sites**	Figure: **9**
CAD Ref: a2779Fa02_09 | A4				
Date: June 2021 | Rev: A	Author: J. Wilcox			

Baudin's Cockatoo – *Calyptorhynchus baudinii*

Baudin's Cockatoo is listed as Endangered under the BC Act and EPBC Act.

Baudin's Cockatoo is endemic to the southwest of Western Australia and is more common in the deep south-west (Johnstone and Storr 1998). The population size is estimated to be 10,000 - 15,000 birds (Garnett *et al*. 2011). Baudin's Cockatoo has declined primarily due to persecution by orchardists and loss of habitat due to wildfires and vegetation clearance in their range (Johnstone and Storr 1998). Baudin's Cockatoos breed in forests of Karri, Marri and Jarrah in the deep southwest, where the annual rainfall is on average more than 750mm. Breeding occurs in late winter to spring (August to November), using a large hollow in a eucalypt, generally in Karri, Marri or Wandoo (Johnstone and Storr 1998). The hollows used are usually 30 - 40cm in diameter and more than 30cm deep. Breeding occurs as far north as Lowden, with an isolated breeding record from Serpentine (Johnstone and Kirkby 2008).

Outside of the breeding season Baudin's Cockatoo can gather into large foraging flocks. In the non-breeding season this species ranges more widely, foraging primarily in habitats that contain Marri, and their distribution is probably defined by where Marri trees occur. Baudin's Cockatoos feed mainly on the seeds of eucalypts, with most of their diet consisting of Marri seeds. They also feed on seeds from other plants (e.g., Jarrah, *Banksia*, *Hakea* or commercial orchard crops such as apples and pears) and take some invertebrate material by stripping bark from trees (Johnstone and Storr 1998, Johnstone *et al*., 2005). Roosting habitat is generally in the tallest trees in riparian habitats, near permanent water or in sheltered gullies (Johnstone and Kirkby 2008).

Baudin's Cockatoo may forage in the study area, particularly on Marri, but will not breed in the vicinity of the study area. The study area is on the northern limit of the distribution of this species, and there are few nearby records of this species on DBCA's Threatened and Priority Fauna Database (Figure 7).

Forest Red-tailed Black-Cockatoo – *Calyptorhynchus banksii naso*

The Forest Red-tailed Black-Cockatoo is listed as Vulnerable under the BC Act and EPBC Act.

The Forest Red-tailed Black-Cockatoo is endemic to the southwest of Western Australia. It is patchily distributed through its range (Johnstone and Storr 1998), with the population size estimated to be 15,000 birds (Johnstone and Kirkby 1999). It occurs in Jarrah, Marri and Karri forests between about Gingin to the north, Albany to the south, and east to Mt Helena, North Bannister and Rocky Gully (Johnstone and Storr 1998). This species also ranges irregularly onto the Swan Coastal Plain to feed on the seeds of the introduced Cape Lilac (*Melia azerdarach*).

Groups of up to 50 birds roost in trees overnight, dispersing into smaller flocks when ranging out to forage during the day. Roosts may be on roadsides, paddocks or forested areas (Johnstone and Kirkby 1999). Forest Red-tailed Black Cockatoos feed primarily on the seeds of Marri and Jarrah, but also feed on the seeds of Blackbutt (*Eucalyptus patens*), Forest Sheoak (*Allocasuarina fraseriana*), Snottygobble (*Persoonia longifolia*) and Cape Lilac (Johnstone and Storr 1998).

This species does not undertake regular seasonal movements, instead exhibiting irregular population fluctuations, perhaps as a response to food availability. The Forest Red-tailed Black Cockatoo nests in hollows in Karri (*Eucalyptus diversicolor*), Marri, Jarrah, Bullich (*Eucalyptus megacarpa*) and Wandoo (*Eucalyptus wandoo*) (Johnstone and Storr 1998, DSEWPaC 2012). However, they have generally been found to prefer nesting in large (mean DBH of 90cm) Marri trees (Johnstone *et al*. 2013). Eggs are laid in October and November (Johnstone and Storr 1998).

Evidence of this species foraging in the study area was recorded during the field survey, and this species was also heard calling nearby (Figure 8). The Jarrah – Marri woodland and Creek habitats are foraging habitat for this species, and it is possible that this species currently breeds in the study area. No evidence of roosting was recorded, but the woodland areas may provide roosting habitat.

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).

There is one Migratory species that potentially occurs in the study area.

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, a large population that appears to be stable Birdlife International 2021b). There are no records of this species within 20km on DBCA's Threatened and Priority Fauna Database (Figure 7), however, the species may occur. The Fork-tailed Swift is a largely aerial species and is unlikely to be affected by changes to the study area.

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. There are two specially protected fauna that potentially occur in the study area.

Brush-tailed Phascogale – *Phascogale tapoatafa*

The Brush-tailed Phascogale is listed as Conservation Dependent under the BC Act.

The Brush-tailed Phascogale is a nocturnal carnivore that occurs in open forests and woodlands with a sparse understory (Van Dyck and Strahan 2008). It has declined due to habitat loss and fragmentation. Females have been found to have non-overlapping home ranges of about 20 – 40 ha, and males have or 100 ha home ranges that may overlap with other males or females (Van Dyck and Strahan 2008). Nest sites include tree hollows and stumps, and within a year an individual phascogale may use up to 40 different sites. There are three nearby records of this species on DBCA's Threatened and Priority Fauna Database (Figure 7). The Brush-tailed Phascogale is likely to occur in the study area, using all habitats.

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 2021b). 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.

The Peregrine Falcon has been recorded within 20km at Morangup, Lower Chittering and Julimar on DBCA's Threatened and Priority Fauna Database (Figure 7). If present, the Peregrine Falcon may forage on adjacent pastures and open areas within the forest, however, the study area is unlikely to be important for this species unless a pair were found to be nesting.

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.

There are five Priority fauna species that potentially occur in the study area, of which two were recorded on this survey.

Barking Owl – *Ninox connivens connivens*

The southwest subpopulation of the Barking Owl is listed as Priority 3 by DBCA.

The southwest subpopulation of the Barking Owl inhabits the southwest corner of Western Australia. The range of this subspecies also extends across the southeast of Australia. It occurs in dry sclerophyll woodlands, particularly in association with watercourses and forest edge (Garnett *et al*. 2010). It nests in large eucalypt hollows in mature trees. The Barking Owl has been recorded within 20km in Avon Valley National Park and Julimar State Forest on DBCA's Threatened and Priority Fauna Database (Figure 7). The habitats of the study area are likely to be suitable for this species, but the status of the species in the local area is unknown as there are few records overall.

Dells' Ctenotus – *Ctenotus delli*

Dell's Ctenotus is listed as Priority 4 by DBCA.

There are five records of Dell's Ctenotus within 20km of the study area on DBCA's Threatened and Priority Fauna Database (Figure 5), all from Julimar between 1983 and 1999. This lizard occurs patchily and uncommonly in the Darling Range, where it inhabits Jarrah and Marri woodlands on a range of soil types (Bush *et al*. 2010, Chapple *et al*. 2019). This species is likely to occur in the Jarrah-Marri woodland habitat in the study area.

Quenda – *Isoodon fusciventer*

The Quenda (or Southern Brown Bandicoot) is listed as Priority 4 by DBCA.

The Quenda has been recorded from multiple sites in Julimar Forest on DBCA's Threatened and Priority Fauna Database (Figure 7). The Quenda is likely to occur in all habitats, however, as it favours areas with a dense understory, the creek habitat and areas of Jarrah – Marri woodland with a shrubby understory are most likely to support this species. Surprisingly, this species was not recorded on the camera traps deployed on this survey. However, it was recorded on a camera trap in the adjacent area in 2020 (Western Wildlife 2020).

Western Brush Wallaby – *Notamacropus irma*

The Western Brush Wallaby is listed as Priority 4 by DBCA.

The Western Brush Wallaby occurs in areas of forest or woodland where there is a dense, shrubby understory. The Western Brush Wallaby has been recorded nearby on DBCA's Threatened and Priority Fauna Database (Figure 7). The home-range size of one individual has been estimated at about 9.9ha for males and 5.3ha for females (Bamford and Bamford 1999), therefore many individuals may be supported in the study area. This species was recorded on 13 of the 20 camera traps deployed (Figure 8, Plate 14), indicating it is relatively common in the area. It was also sighted during the day, and a road-killed individual recorded nearby on Keating Road (Appendix 7). The Western Brush Wallaby is likely to occur in all habitats, resting in dense vegetation during the day and foraging on grasses at night.

Plate 14. Western Brush Wallabies Recorded on Camera Traps in the Study Area.

Tammar Wallaby – *Notamacropus eugenii derbianus*

The Tammar Wallaby is listed as Priority 4 by DBCA.

The Tammar Wallaby was once widespread in south-western Australia, but now occurs only on islands and in several reserves and National Parks (Woinarski *et al*. 2014). Translocated populations occur in Julimar State Forest and nearby at Paruna Sanctuary, and there are records from these populations on DBCA's Threatened and Priority Fauna Database (Figure 7). This species inhabits dense vegetation during the day, foraging in open grassy areas at night (Woinarski *et al*. 2014). The Tammar Wallaby was recorded on two of the 20 camera traps deployed (Figure 8, Plate 15), and potentially occurs in all habitats.

Plate 15. Tammar Wallabies Recorded on Camera Traps in the Study Area.

5.2.5 Locally Significant Fauna

The Carpet Python occurs in a variety of habitats, though it appears to require large tracts of bushland in order to persist (Bush *et al*. 2007). This species has been recorded within 20km of the study area on the WA Museum Specimen Database (Appendix 3) and is known to occur in Julimar State Forest (Johnson *et al*. 2006). The large tracts of native vegetation in forests and reserves are likely to be important for maintaining this species in the region.

5.3 Invertebrates of Conservation Significance

This report is primarily concerned with vertebrate fauna. In general, the invertebrate fauna is far less well known than the vertebrate fauna, while being far more numerous. No field survey for invertebrate fauna was undertaken, however, four invertebrates of conservation significance were listed on DBCA's Threatened and Priority Database within 20km of the study area (Figure 10).

5.3.1 Threatened Invertebrates

A single threatened invertebrate was recorded on DBCA's Threatened and Priority Database within 20km of the study area (Figure 10).

Carter's Freshwater Mussel – *Westralunio carteri*

Carter's Freshwater Mussel is listed as Vulnerable under the BC Act and EPBC Act.

Carter's Freshwater Mussel has been recorded nearby on DBCA's Threatened and Priority Fauna Database (Figure 10), in Marbling Brook, Chittering Valley Road and in West Toodyay. This long-lived species has a declining population, principally due to a decline in its river habitats. This species occurs in perennial freshwater systems, favouring areas with woody debris, and overhanging riparian vegetation (Ponder *et al*. 2016). It is unlikely that Carter's Freshwater Mussel occurs in the creek habitat of the study area as the creeks would not hold water for a sufficient length of time to support this species.

5.3.2 Priority Invertebrates

Three Priority invertebrates were listed on DBCA's Threatened and Priority Database within 20km of the study area (Figure 10).

Inornate Trapdoor Spider – *Euplos inornatus*

The Inornate Trapdoor Spider is listed as Priority 3 by DBCA.

The Inornate Trapdoor Spider occurs on the eastern edge of Swan Coastal Plain, with most records from the Darling Scarp. There is a single record within 20km of the study area on DBCA's Threatened and Priority Fauna Database, on Chittering Rd near Bullsbrook (Figure 10). This species potentially occurs in Jarrah – Marri woodland in the study area.

Julimar Shield-backed Trapdoor Spider – *Idiosoma mcclementsorum*

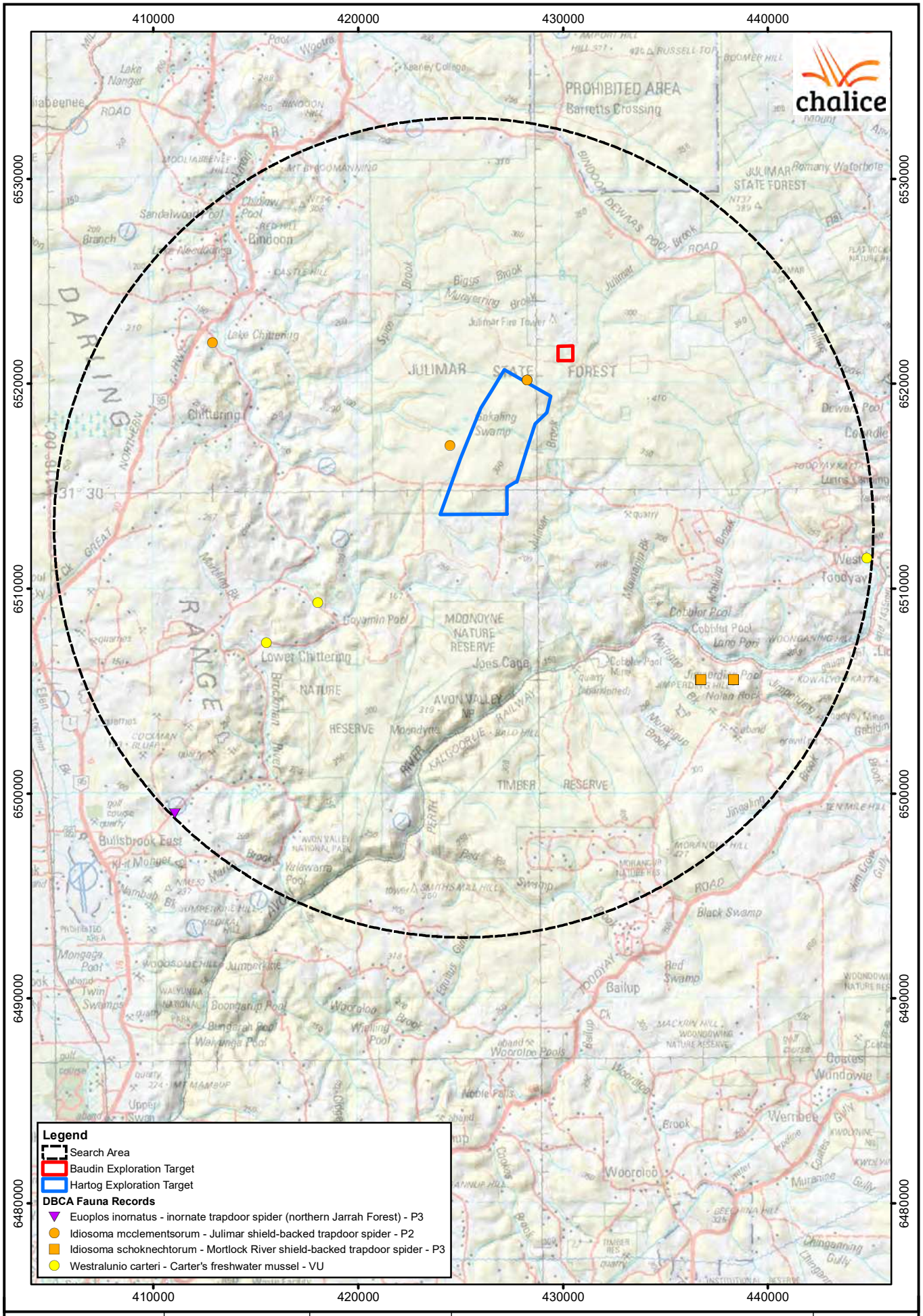
The Julimar Shield-backed Trapdoor Spider is listed as Priority 2 by DBCA.

The Julimar Shield-backed Trapdoor Spider has a highly restricted distribution in the northern Jarrah forest. It is known to occur between Chittering Lakes, Julimar, Toodyay and Gillingara (Rix *et al*. 2018). They build a burrow in sandy soils over laterite, and the trapdoor is adorned with a moustache-like arrangement of twig-lines (Rix *et al*. 2018). This species is known to occur nearby, with records from Julimar State Forest on DBCA's Threatened and Priority Fauna Database (Figure 10). This species potentially occurs in Jarrah – Marri woodland in the study area.

Mortlock River Shield-backed Trapdoor Spider – *Idiosoma schoknechtorum*

The Mortlock River Shield-backed Trapdoor Spider is listed as Priority 3 by DBCA.

The Mortlock River Shield-backed Trapdoor Spider occurs in the central-western wheatbelt and north-eastern Jarrah forest, with its known range extending from near Toodyay in the north to Quairading in the east and Jarrahdale in the south (Rix *et al*. 2018). Although there are records of this species about 15km to the south of the study area on DBCA's Threatened and Priority Fauna Database (Figure 10), the range of this species is not currently thought to extend as far north as the study area.



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

CAD Ref: a2779Fa02_10 | A4

Date: June 2021 | Rev: A | Author: J. Wilcox

N 0 2 4 km
Scale: 1:250,000
MGA94 (Zone 50)

Western Wildlife

Julimar Project (Hartog and Baudin)
DBCA Records of Invertebrate Fauna

Figure: **10**

6. Discussion

6.1 Vertebrate Fauna Assemblage

The predicted faunal assemblage includes up to 16 frogs, 54 reptiles, 99 birds and 31 mammals (25 native and six introduced). As the habitats in the study area are in good condition and part of a larger area of native vegetation, the faunal assemblage is likely to be relatively intact. The observed faunal assemblage one this survey includes one frog, three reptiles, 39 birds and 12 mammals (eight native and four introduced). This is not a complete list of the vertebrate fauna using the study area, as not all groups are sampled at this level of survey, and the survey was undertaken in a single season.

6.2 Conservation Significant Vertebrate Fauna

Fifteen conservation significant vertebrate fauna have been recorded or potentially occur in the study area (Table 7). The species have been grouped into their conservation significance categories and discussed below.

1. Threatened species.

Six threatened species potentially occur in the study area, of which four were recorded during this survey:

- Forest Red-tailed Black-cockatoo (*Calyptorhynchus latirostris banksii*) - **Recorded**
- Carnaby's Cockatoo (*Calyptorhynchus latirostris*) – **Recorded**
- Baudin's Cockatoo (*Calyptorhynchus baudinii*)
- Chuditch (*Dasyurus geoffroii*) – **Recorded**
- Woylie (*Bettongia penicillata ogilbyi*) – **Recorded**
- Black-flanked Rock-wallaby (*Petrogale lateralis lateralis*)

All three black-cockatoo species are likely to be foraging visitors to the study area, with foraging by Carnaby's Cockatoo and the Forest Red-tailed Black-cockatoo confirmed (Figure 8). Baudin's Cockatoo is on the northern limit of its range in the area and is likely to be an occasional visitor only. The woodlands represent high value foraging habitat as they contain favoured cockatoo food-plants such as Marri (*Corymbia calophylla*), Parrotbush (*Banksia sessilis*) and Pingle (*Banksia squarrosa*). The foraging habitat is likely to be important for supporting both non-breeding and breeding birds.

Both Carnaby's Cockatoo and the Forest Red-tailed Black-cockatoo are known to breed in the subregion, and potentially breed in the study area. Habitats that have nest hollows that support breeding, supported breeding in the past and/or may support breeding in the future, with nearby foraging and water resources are considered to be 'habitats critical to the survival' of Carnaby's Cockatoo (DPAW 2013). All Jarrah, Marri and Karri forests, woodlands and remnants in regions receiving more than 600mm rain annually are considered to be habitats critical to the survival' of the Forest Red-tailed Black-cockatoo and Baudin's Cockatoo (DEC 2008).

The Chuditch was recorded in the study area (Figure 8) and is likely to be a breeding resident. Areas of habitat currently occupied by Chuditch, including for breeding, foraging and/or dispersal, are considered to be 'habitat critical to their survival' (DEC 2012).

The Woylie was recorded in the study area (Figure 8) and is also likely to be a breeding resident. Areas of suitable forest, shrubland or heathland habitat currently occupied by the Woylies are considered to be 'habitat critical to the survival of the species' (Yeatman and Groom 2012).

The Black-flanked Rock-wallaby may disperse though the study area, although the likelihood is low as the habitats of the study area are unsuitable for this species.

2. Migratory species.

One Migratory species potentially occurs in the Study Area:

- Fork-tailed Swift (*Apus pacificus*)

The Fork-tailed Swift is thought to be almost entirely aerial when visiting Australia, so the study area is not likely to provide important habitat for this species.

3. Specially Protected species.

Two Specially Protected species potentially occur in the Study Area:

- Peregrine Falcon (*Falco peregrinus*)
- Brush-tailed Phascogale (*Phascogale tapoatafa*)

The Peregrine Falcon may occur as a foraging visitor, however, the study area is unlikely to be important for this species as its population is large and secure, and its favoured breeding habitat is absent. The Brush-tailed Phascogale is likely to occur in all habitats but was not recorded during the field survey.

4. Priority species

Six Priority species potentially occur in the Study Area, of which two were recorded:

- Dell's Ctenotus (*Ctenotus delli*)
- Barking Owl (southern) (*Ninox connivens connivens*)
- Quenda (*Isoodon fusciventer*)
- Western Brush Wallaby (*Notamacropus irma*) - **Recorded**
- Tammar Wallaby (*Notamacropus eugenii derbianus*) - **Recorded**

The Western Brush Wallaby and Tammar Wallaby were recorded in the study area and are likely to be breeding residents using all habitats. Although not recorded on this survey, the Quenda is regularly recorded at Julimar and is likely to be a breeding resident favouring the creek habitat and woodland areas with dense understory. Dell's Ctenotus is likely to occur in the Jarrah – Marri woodland, as it is known to occur nearby. The Barking Owl is uncommonly recorded, but the habitats of the study area are suitable for this species. If present, the study area would represent part of a home-range for a pair of owls.

5. Locally significant species

One locally significant species was identified; the Carpet Python (*Morelia spilota imbricata*). This species is reliant on large tracts of native vegetation and shelters in tree hollows and hollow logs.

6.3 Conservation Significant Invertebrate Fauna

This report is primarily concerned with vertebrate fauna, however, four invertebrates of conservation significance are known to occur within 20km of the study area. Of these, Carter's Freshwater Mussel (*Westralunio carteri*) is unlikely to occur due to lack of suitable habitat and the Mortlock River Shield-backed Trapdoor Spider (*Idiosoma schoknechtorum*) is unlikely to occur as the study area is outside the known range of the species. Two other spiders potentially occur in the Jarrah – Marri woodland habitat in the study area: the Julimar Shield-backed Trapdoor Spider (*Idiosoma mcclementsorum*) and Inornate Trapdoor Spider (*Euoplos inornatus*).

6.4 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 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 in the Northern Jarrah Forest subregion, and for the most part, the faunal assemblage is likely to be typical of the Jarrah – Marri and Wandoo woodlands of the region. The key importance of the habitats present is twofold. Firstly, the study areas are part of Julimar State Forest, a large area of remnant native vegetation that has value in supporting a relatively intact ecosystem. Large habitat areas are less vulnerable to the impacts of habitat fragmentation and increase the likelihood of faunal populations persisting in the long-term. Secondly, the habitats provide 'habitat critical to the survival' of at least four EPBC Act-listed Threatened species, Carnaby's Cockatoo (*Calyptorhynchus latirostris*), Forest Red-tailed Black-cockatoo (*Calyptorhynchus banksii naso*), Woylie (*Bettongia penicillata ogilbyi*) and Chuditch (*Dasyurus geoffroii*).

6.5 Conclusion

The study area contains three fauna habitats; Jarrah – Marri woodland (1,642.1ha), Wandoo woodland (323.3ha) and Creek (43.2ha), as well as 12.8ha of cleared land. The habitats are likely to support a relatively intact faunal assemblage typical of similar habitat types in the area. The key value of the fauna habitats are as a part of a large are of remnant native vegetation that supports a relatively intact ecosystem and their value as habitat to conservation significant fauna. The habitats of the study area provide habitat critical to the survival of the Woylie, Chuditch, Carnaby's Cockatoo and the Forest Red-tailed Black-cockatoo, all of which were confirmed as occurring in the study area.

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*. Technical Report Series No.1, Western Australian Planning Commission, Perth, 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.

BirdLife Australia (2019). Black-cockatoo breeding sites – buffered. URL: https://catalogue.data.wa.gov.au/dataset/black-cockatoo-breeding-sites-buffered

BirdLife Australia (2020). Black-cockatoo roosting sites – buffered.URL: https://catalogue.data.wa.gov.au/dataset/black-cockatoo-roosting-sites-buffered

BirdLife International (2021a). Important Bird Areas factsheet: Bindoon-Julimar. URL: http://www.birdlife.org

BirdLife International (2021b) 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.

BOM (2020). Climate statistics; Pearce RAAF. URL: http://www.bom.gov.au

Bush, B., Maryan, B., Brown-Cooper, R. and Robinson, D. (2010). *Field Guide to the Reptiles and Frogs of the Perth Region*. Western Australian Museum, Perth.

Bush, B., Maryan, B., Brown-Cooper, R. and Robinson, D. (2007). *Reptiles and Frogs in the Bush: Southwestern Australia*. University of Western Australia Press, Perth.

Chapple, D.G., Tingley, R., Mitchell, N.J., MacDonald, S.L., Keogh, J.S., Shea, G.M., Bowles, P., Cox, N.A. and Woinarski, J.C.Z (2019). *The Action Plan for Australia Lizards and Snakes 2017*. CSIRO Publishing, Clayton South, Victoria.

Churchill, S. (2007). *Australian Bats*. 2nd Edition. Reed New Holland, Sydney.

Cogger, H.G., Cameron, E.E., Sadlier, R.A. and Eggler, P. (1993). *The Action Plan for Australian Reptiles*. Endangered Species Programme Project Number 124, Australian Nature Conservation Agency, Canberra.

DBCA (Department of Biodiversity, Conservation and Attractions) (2007-). *Naturemap: Mapping Western Australia's Biodiversity*. Department of Biodiversity, Conservation and Attractions. URL: https://naturemap.dbca.wa.gov.au

DBCA (2020). Threatened and Priority Fauna Database extract, June 2020.

DEC (Department of Environment and Conservation) (2008). FOREST BLACK COCKATOO (BAUDIN'S COCKATOO *Calyptorhynchus baudinii* AND FOREST RED-TAILED BLACK COCKATOO *Calyptorhynchus banksii naso*) RECOVERY PLAN. DEC, Perth, Western Australia.

DEC (Department of Environment and Conservation) (2012). *Chuditch (Dasyurus geoffroii) recovery plan*. Wildlife Management Program No. 54. DEC, Perth, Western Australia.

DoEE (Department of Environment and Energy) (2018). Interim Biogeographic Regionalisation for Australia (IBRA), Version 7.0 (Subregions).

DPAW (Department of Parks and Wildlife) (2013). *Carnaby's Cockatoo (Calyptorhynchus latirostris) Recovery Plan.* Western Australian Wildlife Management Program No. 52. DPAW, Perth, Western Australia.

DSEWPaC (Department of Sustainability, Environment, Water, Population and Communities) (2011). *Survey guidelines for Australia's threatened mammals. EPBC Act survey guidelines 6.5*. EPBC Act policy statement: Canberra, ACT: DSEWPAC. URL: http://www.environment.gov.au/epbc/publications/threatened-mammals.html.

DSEWPaC (Department of Sustainability, Environment, Water, Populations and Communities) (2012). *EBPC Act referral guidelines for three threatened black cockatoo species*. URL: http://www.environment.gov.au/epbc/publications/wa-black-cockatoos.html.

Duncan, A., Baker, G.B. and Montgomery, N. (1999). *The Action Plan for Australian Bats*. Environment Australia, Canberra.

Environmental Protection Authority (EPA) (2016). *Environmental Factor Guideline – Terrestrial Fauna*. EPA, Western Australia.

EPA (2020). *Technical Guidance – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment*. EPA, Western Australia.

Garnett, S.T. Szabo, J.K. and Dutson, G. (2011). The Action Plan For Australian Birds 2010. CSIRO Publishing, Collingwood, Victoria.

Glossop, B. Clarke, K., Mitchell, D. and Barret, G. (2011). Methods for mapping of Carnaby's Cockatoo Habitat. Government of Western Australia 2011. URL: https://catalogue.data.wa.gov.au/dataset/carnabys-cockatoo-confirmed-roost-sites, https://catalogue.data.wa.gov.au/dataset/carnabys-cockatoo-confirmed-breeding-areas

Government of Western Australia (2000). *Bush forever volume 2: directory of bush forever sites*. Department of Environmental Protection, Perth, Western Australia.

Johnson, B., Reaveley, A. and Morris, K. (2006). Julimar: Turning Full Circle. *Landscope* 21(4) 56 – 61.

Johnstone, R.E. and Kirkby, T. (2008). Distribution, Status, Social Organisation, Movements and Conservation of Baudin's Black-Cockatoo (*Calyptorhynchus baudinii*) in Southwest Australia. *Records of the Western Australian Museum* 25: 107 – 118.

Johnstone, R., Kirkby, T., Stone, P. and Minton, C. (2005) *White-tailed Black-Cockatoos: Identification challenges and changes in distribution and status, and links with a community program – Cockatoo Care.* In: Conserving Carnaby's Black-Cockatoo: Future Directions, Proceedings from a conservation symposium, Edited by C. Gole, Perth, Western Australia.

Johnstone, R.E. & Storr, G.M. (1998). *Handbook of Western Australian Birds. Volume 1: Nonpasserines (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.

Menkhorst, P. and Knight, F. (2004). *A field guide to the mammals of Australia*. 2nd Edition. Oxford University Press, South Melbourne.

Ponder, W. F., Hallan, A., Shea, M. and Clark, S. A. (2016). *Australian Freshwater Molluscs***.** http://keys.lucidcentral.org/keys/v3/freshwater_molluscs/

Rix, M.G., Huey, J.A., Cooper, S.J.B., Austin, A.D. and Harvey, M.S. (2018). Conservation systematics of the shield-backed trapdoor spiders of the *nigrum*-group (*Mygalomorphae*, *Idiopidae*, *Idiosoma*): integrative taxonomy reveals a diverse and threatened fauna from south-western Australia. *Zookeys* 2018 (756) 1 – 121. Published online 2018 May 9. URL: 10.3897/zookeys.756.24397

Shah, B. (2006). *Conservation of Carnaby's Black-Cockatoo on the Swan Coastal Plain, Western Australia* Project Report, Birds Australia Western Australia, Perth.

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.

TSSC (Threatened Species Scientific Committee) (2016). *Conservation Advice* Petrogale lateralis lateralis *black-flanked rock-wallaby*. Canberra: Department of the Environment and Energy. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/66647-conservation-advice-07122016.pdf. In effect under the EPBC Act from 07-Dec-2016.

TSSC (2018). *Conservation Advice* Bettongia penicillata *woylie*. Canberra: Department of the Environment and Energy. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/213-conservation-advice-01022018.pdf. In effect under the EPBC Act from 01-Feb-2018.

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 and Strahan, R. (Ed.) (2008). *The Mammals of Australia*. 3rd Edition. Australian Museum/Reed Books, Sydney.

Western Wildlife (2020). *Julimar Nickel-Copper PGE Project: Basic Vertebrate Fauna Survey, Targeted Chuditch Survey and Cockatoo Habitat Survey 2020*. Unpublished Report to Chalice Gold Mines Limited.

Williams, K. and Mitchell, D. (2002). Jarrah Forest 1 *(JF1 – Northern Jarrah Forest subregion).* In: *A Biodiversity Audit of Western Australia's 53 Biogeographical Subregions in 2002.* Ed by J.E. May and N.L. McKenzie. Dept. of Conservation and Land Management, Western Australia.

Wilson, S. and Swan, G. (2017). *A complete guide to the reptiles of Australia. 5th Edition*. New Holland Publishers (Australia).

Woinarski, J.C.Z., Burbidge, A.A. and Harrison, P.L. (2014). *The Action Plan for Australian Mammals 2012*. CSIRO Publishing.

Yeatman, G.J. and Groom, C.J. (2012). National Recovery Plan for the woylie *Bettongia penicillata*. Wildlife Management Program No. 51. Department of Environment and Conservation, Perth.

Appendix 1. Habitat Assessment Sites.

Appendix 1 – Habitat Assessment Sites.	
Hab 01 Habitat: Jarrah -Marri woodland Landform: gentle slope Vegetation: Jarrah - marri woodland over grasstrees and mixed low open shrubland with patchy Banksia squarrosa thickets. Fire age: no recent fire Disturbance: none noted Soil: grey gravelly sand Rock: laterite gravel Important elements: leaf litter, logs, woody debris, tree hollows, mistletoe Wetlands: none	
Hab 02 Habitat: Wandoo woodland Landform: low hill Vegetation: Wandoo woodland with scattered Jarrah over grasstrees and mixed low open shrubland. Fire age: no recent fire Disturbance: None noted Soil: Orange sandy gravel Rock: laterite gravel Important elements: leaf litter, logs, woody debris, tree hollows Wetlands: none	
Hab 03 Habitat: Jarrah -Marri woodland Landform: gentle slope Vegetation: Jarrah - marri woodland over grasstrees and mixed low shrubland with patchy Banksia squarrosa thickets. Fire age: no recent fire Disturbance: None noted Soil: grey-brown sandy gravel Rock: laterite gravel Important elements: some leaf litter, logs, woody debris, tree hollows Wetlands: none	

Appendix 1 – Habitat Assessment Sites.	
Hab 04 Habitat: Wandoo woodland Landform: low hill Vegetation: Wandoo woodland over grasstrees and some Banksia squarrosa over a mixed low open shrubland. Fire age: no recent fire Disturbance: None noted Soil: Brown sandy gravel Rock: laterite gravel Important elements: some leaf litter, logs, woody debris, tree hollows Wetlands: none	
Hab 05 Habitat: Wandoo woodland Landform: gentle slope Vegetation: Wandoo woodland over grasstrees and mixed low shrubland with patchy Banksia squarrosa thickets. Fire age: no recent fire Disturbance: None noted Soil: Brown sandy gravel Rock: laterite gravel, small outcroppings Important elements: leaf litter, logs, woody debris, tree hollows Wetlands: none	
Hab 06 Habitat: Jarrah -Marri woodland Landform: gentle slope Vegetation: Jarrah - marri woodland with scattered Banksia grandis over grasstrees and mixed low shrubland with patchy Banksia squarrosa thickets. Fire age: no recent fire Disturbance: None noted Soil: Brown gravelly sand Rock: laterite gravel Important elements: some leaf litter, logs, woody debris, tree hollows Wetlands: none	

Appendix 1 – Habitat Assessment Sites.	
Hab 07 Habitat: Jarrah -Marri woodland Landform: gentle slope Vegetation: Jarrah - marri woodland over grasstrees and mixed low shrubland with patchy Banksia squarrosa thickets. Fire age: no recent fire Disturbance: None noted Soil: Brown gravelly sand Rock: laterite gravel Important elements: leaf litter, logs, woody debris, tree hollows Wetlands: none	
Hab 08 Habitat: Jarrah -Marri woodland Landform: gentle slope Vegetation: Jarrah - marri woodland over grasstrees and mixed low shrubland with patchy Banksia squarrosa thickets. Fire age: recent fire Disturbance: Historic logging Soil: grey gravelly sand Rock: laterite gravel Important elements: some leaf litter, logs, woody debris, tree hollows Wetlands: none	
Hab 09 Habitat: Jarrah -Marri woodland Landform: gentle slope Vegetation: Jarrah - marri woodland over grasstrees and woollybush over mixed low shrubland with patchy Banksia squarrosa thickets. Fire age: recent fire Disturbance: None noted Soil: yelow gravelly sand Rock: laterite gravel, small outcroppings Important elements: some leaf litter, logs, woody debris, tree hollows Wetlands: none	

Appendix 1 – Habitat Assessment Sites.	
Hab 10 Habitat: Jarrah -Marri woodland Landform: gentle slope Vegetation: Jarrah - marri woodland over grasstrees and mixed low shrubland with patchy Banksia squarrosa thickets. Fire age: recent fire Disturbance: None noted Soil: Brown sandy gravel Rock: laterite gravel, some rocks Important elements: some leaf litter, logs, woody debris, tree hollows Wetlands: none	
Hab 11 Habitat: Jarrah -Marri woodland Landform: gentle slope Vegetation: Jarrah - marri woodland over grasstrees and mixed low shrubland with occasional Banksia squarrosa thickets. Fire age: recent fire Disturbance: None noted Soil: Brown gravelly sand Rock: laterite gravel, some rocks Important elements: some leaf litter, logs, woody debris, tree hollows Wetlands: none	
Hab 12 Habitat: Jarrah -Marri woodland Landform: gentle slope Vegetation: Jarrah - marri woodland over grasstrees and mixed low shrubland with occasional Banksia squarrosa thickets. Fire age: recent fire Disturbance: None noted Soil: Brown gravelly sand Rock: laterite gravel, some rocks Important elements: some leaf litter, logs, woody debris, tree hollows Wetlands: none	

Appendix 1 – Habitat Assessment Sites.	
Hab 13 Habitat: Jarrah -Marri woodland Landform: gentle slope Vegetation: Jarrah - marri woodland over grasstrees and some Hakea sp. over mixed low shrubland. Fire age: recent fire Disturbance: None noted Soil: Brown sandy gravel Rock: laterite gravel, small outcrops Important elements: leaf litter, logs, woody debris, tree hollows Wetlands: none	
Hab 14 Habitat: Wandoo -Marri woodland Landform: gentle slope Vegetation: Wandoo - marri woodland over grasstrees and Macrozamia sp. over very open mixed low shrubland. Fire age: no recent fire Disturbance: None noted Soil: Brown sandy gravel Rock: laterite gravel Important elements: some leaf litter, logs, woody debris, tree hollows Wetlands: none	
Hab 15 Habitat: Jarrah -Marri woodland Landform: gentle slope Vegetation: Jarrah - marri woodland over grasstrees and woollybush over mixed low shrubland with patchy Banksia squarrosa thickets. Fire age: no recent fire Disturbance: None noted Soil: Brown sandy gravel Rock: laterite gravel Important elements: leaf litter, logs, woody debris, tree hollows Wetlands: none	

Appendix 1 – Habitat Assessment Sites.	
Hab 16 Habitat: Jarrah -Marri woodland Landform: gentle slope Vegetation: Jarrah - marri woodland over grasstrees and woollybush over mixed low shrubland with patchy Banksia squarrosa thickets. Fire age: recent fire Disturbance: None noted Soil: Brown sandy gravel Rock: laterite gravel Important elements: some leaf litter, logs, woody debris, tree hollows Wetlands: none	
Hab 17 Habitat: Jarrah -Marri woodland Landform: gentle slope Vegetation: Jarrah - marri woodland over grasstrees and woollybush over mixed low shrubland with patchy Banksia squarrosa thickets. Fire age: recent fire Disturbance: None noted Soil: Brown sandy gravel Rock: laterite gravel Important elements: some leaf litter, logs, woody debris, tree hollows Wetlands: none	
Hab 18 Habitat: Wandoo - Jarrah -Marri woodland Landform: gentle slope Vegetation: Wandoo -jarrah - marri woodland over grasstrees and Macrozamia sp. over mixed low shrubland with patchy Banksia sessilis thickets. Fire age: recent fire Disturbance: None noted Soil: Brown sandy gravel Rock: laterite gravel Important elements: some leaf litter, logs, woody debris, tree hollows Wetlands: none	

Appendix 1 – Habitat Assessment Sites.	
Hab 19 Habitat: Jarrah -Marri woodland Landform: gentle slope Vegetation: Jarrah - marri woodland with scattered Wandoo over grasstrees and mixed low shrubland with patchy Banksia sessilis thickets. Fire age: recent fire Disturbance: None noted Soil: Brown sandy gravel Rock: laterite gravel Important elements: some leaf litter, logs, woody debris, tree hollows Wetlands: none	
Hab 20 Habitat: Jarrah -Marri woodland Landform: gentle slope Vegetation: Jarrah - marri woodland over grasstrees and mixed low shrubland with patchy Banksia sessilis thickets. Fire age: recent fire Disturbance: None noted Soil: Brown sandy gravel Rock: laterite gravel Important elements: some leaf litter, logs, woody debris, tree hollows Wetlands: none	
Hab 21 Habitat: Jarrah -Marri woodland Landform: gentle slope Vegetation: Jarrah - marri woodland over grasstrees and mixed tall shrubland over Boyra. Fire age: no recent fire Disturbance: None noted Soil: Grey gravelly sandy-clay Rock: laterite gravel, small outcropping Important elements: some leaf litter, logs, woody debris, tree hollows Wetlands: none	

Appendix 1 – Habitat Assessment Sites.	
Hab 22 Habitat: Jarrah -Marri woodland Landform: gentle slope Vegetation: Jarrah - marri woodland over grasstrees and mixed low shrubland with patchy Banksia squarrosa thickets. Fire age: recent fire Disturbance: None noted Soil: Brown sandy gravel Rock: laterite gravel, small outcropping Important elements: some leaf litter, logs, woody debris, tree hollows Wetlands: none	
Hab 23 Habitat: Jarrah -Marri woodland Landform: gentle slope Vegetation: Jarrah - marri woodland over grasstrees and mixed low shrubland with patchy Banksia squarrosa thickets. Fire age: recent fire Disturbance: None noted Soil: Brown sandy gravel Rock: laterite gravel, small outcropping Important elements: some leaf litter, logs, woody debris, tree hollows Wetlands: none	
Hab 24 Habitat: Jarrah -Marri woodland Landform: hilltop Vegetation: Jarrah - marri woodland over grasstrees and mixed low shrubland with patchy Banksia squarrosa thickets. Fire age: no recent fire Disturbance: None noted Soil: Brown gravel Rock: laterite gravel, surface rocks and outcropping Important elements: some leaf litter, logs, woody debris, tree hollows Wetlands: none	

Appendix 1 – Habitat Assessment Sites.	
Hab 25 Habitat: Jarrah -Marri -Wandoo woodland Landform: minor drainage Vegetation: Jarrah - marri - Wandoo woodland over mixed tall shrubland including grasstrees, Hakea sp., Calothamnus sp. and woollybush. Fire age: no recent fire Disturbance: None noted Soil: Brown sandy gravel Rock: laterite gravel Important elements: some leaf litter, logs, woody debris, tree hollows Wetlands: seasonal/ephemeral creek	
Hab 26 Habitat: Wandoo woodland Landform: minor drainage Vegetation: Wandoo woodland over grasstrees and mixed low shrubland. Fire age: no recent fire Disturbance: Motorbike tracks Soil: Brown sandy clay Rock: some laterite gravel Important elements: some leaf litter, logs, woody debris, tree hollows, mistletoe Wetlands: seasonal/ephemeral creek	
Hab 27 Habitat: Wandoo woodland Landform: gentle slope Vegetation: Wandoo woodland over grasstrees and Macrozamia sp. over open mixed low shrubland. Fire age: recent fire Disturbance: None noted Soil: Brown sandy clay Rock: some laterite gravel Important elements: some leaf litter, logs, woody debris, tree hollows Wetlands: none	

Appendix 1 – Habitat Assessment Sites.	
Hab 28 Habitat: Jarrah -Marri woodland Landform: gentle slope Vegetation: Jarrah - marri woodland with scattered Banksia grandis over grasstrees and mixed low shrubland with patchy Banksia squarrosa thickets. Fire age: recent fire Disturbance: None noted Soil: Brown sandy gravel Rock: laterite gravel, surface rocks Important elements: some leaf litter, logs, woody debris, tree hollows Wetlands: none	
Hab 29 Habitat: Jarrah -Marri woodland Landform: gentle slope Vegetation: Jarrah - marri woodland with scattered Banksia grandis over grasstrees and mixed low shrubland with patchy Banksia squarrosa thickets. Fire age: recent fire Disturbance: None noted Soil: Brown sandy gravel Rock: laterite gravel, surface rocks Important elements: some leaf litter, logs, woody debris, tree hollows Wetlands: none	
Hab 30 Habitat: Jarrah -Marri woodland Landform: gentle slope Vegetation: Jarrah - marri woodland over grasstrees and Macrozamia sp. over mixed low shrubland with patchy Banksia squarrosa thickets (burnt). Fire age: recent fire Disturbance: None noted Soil: Brown gravelly sand Rock: laterite gravel, minor outcrops Important elements: logs, woody debris, tree hollows Wetlands: none	

Appendix 1 – Habitat Assessment Sites.	
Hab 31 Habitat: Jarrah -Marri woodland Landform: gentle slope Vegetation: Jarrah - marri woodland over grasstrees and mixed low shrubland with patchy Banksia squarrosa thickets. Fire age: recent fire Disturbance: None noted Soil: Brown gravelly sand Rock: laterite gravel Important elements: some leaf litter, logs, woody debris, tree hollows Wetlands: none	
Hab 32 Habitat: Jarrah -Marri woodland Landform: gentle slope Vegetation: Jarrah - marri woodland over grasstrees and mixed low shrubland with patchy Banksia squarrosa thickets (burnt). Fire age: recent fire Disturbance: None noted Soil: Brown gravelly sand Rock: laterite gravel Important elements: logs, woody debris, tree hollows Wetlands: none	
Hab 33 Habitat: Jarrah -Marri - Wandoo woodland Landform: gentle slope Vegetation: Jarrah - marri - wandoo woodland over grasstrees and Macrozamia sp. over mixed low open shrubland with patchy Banksia squarrosa thickets. Fire age: recent fire Disturbance: None noted Soil: Brown sandy gravel Rock: laterite gravel, rocks and minor outcropping Important elements: some leaf litter, logs, woody debris, tree hollows Wetlands: none	

Appendix 1 – Habitat Assessment Sites.	
Hab 34 Habitat: Wandoo woodland Landform: minor drainage Vegetation: Wandoo woodland over grasstrees and Acacia saligna over mixed low open shrubland. Fire age: no recent fire Disturbance: None noted Soil: Brown clay-loam Rock: laterite gravel, minor outcropping Important elements: some leaf litter, logs, woody debris, tree hollows Wetlands: seasonal/ephemeral creek	
Hab 35 Habitat: Jarrah -Marri woodland Landform: gentle slope Vegetation: Jarrah - marri woodland over grasstrees and mixed low shrubland. Fire age: recent fire Disturbance: None noted Soil: Brown clay-loam Rock: laterite gravel, small outcropping Important elements: some leaf litter, logs, woody debris, tree hollows Wetlands: none	
Hab 36 Habitat: Jarrah -Marri woodland Landform: gentle slope Vegetation: Jarrah - marri woodland over grasstrees and mixed low shrubland with patchy Banksia squarrosa thickets. Fire age: recent fire Disturbance: None noted Soil: Brown sandy gravel Rock: laterite gravel Important elements: some leaf litter, logs, woody debris, tree hollows Wetlands: none	

Appendix 2. Frogs that Potentially Occur in the Study Area.

Site visit 2021 = species records from this survey.
Site visit 2020 = species records from the Julimar Project, south of the study area (Western Wildlife 2020).
Faunafile = species recorded in the Western Shield Monitoring Database (see Table 2).
WAM = species records from the Western Australian Museum Database (see Table 2).
FSDB = 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		Status	Records						
			Site visit 2021	Site visit 2020	Faunafile	WAM	FSDB	DBCA	EBPC
Limnodynastidae (burrowing frogs)									
Western Spotted Frog	*Heleioporus albopunctatus*					+			
Hooting Frog	*Heleioporus barycragus*					+	+		
Whooping Frog	*Heleioporus inornatus*						+		
Moaning Frog	*Heleioporus eyrei*					+			
Sand Frog	*Heleioporus psammophilus*						+		
Pobblebonk or Banjo Frog	*Limnodynastes dorsalis*						+		
Myobatrachidae (ground frogs)									
Quacking Frog	*Crinia georgiana*			+		+	+		
Glauert's Froglet	*Crinia glauerti*					+	+		
Bleating Froglet	*Crinia pseudinsignifera*			+		+	+		
Ticking Frog	*Geocrinia leai*					+			
Humming Frog	*Neobatrachus pelobatoides*					+			
Kunapalari Frog	*Neobatrachus kunapalari*					+			
Shoemaker Frog	*Neobatrachus sutor*					+			
Guenther's Toadlet	*Pseudophryne guentheri*		+			+			
Hylidae (tree frogs)									
Slender Tree Frog	*Litoria adelaidensis*								
Motorbike Frog	*Litoria moorei*					+			
# frog species potentially occurring in the study area:		**16**							

Appendix 3. Reptiles that Potentially Occur in the Study Area.

Site visit 2021 = species records from this survey.
Site visit 2020 = species records from the Julimar Project, south of the study area (Western Wildlife 2020).
Faunafile = species recorded in the Western Shield Monitoring Database (see Table 2).
WAM = species records from the Western Australian Museum Database (see Table 2).
FSDB = 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		Status	Records						
			Site visit 2021	Site visit 2020	Faunafile	WAM	FSDB	DBCA	EBPC
Cheluidae (freshwater turtles)									
Long-necked Turtle	*Chelodina colliei*					+	+		
Carphodactylidae (knob-tailed geckoes)									
Southern Barking Gecko	*Underwoodisaurus milii*					+	+		
Diplodactylidae (ground geckos)									
Clawless Gecko	*Crenadactylus ocellatus*					+			
South Coast Gecko	*Diplodactylus calcicolus*					+			
Speckled Stone Gecko	*Diplodactylus lateroides*					+	+		
Wheatbelt Ground Gecko	*Diplodactylus granariensis*					+	+		
Fine-faced Gecko	*Diplodactylus pulcher*					+			
Reticulated Velvet Gecko	*Hesperoedura reticulata*					+			
Gekkonidae (geckoes)									
Southern Spiny-tailed Gecko	*Strophurus spinigerus*								
Tree Dtella	*Gehyra variegata*					+	+		
Marbled Gecko	*Christinus marmoratus*					+	+		
Pygopodidae (legless lizards)									
Granite Worm-lizard	*Aprasia pulchella*					+			
Sand-Plain Worm-Lizard	*Aprasia repens*					+			
Fraser's Legless Lizard	*Delma fraseri*					+	+		
Gray's Legless Lizard	*Delma grayii*					+			
Burton's Legless Lizard	*Lialis burtonis*					+	+		
Common Scaleyfoot	*Pygopus lepidopodus*								
Agamidae (dragon lizards)									
Bearded Dragon	*Pogona minor*					+	+		
Scincidae (skink lizards)									
South-West Cool Skink	*Acritoscincus trilineatus*					+			
Fence Skink	*Cryptoblepharus buchananii*		+	+		+	+		
	Ctenotus australis					+			
Darling Range Ctenotus	*Ctenotus delli*	P				+		+	
West Coast Ctenotus	*Ctenotus fallens*					+	+		
Odd-striped Ctenotus	*Ctenotus impar*								
	Ctenotus labillardieri								
	Ctenotus schomburgkii					+			
Crevice Skink	*Egernia napoleonis*					+			
Broad-banded Sandswimmer	*Eremiascincus richardsonii*					+			
	Hemiergis initialis					+	+		
	Lerista distinguenda					+	+		

Appendix 3. (cont.)

Species		Status	Records						
			Site visit 2021	Site visit 2020	Faunafile	WAM	FSRD	DBCA	EBPC
Scincidae (cont.)									
Bull Skink	*Liopholis multiscutata*					+			
Spectacled Rock Skink	*Liopholis pulchra*					+			
Dwarf Skink	*Menetia greyii*					+	+		
Dusky Morethia	*Morethia obscura*		+			+	+		
Western Bluetongue	*Tiliqua occipitalis*								
Bobtail	*Tiliqua rugosa*				+	+	+		
Varanidae (monitors or goannas)									
Gould's Goanna	*Varanus gouldii*						+		
Black-headed Tree Goanna	*Varanus tristis*					+	+		
Typhlopidae (blind snakes)									
Southern Blind Snake	*Anilios australis*					+	+		
Rotund Blind Snake	*Anilios pinguis*					+	+		
Beaked Blind Snake	*Anilios waitii*					+			
Pythonidae (pythons)									
Stimson's Python	*Antaresia stimsoni*					+			
South-West Carpet Python	*Morelia spilota imbricata*	LS				+			
Elapidae (front-fanged snakes)									
Southern Shovel-nosed Snake	*Brachyurophis semifasciatus*					+			
Yellow-faced Whip-Snake	*Demansia psammophis*					+			
Bardick	*Echiopsis curta*					+			
Black-naped Snake	*Neelaps bimaculatus*								
Western Tiger Snake	*Notechis scutatus*				+				
Gould's Snake	*Parasuta gouldii*					+	+		
Black-backed Hooded Snake	*Parasuta nigriceps*								
Mulga Snake	*Pseudechis australis*					+			
Dugite	*Pseudonaja affinis*		+			+	+		
Gwardar	*Pseudonaja mengdeni*					+			
Jan's Banded Snake	*Simoselaps bertholdi*					+			
# reptile species potentially occurring in the study area::		**54**							

Appendix 4. Birds that Potentially Occur in the Study Area.

Site visit 2021 = species records from this survey.
Site visit 2020 = species records from the Julimar Project, south of the study area (Western Wildlife 2020).
Birdata = species records from the Birdata Database (see Table 2).
BA = species records from the Bird Australia Atlas Database (see Table 2).
WAM = species records from the Western Australian Museum Database (see Table 2).
FSDB = 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).
Int = introduced species.

Species		Status	Records							
			Site visit 2021	Site visit 2020	Birdata	BA	WAM	FSRD	DBCA	EBPC
Dromaiidae (emu)										
Emu	*Dromaius novaehollandiae*		+	+	+	+		+		
Anatidae (ducks and swans)										
Grey Teal	*Anas gracilis*				+	+				
Pacific Black Duck	*Anas superciliosus*				+	+				
Australian Wood Duck	*Chenonetta jubata*				+	+				
Australian Shelduck	*Tadorna tadornoides*				+	+				
Phasianidae (pheasants and quails)										
Stubble Quail	*Coturnix pectoralis*					+				
Threskiornithidae (ibis and spoonbills)										
Australian White Ibis	*Threskiornis moluccus*				+	+				
Straw-necked Ibis	*Threskiornis spinicollis*				+	+				
Accipitridae (kites, hawks and eagles)										
Black-shouldered Kite	*Elanus caeruleus*					+	+			
Square-tailed Kite	*Hamirostra isura*					+				
Whistling Kite	*Haliastur sphenurus*				+	+	+			
Brown Goshawk	*Accipiter fasciatus*				+	+				
Collared Sparrowhawk	*Accipiter cirrocephalus*				+	+		+		
Wedge-tailed Eagle	*Aquila audax*		+		+	+		+		
Little Eagle	*Aquila morphnoides*				+	+	+			
Turnicidae (button-quails)										
Painted Button-quail	*Turnix varia*		+	+		+		+		
Columbidae (pigeons and doves)										
Laughing Turtle-Dove	*Streptopelia senegalensis*	Int.			+	+				
Common Bronzewing	*Phaps chalcoptera*			+	+	+		+		
Crested Pigeon	*Ocyphaps lophotes*				+	+				
Cuculidae (cuckoos)										
Pallid Cuckoo	*Cuculus pallidus*				+	+				
Fan-tailed Cuckoo	*Cacamantis flabelliformis*				+	+		+		
Horsfield's Bronze-Cuckoo	*Chrysococcyx basalis*							+		
Shining Bronze-Cuckoo	*Chrysococcyx lucidus*							+		
Tytonidae (barn owls)										
Barn Owl	*Tyto alba*									
Strigidae (hawk-owls)										
Barking Owl	*Ninox connivens connivens*	P							+	
Southern Boobook Owl	*Ninox novaeseelandiae*				+	+		+		

Appendix 4. (cont.)

Species		Status	Records							
			Site visit 2021	Site visit 2020	Birdata	BA	WAM	FSRD	DBCA	EBPC
Podargidae (frogmouths)										
Tawny Frogmouth	*Podargus strigoides*				+	+	+			
Aegothelidae (owlet-nightjar)										
Australian Owlet-nightjar	*Aegotheles cristatus*					+				
Apodidae (swifts)										
Fork-tailed Swift	*Apus pacificus*	Mi								+
Alcedinidae (forest kingfishers)										
Laughing Kookaburra	*Dacelo novaeguineae*	Int.	+	+	+	+		+		
Sacred Kingfisher	*Todiramphus sanctus*				+	+				
Meropidae (bee-eaters)										
Rainbow Bee-eater	*Merops ornatus*				+	+				
Falconidae (falcons)										
Brown Falcon	*Falco berigora*				+	+				
Peregrine Falcon	*Falco peregrinus*	OS				+			+	
Australian Hobby	*Falco longipennis*					+				
Australian Kestrel	*Falco cenchroides*				+	+				
Cacatuidae (cockatoos)										
Forest Red-tailed Black-Cockatoo	*Calyptorhynchus banksii*	T	+	+	+	+		+	+	
Baudin's Black-Cockatoo	*Calyptorhynchus baudini*	T				+			+	
Carnaby's Black-Cockatoo	*Calyptorhynchus latirostris*	T	+	+	+	+	+	+	+	
Western Long-billed Corella	*Cacatua pastinator*				+	+				
Little Corella	*Cacatua sanguinea*				+	+				
Galah	*Cacatua roseicapilla*			+		+	+	+		
Psittacidae (lorikeets and parrots)										
Purple-crowned Lorikeet	*Glossopsitta porphyrocephala*				+	+		+		
Western Rosella	*Platycercus icterotis*				+	+				
Red-capped Parrot	*Platycercus spurius*		+	+			+	+		
Australian Ringneck	*Platycercus zonarius*		+	+		+		+		
Elegant Parrot	*Neophema elegans*				+	+		+		
Climacteridae (tree-creepers)										
Rufous Tree-creeper	*Climacteris rufus*		+		+	+		+		
Maluridae (fairy-wrens)										
Red-winged Fairy-wren	*Malurus elegans*				+					
Splendid Fairy-wren	*Malurus splendens*		+		+	+		+		

Appendix 4. (cont.)

Species		Status	Records							
			Site visit 2021	Site visit 2020	Birdata	BA	WAM	FSRD	DBCA	EBPC
Meliphagidae (honeyeaters)										
Red Wattlebird	*Anthochaera carunculata*		+		+	+	+	+		
Western Wattlebird	*Anthochaera lunulata*					+				
Brown-headed Honeyeater	*Melithreptus breviorostris*				+	+				
White-naped Honeyeater	*Melithreptus chloropsis*		+			+		+		
Singing Honeyeater	*Gavicalis virescens*		+	+	+	+		+		
Brown Honeyeater	*Lichmera indistincta*		+	+	+	+		+		
New Holland Honeyeater	*Phylidonyris novaehollandiae*				+	+		+		
White-cheeked Honeyeater	*Phylidonyris nigra*		+		+	+		+		
Tawny-crowned Honeyeater	*Glyciphila melanops*		+		+	+		+		
Yellow-plumed Honeyeater	*Ptilotula ornata*		+		+	+				
Western Spinebill	*Acanthorhynchus superciliosus*		+	+	+	+		+		
Pardalotidae (pardalotes)										
Spotted Pardalote	*Pardalotus punctatus*				+	+	+	+		
Striated Pardalote	*Pardalotus striatus*		+		+	+		+		
Acanthizidae (thornbills and allies)										
White-browed Scrubwren	*Sericornis frontalis*					+				
Weebill	*Smicrornis brevirostris*		+	+	+	+		+		
Western Gerygone	*Gerygone fusca*		+	+	+	+		+		
Inland Thornbill	*Acanthiza apicalis*		+	+	+	+		+		
Western Thornbill	*Acanthiza inornata*		+	+	+	+		+		
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*		+	+	+	+				
Pomatostomidae (babblers)										
White-browed Babbler	*Pomatostomus superciliaris*				+	+		+		
Artamidae (woodswallows)										
Black-faced Woodswallow	*Artamus cinereus*				+	+				
Dusky Woodswallow	*Artamus cyanopterus*		+		+	+	+			
Cracticidae (butcherbirds, currawongs & magpies)										
Pied Butcherbird	*Cracticus nigrogularis*				+	+				
Grey Butcherbird	*Cracticus torquatus*			+	+	+				
Australian Magpie	*Cracticus tibicen*		+	+	+	+		+		
Grey Currawong	*Strepera versicolor*		+		+	+		+		
Campephagidae (cuckoo-shrikes)										
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*		+		+	+				
White-winged Triller	*Lalage tricolor*									
Neosittidae (sittellas)										
Varied Sittella	*Daphoenositta chrysoptera*		+		+	+		+		
Pachycephalidae (whistlers)										
Crested Shrike-tit	*Falcunculus frontatus*					+				
Rufous Whistler	*Pachycephala rufiventris*		+	+	+	+		+		
Western Golden Whistler	*Pachycephala occidentalis*		+	+	+	+		+		
Grey Shrike-thrush	*Colluricincla harmonica*		+	+	+	+	+	+		
Rhipiduridae (fantails)										
Grey Fantail	*Rhipidura albiscapa*		+	+	+	+		+		
Willie Wagtail	*Rhipidura leucophrys*			+	+	+				

Appendix 4. (cont.)

Species	Status	Records							
		Site visit 2021	Site visit 2020	Birdata	BA	WAM	FSRD	DBCA	EBPC
Monarchidae (monarchs, flycatchers and allies)									
Restless Flycatcher *Myiagra inquieta*					+				
Magpie-lark *Grallina cyanoleuca*				+	+				
Corvidae (ravens and crows)									
Australian Raven *Corvus coronoides*		+	+	+	+	+	+		
Petroicidae (Australian robins)									
Western Yellow Robin *Eopsaltria australis griseogularis*		+			+		+		
Jacky Winter *Microeca fascinans*				+					
Red-capped Robin *Petroica goodenovii*				+	+	+	+		
Scarlet Robin *Petroica boodang*		+	+	+	+		+		
Hirundinidae (swallows)									
White-backed Swallow *Cheramoeca leucosternus*					+		+		
Welcome Swallow *Hirundo neoxena*				+	+				
Tree Martin *Petrochelidon nigricans*		+	+	+	+	+	+		
Locustellidae (songlarks, grassbirds and allies)									
Rufous Songlark *Cincloramphus mathewsi*				+	+				
Zosteropidae (white-eyes)									
Silvereye *Zosterops lateralis*		+	+	+	+		+		
Dicaeidae (flower-peckers)									
Mistletoebird *Dicaeum hirundinaceum*		+		+	+		+		
Motacillidae (pipits and true wagtails)									
Australian Pipit *Anthus australis*			+						
# bird species potentially occurring in the study area:	**99**								

Appendix 5. Mammals that Potentially Occur in the Study Area.

Site visit 2021 = species records from this survey.
Site visit 2020 = species records from the Julimar Project, south of the study area (Western Wildlife 2020).
Faunafile = species from the Western Shield Monitoring Database (see Table 2).
Quenda = species records from the Quenda Community Survey (see Table 2).
WAM = species records from the Western Australian Museum Database (see Table 2).
FSDB = 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).
Int = introduced species.

Species		Status	Records							
			Site visit 2021	Site visit 2020	Faunafile	Quenda	WAM	FSDB	DBCA	EBPC
Tachyglossidae (echidnas)										
Echidna	*Tachyglossus aculeatus*		+	+			+	+		
Dasyuridae (dasyurid marsupials)										
Mardo (Yellow-footed Antechinus)	*Antechinus flavipes*		+	+						
Chuditch	*Dasyurus geoffroii*	T	+	+			+	+	+	+
Brush-tailed Phascogale	*Phascogale tapoatafa*	SP			+				+	
Little Long-tailed Dunnart	*Sminthopsis dolichura*						+	+		
Gilbert's Dunnart	*Sminthopsis gilberti*						+	+		
Grey-bellied Dunnart	*Sminthopsis griseoventer*						+			
Peramelidae (bandicoots)										
Quenda or Southern Brown Bandicoot	*Isoodon fusciventer*	P		+	+	+		+	+	
Burramyidae (pygmy possums)										
Western Pygmy Possum	*Cercartetus concinnus*						+			
Tarsipedidae (honey possum)										
Honey Possum	*Tarsipes rostratus*						+	+		
Phalangeridae (possums)										
Brush-tailed Possum	*Trichosurus vulpecula*		+	+				+		
Potoroidae (bettongs and potoroos)										
Woylie	*Bettongia penicillata ogilbyi*	T	+						+	+
Macropodidae (kangaroos and wallabies)										
Western Brush Wallaby	*Notamacropus irma*	P	+				+		+	
Tammar Wallaby	*Notamacropus eugenii derbianus*	P	+				+	+	+	
Western Grey Kangaroo	*Macropus fuliginosus*		+	+			+	+		
Black-flanked Rock-wallaby	*Petrogale lateralis lateralis*	T							+	+
Mollosidae (mastiff bats)										
White-striped Bat	*Austonomus australis*							+		
South-western Free-tailed Bat	*Mormopterus kitcheneri*							+		
Vespertilionidae (vesper bats)										
Gould's Wattled Bat	*Chalinolobus gouldii*							+		
Chocolate Wattled Bat	*Chalinolobus morio*							+		
Southern Forest Bat	*Vespedalus regulus*						+	+		
Lesser Long-eared Bat	*Nyctophilus geoffroyi*							+		
Gould's Long-eared Bat	*Nyctophilus gouldii*									
Greater Long-eared Bat	*Nyctophilus major*							+		

Appendix 5. (cont.)

Species		Status	Records							
			Site visit 2021	Site visit 2020	Faunafile	Quenda	WAM	FSDB	DBCA	EBPC
Muridae (rats and mice)										
House Mouse	*Mus musculus*	Int.		+	+		+	+		
Western Bush Rat	*Rattus fuscipes*							+		
Black Rat	*Rattus rattus*	Int.			+		+			
Leporidae (rabbits and hares)										
Rabbit	*Oryctolagus cuniculus*	Int.	+	+	+		+	+		
Canidae (foxes and dogs)										
European Red Fox	*Vulpes vulpes*	Int.	+	+				+		
Felidae (cats)										
Feral Cat	*Felis catus*	Int.	+	+			+	+		
Suidae (pigs)										
Pig	*Sus scrofa*	Int.	+					+		
# mammal species:		**31**								

Appendix 6. EPBC Protected Matters Search Tool Results.

Threatened and Migratory species listed for the 5km radius surrounding 31.473°S, 116.235°E on the EPBC Protected Matters Search Tool.

Species	Status	Type of Presence
Calidris ferruginea Curlew Sandpiper	Critically Endangered & Migratory (wetland)	Species or species habitat MAY occur within area
Numenious madagascariensis Eastern Curlew	Critically Endangered & Migratory (wetland)	Species or species habitat MAY occur within area
Calyptorhynchus banksii naso Forest Red-tailed Black Cockatoo	Vulnerable	Species or species habitat LIKELY TO occur within area
Calyptorhynchus latirostris Carnaby's Black-Cockatoo	Endangered	Species or species habitat KNOWN TO occur within area
Leipoa ocellata Malleefowl	Vulnerable	Species or species habitat LIKELY TO occur within area
Rostratula australis Australian Painted Snipe	Endangered & Migratory	Species or species habitat LIKELY TO occur within area
Dasyurus geoffroii Chuditch	Vulnerable	Species or species habitat KNOWN TO occur within area
Bettongia penicillata ogilbyi Woylie	Endangered	Species or species habitat MAY occur within area
Petrogale lateralis lateralis Black-flanked Rock Wallaby	Endangered	Species or species habitat LIKELY TO occur within area
Apus pacificus Fork-tailed Swift	Migratory (terrestrial)	Species or species habitat LIKELY TO occur within area
Motacilla cinerea Grey Wagtail	Migratory (terrestrial)	Species or species habitat MAY occur within area
Tringa hypoleucos Common Sandpiper	Migratory (wetland)	Species or species habitat MAY occur within area
Calidris acuminata Sharp-tailed Sandpiper	Migratory (wetland)	Species or species habitat MAY occur within area
Calidris melanotos Pectoral Sandpiper	Migratory (wetland)	Species or species habitat MAY occur within area
Pandion haliaetus Osprey	Migratory (wetland)	Species or species habitat MAY occur within area

Appendix 7. Fauna Recorded in the Study Area April - May 2021.

Appendix 7 – fauna recorded in the study area							
Easting	Northing	Taxon Name	Common Name	Site	Status	ObsType	Date
424862	6514156	*Acanthiza apicalis*	Inland Thornbill	Hab 01		Day Sighting	14/5/21
430223	6521150	*Acanthiza apicalis*	Inland Thornbill	Hab 14		Day Sighting	19/4/21
425452	6515764	*Acanthiza apicalis*	Inland Thornbill	Hab 24		Day Sighting	17/5/21
425183	6516343	*Acanthiza apicalis*	Inland Thornbill	Hab 26		Day Sighting	17/5/21
430381	6521456	*Acanthiza apicalis*	Inland Thornbill	Hab 28		Day Sighting	17/5/21
426352	6516268	*Acanthiza apicalis*	Inland Thornbill	Hab 30		Day Sighting	17/5/21
424862	6514156	*Acanthiza chrysorrhoea*	Yellow-rumped Thornbill	Hab 01		Day Sighting	14/5/21
425034	6515700	*Acanthiza chrysorrhoea*	Yellow-rumped Thornbill	Hab 25		Day Sighting	17/5/21
425377	6514343	*Acanthiza inornata*	Western Thornbill	Hab 02		Day Sighting	14/5/21
426196	6514314	*Acanthiza inornata*	Western Thornbill	Hab 03		Day Sighting	14/5/21
426328	6518803	*Acanthiza inornata*	Western Thornbill	Hab 17		Day Sighting	19/4/21
425034	6515700	*Acanthiza inornata*	Western Thornbill	Hab 25		Day Sighting	17/5/21
424801	6515090	*Acanthorhychus superciliosus*	Western Spinebill	Hab 05		Day Sighting	14/5/21
425845	6515913	*Acanthorhychus superciliosus*	Western Spinebill	Hab 07		Day Sighting	19/4/21
425483	6517023	*Acanthorhychus superciliosus*	Western Spinebill	Hab 08		Day Sighting	19/4/21
425914	6517706	*Acanthorhychus superciliosus*	Western Spinebill	Hab 09		Digging	19/4/21
428216	6519229	*Acanthorhychus superciliosus*	Western Spinebill	Hab 12		Day Sighting	14/5/21
427762	6520153	*Acanthorhychus superciliosus*	Western Spinebill	Hab 15		Day Sighting	14/5/21
426328	6518803	*Acanthorhychus superciliosus*	Western Spinebill	Hab 17		Day Sighting	19/4/21
425452	6515764	*Acanthorhychus superciliosus*	Western Spinebill	Hab 24		Day Sighting	17/5/21
425034	6515700	*Acanthorhychus superciliosus*	Western Spinebill	Hab 25		Day Sighting	17/5/21
425183	6516343	*Acanthorhychus superciliosus*	Western Spinebill	Hab 26		Day Sighting	17/5/21
426133	6516895	*Acanthorhychus superciliosus*	Western Spinebill	Hab 31		Day Sighting	17/5/21
426425	6517425	*Acanthorhychus superciliosus*	Western Spinebill	Hab 32		Day Sighting	17/5/21
427203	6515585	*Antechinus flavipes*	Mardo	Cg41B		Camera trap	30/4/21
425377	6514343	*Anthochaera carunculata*	Red Wattlebird	Hab 02		Day Sighting	14/5/21
427730	6516248	*Aquila audax*	Wedge-tailed Eagle	Hab 21		Day Sighting	19/4/21
425034	6515700	*Artamus cyanopterus*	Dusky Woodswallow	Hab 25		Day Sighting	17/5/21
427752	6516184	*Bettongia penicillata ogilbyi*	Woylie	Cg23B	CR	Camera trap	30/4/21
427203	6515585	*Bettongia penicillata ogilbyi*	Woylie	Cg41B	CR	Camera trap	30/4/21
426406	6514020	*Calyptorhynchus banksii naso*	Forest Red-tailed Black-cockatoo	No site	VU	Day Sighting	14/5/21
424745	6514055	*Calyptorhynchus banksii naso*	Forest Red-tailed Black-cockatoo	No site	VU	Foraging signs (Marri)	17/5/21

Appendix 7 – fauna recorded in the study area							
Easting	Northing	Taxon Name	Common Name	Site	Status	ObsType	Date
424608	6513620	*Calyptorhynchus banksii naso*	Forest Red-tailed Black-cockatoo	No site	VU	Foraging signs (Marri)	17/5/21
430080	6521820	*Calyptorhynchus banksii naso*	Forest Red-tailed Black-cockatoo	No site	VU	Foraging signs (Marri)	17/5/21
426518	6517525	*Calyptorhynchus latirostris*	Carnaby's Cockatoo	No site	EN	Foraging signs (Marri)	17/5/21
425738	6516352	*Calyptorhynchus latirostris*	Carnaby's Cockatoo	No site	EN	Foraging signs (Marri)	17/5/21
430080	6521820	*Calyptorhynchus latirostris*	Carnaby's Cockatoo	No site	EN	Foraging signs (Marri)	17/5/21
427347	6517754	*Calyptorhynchus latirostris*	Carnaby's Cockatoo	No site	EN	Foraging signs (Marri)	17/5/21
425377	6514343	*Climacteris rufus*	Rufous Tree-creeper	Hab 02		Day Sighting	14/5/21
426283	6513863	*Climacteris rufus*	Rufous Tree-creeper	Hab 04		Day Sighting	14/5/21
424786	6515060	*Collurincla harmonica*	Grey Shrike-thrush	Cg15B		Camera trap	30/4/21
425377	6514343	*Collurincla harmonica*	Grey Shrike-thrush	Hab 02		Day Sighting	14/5/21
424801	6515090	*Collurincla harmonica*	Grey Shrike-thrush	Hab 05		Day Sighting	14/5/21
430381	6521456	*Collurincla harmonica*	Grey Shrike-thrush	Hab 28		Day Sighting	17/5/21
429923	6521437	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike	Hab 29		Day Sighting	17/5/21
430228	6521152	*Corvus coronoides*	Australian Raven	Cg24B		Camera trap	30/4/21
425034	6515700	*Corvus coronoides*	Australian Raven	Hab 25		Day Sighting	17/5/21
430182	6521780	*Cracticus tibicen*	Australian Magpie	Hab 27		Day Sighting	17/5/21
427762	6520153	*Cryptoblepharus buchannanii*	Fence Skink	Hab 15		Day Sighting	19/4/21
429923	6521437	*Cryptoblepharus buchannanii*	Fence Skink	Hab 29		Day Sighting	17/5/21
425377	6514343	*Dacelo novaeguineae*	Laughing Kookaburra	Hab 02		Day Sighting	14/5/21
425183	6516343	*Daphoenositta chrysoptera*	Varied Sittella	Hab 26		Day Sighting	17/5/21
425817	6515924	*Dasyurus geoffroii*	Chuditch	Cg03B	VU	Camera trap	30/4/21
427725	6520187	*Dasyurus geoffroii*	Chuditch	Cg07B	VU	Camera trap	30/4/21
425661	6515068	*Dasyurus geoffroii*	Chuditch	Cg09B	VU	Camera trap	30/4/21
427463	6518633	*Dasyurus geoffroii*	Chuditch	Cg10B	VU	Camera trap	30/4/21
428217	6519226	*Dasyurus geoffroii*	Chuditch	Cg13B	VU	Camera trap	30/4/21
424786	6515060	*Dasyurus geoffroii*	Chuditch	Cg15B	VU	Camera trap	30/4/21
427033	6514981	*Dasyurus geoffroii*	Chuditch	Cg16B	VU	Camera trap	30/4/21
428374	6517930	*Dasyurus geoffroii*	Chuditch	Cg20B	VU	Camera trap	30/4/21
427173	6519312	*Dasyurus geoffroii*	Chuditch	Cg22B	VU	Camera trap	30/4/21
427752	6516184	*Dasyurus geoffroii*	Chuditch	Cg23B	VU	Camera trap	30/4/21
430228	6521152	*Dasyurus geoffroii*	Chuditch	Cg24B	VU	Camera trap	30/4/21
429003	6519168	*Dasyurus geoffroii*	Chuditch	Cg25B	VU	Camera trap	30/4/21
425922	6517696	*Dasyurus geoffroii*	Chuditch	Cg26B	VU	Camera trap	30/4/21
428392	6519868	*Dasyurus geoffroii*	Chuditch	Cg27B	VU	Camera trap	30/4/21
427203	6515585	*Dasyurus geoffroii*	Chuditch	Cg41B	VU	Camera trap	30/4/21
426713	6518003	*Dasyurus geoffroii*	Chuditch	Cg42B	VU	Camera trap	30/4/21

Appendix 7 – fauna recorded in the study area							
Easting	Northing	Taxon Name	Common Name	Site	Status	ObsType	Date
425474	6517022	*Dasyurus geoffroii*	Chuditch	Cg46B	VU	Camera trap	30/4/21
425401	6513632	*Dasyurus geoffroii*	Chuditch	No site	VU	Scats	17/5/21
425183	6516343	*Dicaeum hirundinaceum*	Mistletoebird	Hab 26		Day Sighting	17/5/21
430182	6521780	*Dicaeum hirundinaceum*	Mistletoebird	Hab 27		Day Sighting	17/5/21
427463	6518633	*Dromaius novaehollandiae*	Emu	Cg10B		Camera trap	30/4/21
426196	6514314	*Dromaius novaehollandiae*	Emu	Hab 03		Scats	14/5/21
425452	6515764	*Dromaius novaehollandiae*	Emu	Hab 24		Scats	17/5/21
426425	6517425	*Dromaius novaehollandiae*	Emu	Hab 32		Scats	17/5/21
427517	6516919	*Dromaius novaehollandiae*	Emu	Hab 35		Scats	17/5/21
429923	6521437	*Eopsaltria australis griseogularis*	Western Yellow Robin	Hab 29		Day Sighting	17/5/21
424786	6515060	*Felis catus*	Cat	Cg15B		Camera trap	30/4/21
425474	6517022	*Felis catus*	Cat	Cg46B		Camera trap	30/4/21
424801	6515090	*Gavicalis virescens*	Singing Honeyeater	Hab 05		Day Sighting	19/4/21
427762	6520153	*Gavicalis virescens*	Singing Honeyeater	Hab 15		Day Sighting	19/4/21
425034	6515700	*Gavicalis virescens*	Singing Honeyeater	Hab 25		Day Sighting	17/5/21
424862	6514156	*Gerygone fusca*	Western Gerygone	Hab 01		Day Sighting	14/5/21
425483	6517023	*Gerygone fusca*	Western Gerygone	Hab 08		Day Sighting	14/5/21
430223	6521150	*Gerygone fusca*	Western Gerygone	Hab 14		Day Sighting	19/4/21
428390	6518713	*Gerygone fusca*	Western Gerygone	Hab 19		Day Sighting	14/5/21
425452	6515764	*Gerygone fusca*	Western Gerygone	Hab 24		Day Sighting	17/5/21
425034	6515700	*Gerygone fusca*	Western Gerygone	Hab 25		Day Sighting	17/5/21
430381	6521456	*Gerygone fusca*	Western Gerygone	Hab 28		Day Sighting	17/5/21
426352	6516268	*Gerygone fusca*	Western Gerygone	Hab 30		Day Sighting	17/5/21
426328	6518803	*Glyciphila melanops*	Tawny-crowned Honeyeater	Hab 17		Day Sighting	19/4/21
425034	6515700	*Glyciphila melanops*	Tawny-crowned Honeyeater	Hab 25		Day Sighting	17/5/21
424862	6514156	*Lichmera indistincta*	Brown Honeyeater	Hab 01		Day Sighting	14/5/21
426283	6513863	*Lichmera indistincta*	Brown Honeyeater	Hab 04		Day Sighting	14/5/21
424801	6515090	*Lichmera indistincta*	Brown Honeyeater	Hab 05		Day Sighting	14/5/21
424801	6515090	*Lichmera indistincta*	Brown Honeyeater	Hab 05		Day Sighting	19/4/21
427762	6520153	*Lichmera indistincta*	Brown Honeyeater	Hab 15		Day Sighting	19/4/21
426328	6518803	*Lichmera indistincta*	Brown Honeyeater	Hab 17		Day Sighting	19/4/21
425034	6515700	*Lichmera indistincta*	Brown Honeyeater	Hab 25		Day Sighting	17/5/21
425183	6516343	*Lichmera indistincta*	Brown Honeyeater	Hab 26		Day Sighting	17/5/21
426425	6517425	*Lichmera indistincta*	Brown Honeyeater	Hab 32		Day Sighting	17/5/21
427742	6517514	*Lichmera indistincta*	Brown Honeyeater	Hab 34		Day Sighting	17/5/21
425661	6515068	*Macropus fuliginosus*	Western Grey Kangaroo	Cg09B		Camera trap	30/4/21
427463	6518633	*Macropus fuliginosus*	Western Grey Kangaroo	Cg10B		Camera trap	30/4/21

Appendix 7 – fauna recorded in the study area							
Easting	Northing	Taxon Name	Common Name	Site	Status	ObsType	Date
424786	6515060	*Macropus fuliginosus*	Western Grey Kangaroo	Cg15B		Camera trap	30/4/21
427173	6519312	*Macropus fuliginosus*	Western Grey Kangaroo	Cg22B		Camera trap	30/4/21
426342	6518785	*Macropus fuliginosus*	Western Grey Kangaroo	Cg31B		Camera trap	30/4/21
428439	6518705	*Macropus fuliginosus*	Western Grey Kangaroo	Cg32B		Camera trap	30/4/21
424862	6514156	*Macropus fuliginosus*	Western Grey Kangaroo	Hab 01		Scats	14/5/21
426196	6514314	*Macropus fuliginosus*	Western Grey Kangaroo	Hab 03		Scats	14/5/21
424801	6515090	*Macropus fuliginosus*	Western Grey Kangaroo	Hab 05		Scats	14/5/21
426719	6518003	*Macropus fuliginosus*	Western Grey Kangaroo	Hab 10		Scats	14/5/21
427509	6518602	*Macropus fuliginosus*	Western Grey Kangaroo	Hab 11		Scats	14/5/21
428216	6519229	*Macropus fuliginosus*	Western Grey Kangaroo	Hab 12		Day Sighting	19/4/21
427762	6520153	*Macropus fuliginosus*	Western Grey Kangaroo	Hab 15		Scats	14/5/21
427143	6519313	*Macropus fuliginosus*	Western Grey Kangaroo	Hab 16		Scats	14/5/21
428388	6517924	*Macropus fuliginosus*	Western Grey Kangaroo	Hab 20		Scats	14/5/21
427730	6516248	*Macropus fuliginosus*	Western Grey Kangaroo	Hab 21		Scats	14/5/21
425452	6515764	*Macropus fuliginosus*	Western Grey Kangaroo	Hab 24		Scats	17/5/21
430381	6521456	*Macropus fuliginosus*	Western Grey Kangaroo	Hab 28		Day Sighting	17/5/21
427348	6517763	*Macropus fuliginosus*	Western Grey Kangaroo	Hab 33		Day Sighting	17/5/21
427517	6516919	*Macropus fuliginosus*	Western Grey Kangaroo	Hab 35		Scats	17/5/21
427752	6516184	*Malurus splendens*	Splendid Fairy-wren	Cg23B		Camera trap	30/4/21
430223	6521150	*Malurus splendens*	Splendid Fairy-wren	Hab 14		Day Sighting	14/5/21
427762	6520153	*Malurus splendens*	Splendid Fairy-wren	Hab 15		Day Sighting	19/4/21
430381	6521456	*Malurus splendens*	Splendid Fairy-wren	Hab 28		Day Sighting	17/5/21
425377	6514343	*Melithreptus chloropsis*	White-naped Honeyeater	Hab 02		Day Sighting	14/5/21
430381	6521456	*Morethia obscura*		Hab 28		Day Sighting	17/5/21
425661	6515068	*Notamacropus eugenii derbianus*	Tammar Wallaby	Cg09B	P4	Camera trap	30/4/21
425474	6517022	*Notamacropus eugenii derbianus*	Tammar Wallaby	Cg46B	P4	Camera trap	30/4/21
427725	6520187	*Notamacropus irma*	Western Brush Wallaby	Cg07B	P4	Camera trap	30/4/21
427463	6518633	*Notamacropus irma*	Western Brush Wallaby	Cg10B	P4	Camera trap	30/4/21
428217	6519226	*Notamacropus irma*	Western Brush Wallaby	Cg13B	P4	Camera trap	30/4/21
424786	6515060	*Notamacropus irma*	Western Brush Wallaby	Cg15B	P4	Camera trap	30/4/21
428374	6517930	*Notamacropus irma*	Western Brush Wallaby	Cg20B	P4	Camera trap	30/4/21
427173	6519312	*Notamacropus irma*	Western Brush Wallaby	Cg22B	P4	Camera trap	30/4/21
429003	6519168	*Notamacropus irma*	Western Brush Wallaby	Cg25B	P4	Camera trap	30/4/21
428392	6519868	*Notamacropus irma*	Western Brush Wallaby	Cg27B	P4	Camera trap	30/4/21
426342	6518785	*Notamacropus irma*	Western Brush Wallaby	Cg31B	P4	Camera trap	30/4/21
428439	6518705	*Notamacropus irma*	Western Brush Wallaby	Cg32B	P4	Camera trap	30/4/21
427203	6515585	*Notamacropus irma*	Western Brush Wallaby	Cg41B	P4	Camera trap	30/4/21

Appendix 7 – fauna recorded in the study area							
Easting	Northing	Taxon Name	Common Name	Site	Status	ObsType	Date
426713	6518003	*Notamacropus irma*	Western Brush Wallaby	Cg42B	P4	Camera trap	30/4/21
425474	6517022	*Notamacropus irma*	Western Brush Wallaby	Cg46B	P4	Camera trap	30/4/21
428348	6519731	*Notamacropus irma*	Western Brush Wallaby	No site	P4	Day Sighting	14/5/21
428400	6518890	*Notamacropus irma*	Western Brush Wallaby	No site	P4	Day Sighting	19/4/21
423170	6514320	*Notamacropus irma*	Western Brush Wallaby	No site	P4	Dead	19/4/21
428409	6517924	*Notamacropus irma*	Western Brush Wallaby	No site	P4	Day Sighting	14/5/21
426196	6514314	*Pachycephala occidentalis*	Golden Whistler	Hab 03		Day Sighting	14/5/21
425845	6515913	*Pachycephala occidentalis*	Golden Whistler	Hab 07		Day Sighting	19/4/21
425452	6515764	*Pachycephala occidentalis*	Golden Whistler	Hab 24		Day Sighting	17/5/21
424862	6514156	*Pachycephala rufiventris*	Rufous Whistler	Hab 01		Day Sighting	14/5/21
425377	6514343	*Pachycephala rufiventris*	Rufous Whistler	Hab 02		Day Sighting	14/5/21
427730	6516248	*Pachycephala rufiventris*	Rufous Whistler	Hab 21		Day Sighting	14/5/21
424862	6514156	*Pardalotus striatus*	Striated Pardalote	Hab 01		Day Sighting	14/5/21
425377	6514343	*Pardalotus striatus*	Striated Pardalote	Hab 02		Day Sighting	14/5/21
426196	6514314	*Pardalotus striatus*	Striated Pardalote	Hab 03		Day Sighting	14/5/21
429007	6519159	*Pardalotus striatus*	Striated Pardalote	Hab 18		Day Sighting	14/5/21
425452	6515764	*Pardalotus striatus*	Striated Pardalote	Hab 24		Day Sighting	17/5/21
425034	6515700	*Pardalotus striatus*	Striated Pardalote	Hab 25		Day Sighting	17/5/21
425183	6516343	*Pardalotus striatus*	Striated Pardalote	Hab 26		Day Sighting	17/5/21
430182	6521780	*Pardalotus striatus*	Striated Pardalote	Hab 27		Day Sighting	17/5/21
430381	6521456	*Pardalotus striatus*	Striated Pardalote	Hab 28		Day Sighting	17/5/21
426425	6517425	*Pardalotus striatus*	Striated Pardalote	Hab 32		Day Sighting	17/5/21
429007	6519159	*Petrochelidon nigricans*	Tree Martin	Hab 18		Day Sighting	19/4/21
427725	6520187	*Petroica boodang*	Scarlet Robin	Cg07B		Camera trap	30/4/21
424862	6514156	*Petroica boodang*	Scarlet Robin	Hab 01		Day Sighting	14/5/21
426283	6513863	*Petroica boodang*	Scarlet Robin	Hab 04		Day Sighting	14/5/21
427509	6518602	*Petroica boodang*	Scarlet Robin	Hab 11		Day Sighting	19/4/21
425183	6516343	*Petroica boodang*	Scarlet Robin	Hab 26		Day Sighting	17/5/21
426425	6517425	*Petroica boodang*	Scarlet Robin	Hab 32		Day Sighting	17/5/21
427762	6520153	*Phylidonyris nigra*	White-cheeked Honeyeater	Hab 15		Day Sighting	19/4/21
425183	6516343	*Phylidonyris nigra*	White-cheeked Honeyeater	Hab 26		Day Sighting	17/5/21
426283	6513863	*Platycercus spurius*	Red-capped Parrot	Hab 04		Day Sighting	14/5/21
425034	6515700	*Platycercus spurius*	Red-capped Parrot	Hab 25		Day Sighting	17/5/21
427348	6517763	*Platycercus spurius*	Red-capped Parrot	Hab 33		Day Sighting	17/5/21
425377	6514343	*Platycercus zonarius*	Australian Ringneck	Hab 02		Day Sighting	14/5/21
426196	6514314	*Platycercus zonarius*	Australian Ringneck	Hab 03		Day Sighting	14/5/21
427762	6520153	*Platycercus zonarius*	Australian Ringneck	Hab 15		Day Sighting	19/4/21

Appendix 7 – fauna recorded in the study area							
Easting	Northing	Taxon Name	Common Name	Site	Status	ObsType	Date
427730	6516248	*Platycercus zonarius*	Australian Ringneck	Hab 21		Day Sighting	14/5/21
427033	6514981	*Platycercus zonarius*	Australian Ringneck	Hab 23		Day Sighting	19/4/21
425452	6515764	*Platycercus zonarius*	Australian Ringneck	Hab 24		Day Sighting	17/5/21
425034	6515700	*Platycercus zonarius*	Australian Ringneck	Hab 25		Day Sighting	17/5/21
429923	6521437	*Platycercus zonarius*	Australian Ringneck	Hab 29		Day Sighting	17/5/21
425474	6517022	*Pseudonaja affinis*	Dugite	Cg46B		Camera trap	30/4/21
425183	6516343	*Pseudophryne guentheri*	Guenther's Toadlet	Hab 26		Day Sighting	17/5/21
425034	6515700	*Ptilotula ornata*	Yellow-plumed Honeyeater	Hab 25		Day Sighting	17/5/21
425183	6516343	*Ptilotula ornata*	Yellow-plumed Honeyeater	Hab 26		Day Sighting	17/5/21
424862	6514156	*Rhipidura albiscapa*	Grey Fantail	Hab 01		Day Sighting	14/5/21
425377	6514343	*Rhipidura albiscapa*	Grey Fantail	Hab 02		Day Sighting	14/5/21
424801	6515090	*Rhipidura albiscapa*	Grey Fantail	Hab 05		Day Sighting	19/4/21
425483	6517023	*Rhipidura albiscapa*	Grey Fantail	Hab 08		Day Sighting	14/5/21
428216	6519229	*Rhipidura albiscapa*	Grey Fantail	Hab 12		Day Sighting	14/5/21
427762	6520153	*Rhipidura albiscapa*	Grey Fantail	Hab 15		Day Sighting	19/4/21
425034	6515700	*Rhipidura albiscapa*	Grey Fantail	Hab 25		Day Sighting	17/5/21
430381	6521456	*Rhipidura albiscapa*	Grey Fantail	Hab 28		Day Sighting	17/5/21
429923	6521437	*Rhipidura albiscapa*	Grey Fantail	Hab 29		Day Sighting	17/5/21
426352	6516268	*Rhipidura albiscapa*	Grey Fantail	Hab 30		Day Sighting	17/5/21
427517	6516919	*Rhipidura albiscapa*	Grey Fantail	Hab 35		Day Sighting	17/5/21
424862	6514156	*Smicrornis brevirostris*	Weebill	Hab 01		Day Sighting	14/5/21
425377	6514343	*Smicrornis brevirostris*	Weebill	Hab 02		Day Sighting	14/5/21
426196	6514314	*Smicrornis brevirostris*	Weebill	Hab 03		Day Sighting	14/5/21
426283	6513863	*Smicrornis brevirostris*	Weebill	Hab 04		Day Sighting	14/5/21
424801	6515090	*Smicrornis brevirostris*	Weebill	Hab 05		Day Sighting	14/5/21
425845	6515913	*Smicrornis brevirostris*	Weebill	Hab 07		Day Sighting	14/5/21
425483	6517023	*Smicrornis brevirostris*	Weebill	Hab 08		Day Sighting	19/4/21
427509	6518602	*Smicrornis brevirostris*	Weebill	Hab 11		Day Sighting	19/4/21
428301	6519899	*Smicrornis brevirostris*	Weebill	Hab 13		Day Sighting	14/5/21
430223	6521150	*Smicrornis brevirostris*	Weebill	Hab 14		Day Sighting	19/4/21
427143	6519313	*Smicrornis brevirostris*	Weebill	Hab 16		Day Sighting	14/5/21
428390	6518713	*Smicrornis brevirostris*	Weebill	Hab 19		Day Sighting	19/4/21
425452	6515764	*Smicrornis brevirostris*	Weebill	Hab 24		Day Sighting	17/5/21
425034	6515700	*Smicrornis brevirostris*	Weebill	Hab 25		Day Sighting	17/5/21
430182	6521780	*Smicrornis brevirostris*	Weebill	Hab 27		Day Sighting	17/5/21
430381	6521456	*Smicrornis brevirostris*	Weebill	Hab 28		Day Sighting	17/5/21
429923	6521437	*Smicrornis brevirostris*	Weebill	Hab 29		Day Sighting	17/5/21

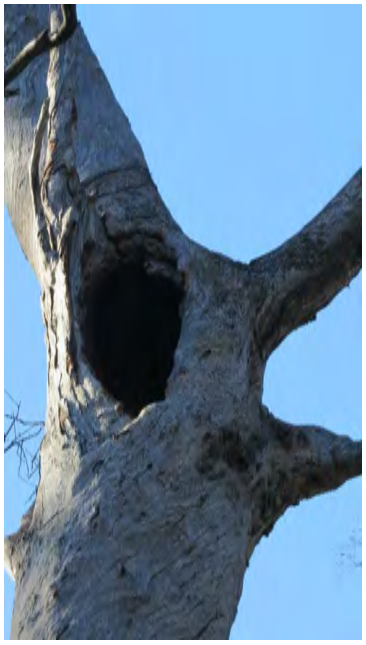
Appendix 7 – fauna recorded in the study area							
Easting	Northing	Taxon Name	Common Name	Site	Status	ObsType	Date
426352	6516268	*Smicrornis brevirostris*	Weebill	Hab 30		Day Sighting	17/5/21
426133	6516895	*Smicrornis brevirostris*	Weebill	Hab 31		Day Sighting	17/5/21
426425	6517425	*Smicrornis brevirostris*	Weebill	Hab 32		Day Sighting	17/5/21
427742	6517514	*Smicrornis brevirostris*	Weebill	Hab 34		Day Sighting	17/5/21
427517	6516919	*Smicrornis brevirostris*	Weebill	Hab 35		Day Sighting	17/5/21
428374	6517930	*Sminthopsis sp.*	dunnart sp.	Cg20B		Camera trap	30/4/21
425474	6517022	*Sminthopsis sp.*	dunnart sp.	Cg46B		Camera trap	30/4/21
426342	6518785	*Strepera versicolor*	Grey Currawong	Cg31B		Camera trap	30/4/21
425474	6517022	*Strepera versicolor*	Grey Currawong	Cg46B		Camera trap	30/4/21
426283	6513863	*Strepera versicolor*	Grey Currawong	Hab 04		Day Sighting	14/5/21
425483	6517023	*Strepera versicolor*	Grey Currawong	Hab 08		Day Sighting	19/4/21
425183	6516343	*Strepera versicolor*	Grey Currawong	Hab 26		Day Sighting	17/5/21
430182	6521780	*Sus scrofa*	Pig	Hab 27		Scats	17/5/21
425817	6515924	*Tachyglossus aculeata*	Echidna	Cg03B		Camera trap	30/4/21
427725	6520187	*Tachyglossus aculeata*	Echidna	Cg07B		Camera trap	30/4/21
425661	6515068	*Tachyglossus aculeata*	Echidna	Cg09B		Camera trap	30/4/21
424786	6515060	*Tachyglossus aculeata*	Echidna	Cg15B		Camera trap	30/4/21
427033	6514981	*Tachyglossus aculeata*	Echidna	Cg16B		Camera trap	30/4/21
428374	6517930	*Tachyglossus aculeata*	Echidna	Cg20B		Camera trap	30/4/21
427173	6519312	*Tachyglossus aculeata*	Echidna	Cg22B		Camera trap	30/4/21
427752	6516184	*Tachyglossus aculeata*	Echidna	Cg23B		Camera trap	30/4/21
430228	6521152	*Tachyglossus aculeata*	Echidna	Cg24B		Camera trap	30/4/21
429003	6519168	*Tachyglossus aculeata*	Echidna	Cg25B		Camera trap	30/4/21
428392	6519868	*Tachyglossus aculeata*	Echidna	Cg27B		Camera trap	30/4/21
426342	6518785	*Tachyglossus aculeata*	Echidna	Cg31B		Camera trap	30/4/21
428439	6518705	*Tachyglossus aculeata*	Echidna	Cg32B		Camera trap	30/4/21
427203	6515585	*Tachyglossus aculeata*	Echidna	Cg41B		Camera trap	30/4/21
426713	6518003	*Tachyglossus aculeata*	Echidna	Cg42B		Camera trap	30/4/21
424862	6514156	*Tachyglossus aculeata*	Echidna	Hab 01		Digging	14/5/21
424801	6515090	*Tachyglossus aculeata*	Echidna	Hab 05		Digging	14/5/21
427762	6520153	*Tachyglossus aculeata*	Echidna	Hab 15		Digging	14/5/21
428390	6518713	*Tachyglossus aculeata*	Echidna	Hab 19		Digging	19/4/21
425034	6515700	*Tachyglossus aculeata*	Echidna	Hab 25		Scats	17/5/21
430182	6521780	*Tachyglossus aculeata*	Echidna	Hab 27		Day Sighting	17/5/21
430228	6521152	*Trichosurus vulpecula*	Brush-tailed Possum	Cg24B		Camera trap	30/4/21
425474	6517022	*Trichosurus vulpecula*	Brush-tailed Possum	Cg46B		Camera trap	30/4/21
426425	6517425	*Turnix varia*	Painted Button-quail	Hab 32		Day Sighting	17/5/21

Appendix 7 – fauna recorded in the study area							
Easting	Northing	Taxon Name	Common Name	Site	Status	ObsType	Date
424786	6515060	*Vulpes vulpes*	Fox	Cg15B		Camera trap	30/4/21
427033	6514981	*Vulpes vulpes*	Fox	Cg16B		Camera trap	30/4/21
427752	6516184	*Vulpes vulpes*	Fox	Cg23B		Camera trap	30/4/21
425922	6517696	*Vulpes vulpes*	Fox	Cg26B		Camera trap	30/4/21
427203	6515585	*Vulpes vulpes*	Fox	Cg41B		Camera trap	30/4/21
426283	6513863	*Zosterops lateralis*	Silvereye	Hab 04		Day Sighting	14/5/21
424801	6515090	*Zosterops lateralis*	Silvereye	Hab 05		Day Sighting	19/4/21
425034	6515700	*Zosterops lateralis*	Silvereye	Hab 25		Day Sighting	17/5/21
425183	6516343	*Zosterops lateralis*	Silvereye	Hab 26		Day Sighting	17/5/21

Appendix 6 Black Cockatoo Habitat Survey (Western Wildlife 2021a)

Julimar Nickel-Copper PGE Project: Hartog and Baudin Exploration Targets

Targeted Cockatoo Habitat Tree Survey 2021


Prepared for: Chalice Mining Limited

Prepared by: Western Wildlife
8 Ridgeway Pl
Mahogany Creek WA 6072
Ph: 0427 510 934

September 2021

Table of Contents

1. Introduction 2

1.1 The Survey Area 2

2. Methods 4

2.1 Guidance Documents and Licencing 4

2.2 Personnel 4

2.3 Field Studies 4

3. Survey Limitations 6

4. Habitat Trees 7

5. Conclusion 7

6. References 11

Tables, Figures & Plates

Table 1. Fauna Survey Limitations. 6

Table 2. Habitat Trees Recorded in the Study Area. 7

Figure 1. Julimar Project (Hartog and Baudin) – Targeted Cockatoo Survey Area. 3

Figure 2. Julimar Project (Hartog and Baudin) – Habitat Trees. 8

Plate 1. Jarrah - Marri woodland. 2

Plate 2. Wandoo woodland. 2

1. Introduction

Chalice Mining Limited (CML) propose to conduct exploration drilling in the Hartog and Baudin Exploration Targets at their Julimar Nickel-Copper PGE Project (Julimar Project). As these areas are located in Julimar State Forest, CML commissioned Western Wildlife to carry out a targeted cockatoo habitat tree survey of the proposed access routes and drill sites.

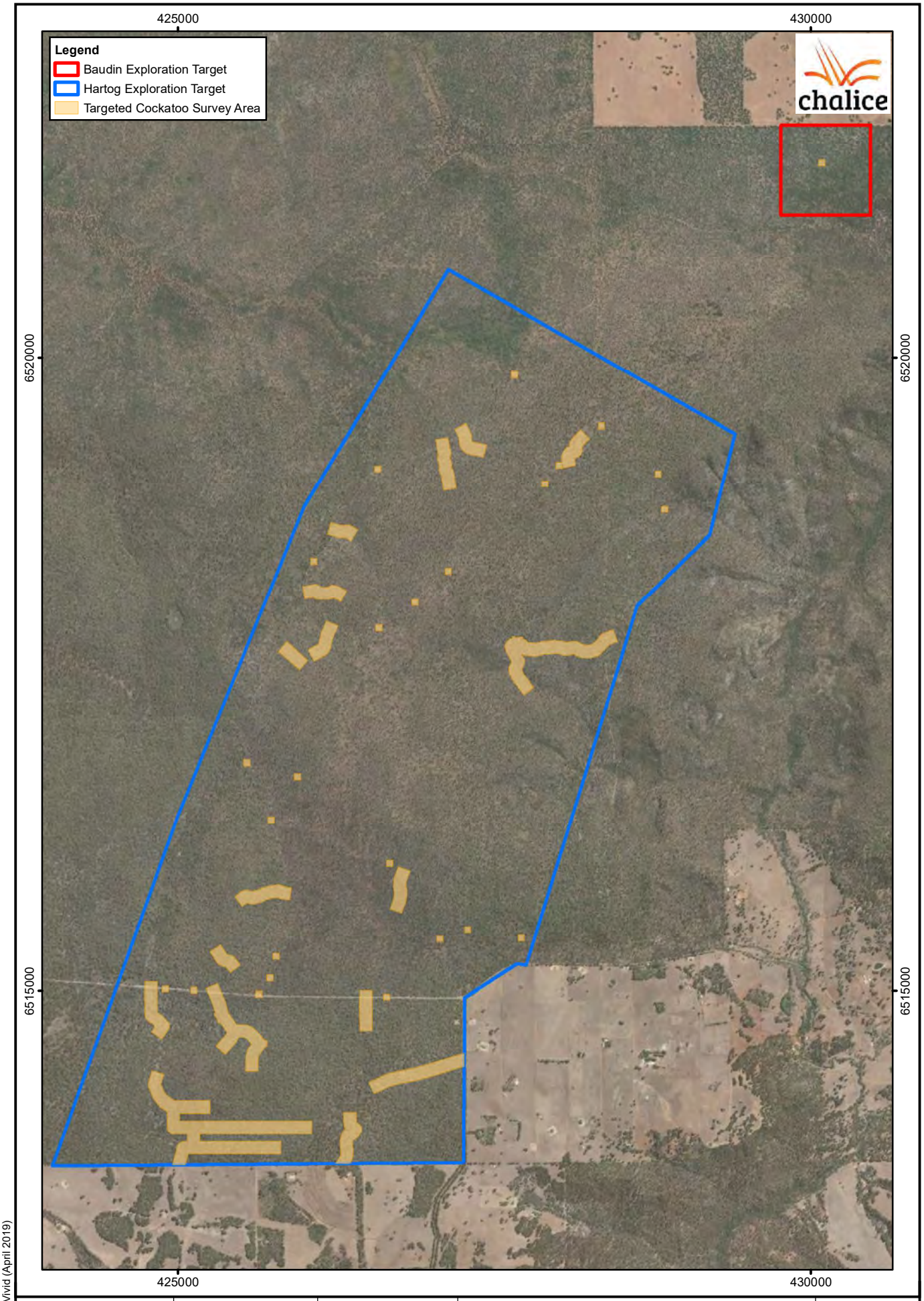
This report details the findings of the targeted survey conducted in August - September 2021.

1.1 The Survey Area

The Hartog (1,971.1ha) and Baudin (50.3ha) Exploration Targets are situated off Julimar Rd, Julimar, in the Shire of Toodyay. Further background on these areas are presented in Western Wildlife (2021). Within each Target, areas of possible disturbance were identified, and these formed the 109.3ha study area for this survey (Figure 1). The habitats of the study area consists of Jarrah-Marri woodlands (Plate 1), Wandoo woodlands (Plate 2) and minor creeks.

Plate 1. Jarrah - Marri woodland.

Plate 2. Wandoo woodland.



Imagery: ESRI, Vivid (April 2019)

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

CAD Ref: a2779Fa009_01 | A4

Date: September 2021 | Rev: A | Author: J. Wilcox

N

0 320 640 m

Scale: 1:40,000
MGA94 (Zone 50)

Western Wildlife

Julimar Project (Hartog and Baudin)
Targeted Cockatoo Survey Area

Figure: 1

2. Methods

2.1 Guidance Documents and Licencing

The targeted cockatoo habitat survey was conducted with reference to the following documents:

- *Technical guidance: terrestrial vertebrate fauna surveys for environmental impact assessment* (EPA 2020)
- *EPBC Act Referral Guidelines for Three Threatened Black-Cockatoo Species* (DSEWPaC 2012)

The survey was undertaken under Fauna Taking (Biological Assessment) Licence BA27000274 and an Authorisation to Take or Disturb Threatened Species TFA 2020-0080.

2.2 Personnel

The field survey was undertaken by Dr Wes Bancroft (*PhD*) and Mr Andy McCreery (*BSc*). Wes has over 22 years' experience in the industry and Andy has 10 years' experience. Both have undertaken similar targeted surveys for cockatoo habitat. Ms Jenny Wilcox (*BSc Hons*) from Western Wildlife prepared the report. Jenny Wilcox has 21 years' experience in carrying out fauna surveys in Western Australia, including in the Northern Jarrah Forest IBRA subregion, and has familiarity with the study areas from previous fauna surveys.

2.3 Field Studies

The survey was conducted over five days in August and September 2021 (16th, 23rd and 24th August and the 8th and 11th September). A comprehensive effort was made to survey all potential habitat trees in the survey area. Trees species in the study area that potentially support breeding by Carnaby's Cockatoo (*Calyptorhynchus latirostris*) or the Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*) include:

- Jarrah (*Eucalyptus marginata*)
- Marri (*Corymbia calophylla*)
- Wandoo (*Eucalyptus wandoo*)
- Powderbark Wandoo (*Eucalyptus accedens*)

The size of the tree is considered to be an indication of the hollow-bearing potential of the tree (DSEWPaC 2012), with a diameter at breast height (DBH) of 500mm or more considered suitable for Jarrah and Marri, and 300mm or more for Wandoo or Powderbark Wandoo. All trees that met the DBH criterion were recorded with a GPS location, the tree species and whether alive or dead. The tree hollows were classified into the following categories:

- 1 = Tree occupied by breeding cockatoos.
- 2 = Tree contains hollow/s potentially suitable for cockatoos and shows evidence of use by cockatoos (e.g., chew marks).
- 3 = Tree contains hollow/s potentially suitable for cockatoos.
- 4 = Tree contains hollow/s suitable for other fauna, but none potentially suitable for cockatoos.
- 5 = No visible hollows.

In order to determine occupancy of a potential hollow, the tree was scraped with a stick to see if a sitting female would emerge.

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 1.

Table 1. Fauna Survey Limitations.

Potential Limitation	Extent of limitation for the fauna survey	
Availability of data and information	Not limiting	This survey was not reliant on the availability of data and information from other sources.
Competency/experience of the survey team, including experience in the bioregion surveyed	Not limiting	The field survey was undertaken by personnel that are experienced in undertaking cockatoo habitat tree surveys.
Scope of survey (e.g., faunal groups excluded from the survey)	Not limiting	This survey was for habitat only, and all habitat trees that met criteria were identified.
Timing, weather and season	Minor limitation	Timing is not critical as habitat trees are present year-round. The survey was undertaken at the beginning of the main September – January breeding season for Carnaby's Cockatoo and the Forest Red-tailed Black-cockatoo, so current nesting may not have been determined. However, likely nesting trees were identified from their chew marks.
Disturbance that may have affected the results	Not limiting	Some of the study area had been recently burnt, but this did not affect the outcomes of the habitat survey.
The proportion of fauna identified, recorded or collected	Not limiting	This survey targeted cockatoo habitat only and did not aim to collect records of fauna.
The adequacy of the survey intensity and proportion of survey achieved (e.g., extent to which the area was surveyed)	Not limiting	The survey was completed at a high intensity. So far as possible, all habitat trees within the study area were identified.
Access problems	Not limiting	All areas were accessible.
Problems with data and analysis, including sampling biases	Not limiting	No complex analyses were undertaken, and no problems were noted.

4. Habitat Trees

A total of 1,954 habitat trees of four species were identified in the survey area (Table 2, Figure 2). No active nests were recorded, but four trees showed signs of use such as chew marks around the hollow, suggesting that these trees may be nesting trees (see photo, front cover). A further 470 trees contained hollows potentially suitable for cockatoos. About half of the trees recorded met the DBH criterion but did not have any visible hollows.

Table 2. Habitat Trees Recorded in the Study Area.

Tree species	Tree Category*					Total
	1	2	3	4	5	
Jarrah *Eucalyptus marginata*	-	1	247	272	472	992
Marri *Corymbia calophylla*	-	2	134	50	120	306
Powderbark Wandoo *Eucalyptus accedens*	-	-	17	33	129	179
Wandoo *Eucalyptus wandoo*	-	1	72	82	322	477
Total:	**0**	**4**	**470**	**437**	**1,043**	**1,954**

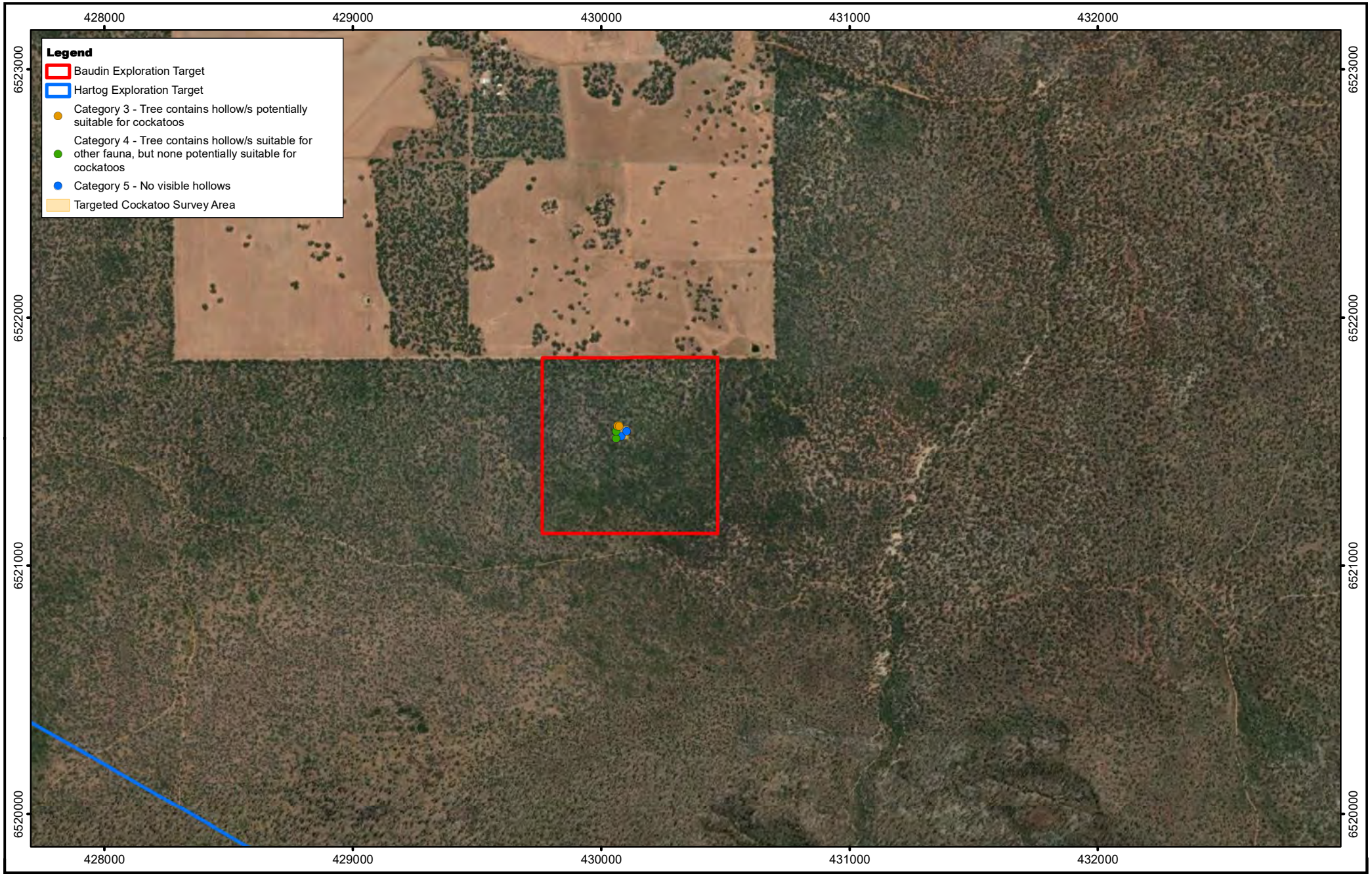
*Tree categories:

- 1 = Tree occupied by breeding cockatoos.
- 2 = Tree contains hollow/s potentially suitable for cockatoos and shows evidence of use by cockatoos (e.g. chew marks)
- 3 = Tree contains hollow/s potentially suitable for cockatoos
- 4 = Tree contains hollow/s suitable for other fauna, but none potentially suitable for cockatoos
- 5 = No visible hollows

5. Conclusion

The survey area was comprehensively surveyed for cockatoo habitat trees and 1,954 trees were recorded. Although 470 trees with potential cockatoo hollows were identified, these were surveyed from the ground only and some are unlikely to be suitable e.g., due to inappropriate hollow depth. Conversely, some hollows may not have been identified if not visible from the ground, particularly hollows in tree forks. This is uncertainty is somewhat ameliorated by the approach of identifying all trees that meet the DBH criterion, as these as a group are considered potential breeding habitat.

It is possible that Carnaby's Cockatoo and/or the Forest Red-tailed Black-cockatoo nest in the study area. Although no active nests were found, four hollows showed signs of use. As the survey was undertaken at the beginning of the breeding season, it is possible that birds may return to these trees later in the season.



Sheet Layout

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

CAD Ref: a2779Fa009_02 | A4

Date: September 2021 | Rev: A | Author: J. Wilcox

N

0 150 300 m

Scale: 1:20,000
MGA94 (Zone 50)

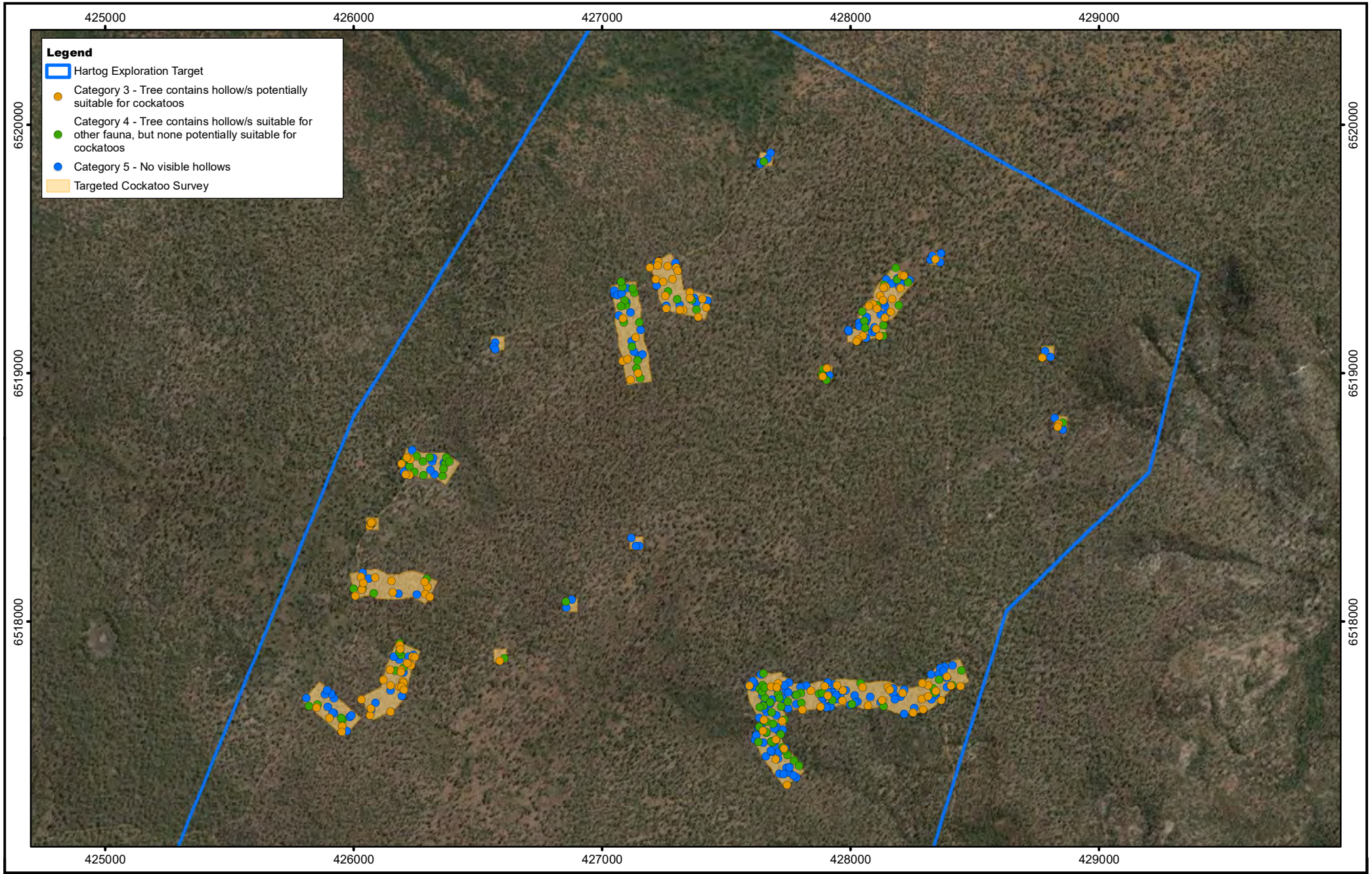
Western Wildlife

Julimar Project (Hartog and Baudin)

Habitat Trees

Figure:

2.1



Sheet Layout

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

CAD Ref: a2779Fa009_02 | A4

Date: September 2021 | Rev: A | Author: J. Wilcox

N

0 150 300 m

Scale: 1:20,000
MGA94 (Zone 50)

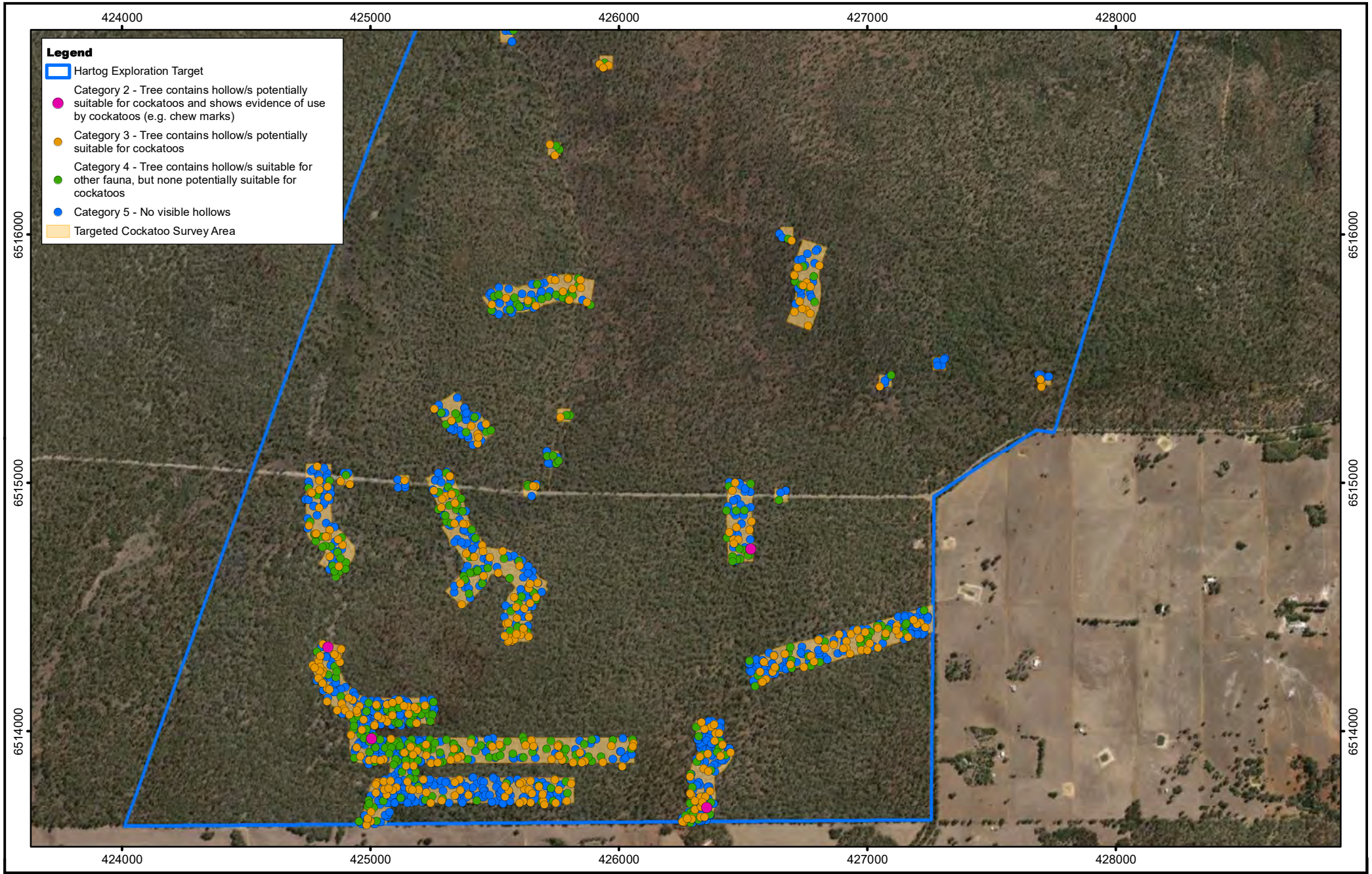
Western Wildlife

Julimar Project (Hartog and Baudin)

Habitat Trees

Figure:

2.2



Sheet Layout

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

CAD Ref: a2779Fa009_02 | A4

Date: September 2021 | Rev: A | Author: J. Wilcox

N

0 150 300 m

Scale: 1:20,000
MGA94 (Zone 50)

Western Wildlife

Julimar Project (Hartog and Baudin)

Habitat Trees

Figure:

2.3

6. References

DSEWPaC (Department of Sustainability, Environment, Water, Populations and Communities) (2012). *EBPC Act referral guidelines for three threatened black cockatoo species*. URL: http://www.environment.gov.au/epbc/publications/wa-black-cockatoos.html.

EPA (2020). *Technical Guidance – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment*. EPA, Western Australia.

Western Wildlife (2020). *Julimar Nickel-Copper PGE Project: Hartog and Baudin's Exploration Targets: Basic Vertebrate Fauna Survey and Targeted Conservation Significant Mammal Survey 2021*. Unpublished Report to Chalice Gold Mines Limited.

Appendix 7 Risk Assessment Tools

		Consequences				
		Insignifican	Minor	Moderate	Major	Severe
Likelihood	Rare	Low	Low	Low	Moderate	Moderate
	Unlikely	Low	Low	Moderate	Moderate	High
	Possible	Low	Moderate	Moderate	High	High
	Likely	Low	Moderate	High	Extreme	Extreme
	Almost Certain	Low	High	High	Extreme	Extreme

Descriptor	Explanation
Rare	May occur in exceptional circumstances (would be considered highly unusual); may occur in the next 30 -40 years (<5% per year).
Unlikely	Not likely to occur; may occur within the next 10- 20 years (5%-10% probability).
Possible	May occur within 5-10 years (10%-50% probability).
Likely	Known to occur or has occurred in the past; is likely to occur in the next 24-36 months (50-80% probability).
Almost Certain	Expected to occur in the next 12-24 months (80-100% probability).

Environmental Factor		Insignificant 1	Minor 2	Moderate 3	Major 4	Extreme 5
Approvals		Minor administrative matter.	Potentially reportable event of some environmental significance.	Reportable event of considerable environmental	Significant non compliance that is close to the Company's limit of ability to rectify.	Forces Company into Bankruptcy.
Biodiversity / Flora / Fauna / Ecosystem	Flora and Vegetation	Localised and short term decrease in health, abundance and structure of vegetation communities that are well represented in the region.	Localised and medium term decrease in health, abundance and structure of vegetation communities that are well represented in the region.	Localised and long term decrease in health, abundance and structure of vegetation communities that are not well represented in the region.	Widespread and medium term decrease in health, abundance and structure of vegetation communities that are not well represented in the region.	Permanent loss of vegetation communities that are not well represented in the region.
		No direct loss of conservation significant flora in Development Envelope although increased stress incurred through indirect or induced processes.	Minor, localised loss of conservation significant flora either through direct, indirect or induced processes.	Regional loss of conservation significant flora with no impacts on species survival.	Project places significant pressure on continued survival of conservation significant species.	Project results in extinction of conservation significant species on a regional scale.
		Manageable, localised weed infestation that does not result in competition with native species.	Manageable, localised weed infestation that results in minor competition with native species.	Localised weed infestation that results in competition with native species requiring considerable management/control measures.	Regional weed infestation that results in competition with native species requiring extensive management/control measures.	Uncontrollable regional weed infestation that results in competition with native species.
	Terrestrial Fauna	Localised and short term loss of habitat (including that of conservation significant species) that is well represented in the region, overall habitat area remains intact with minimal fragmentation.	Localised and medium term loss of habitat (including that of conservation significant species) that is well represented in the region, some short term habitat fragmentation	Localised and permanent or widespread and long term loss of habitat (including that of conservation significant species) that is not well represented in the region, medium term habitat fragmentation.	Permanent and widespread loss of habitat (including that of conservation significant species) that is not well represented in the region, permanent habitat fragmentation.	Permanent loss and fragmentation of habitat (including that of conservation significant species) that is not well represented in the region.
		Some displacement of fauna that has no lasting effects on population viability or abundance.	Some displacement of fauna that has short term effects on population viability or abundance.	Displacement of fauna that has medium term effects on population viability or abundance	Displacement of fauna that puts populations at risk of local extinction	Fauna displacement leads to extinction of species on a regional scale.
		No measurable impacts to behaviour of fauna in local area.	Short term impact to behaviour of fauna in local area.	Medium term impact to behaviour of fauna in local area.	Long term and widespread impact to behaviour of fauna.	Permanent change to behaviour of fauna in the regional area.
		Localised and short-term decrease in fauna abundance (including conservation significant fauna) occurring in the Development Envelope.	Localised and long-term or widespread, and short-term decrease in fauna abundance (including conservation significant fauna) within the Development Envelope.	Localised and irreversible or widespread and long-term decrease in fauna abundance (including conservation significant fauna).	Significant, widespread, and persistent decrease in fauna abundance (including conservation significant fauna).	Permanent loss of a significant portion of fauna population (including conservation significant fauna).
		Minor increase in pest species numbers, but does not result in impacts to the population viability or abundance of native species.	Minor increase in pest species numbers, resulting in localised impacts to the population viability or abundance of native species.	Major increase in pest species numbers, resulting in widespread impacts to the population viability or abundance of native species.	Pest species introduced and populations expand into the regional area resulting in long term exclusion of native species.	Pest species introduced and populations expand into the regional area resulting in permanent exclusion of native species.
	Subterranean Fauna	Short term loss to the representation, diversity, viability and ecological function of subterranean fauna species, populations or assemblages in the Development Envelope.	Medium term loss to the representation, diversity, viability and ecological function of subterranean species, populations or fauna assemblages in the local area.	Long term loss to the representation, diversity, viability and ecological function of subterranean fauna species, populations or assemblages in the local area.	Short or medium term loss to the representation, diversity, viability and ecological function of subterranean species, populations or fauna assemblages in the regional area.	Permanent loss to the representation, diversity, viability and ecological function of subterranean species, populations or fauna assemblages in the regional area.
Water Resources	Surface Water	Minor change to surface water quality within the project area that does not change its ability to be used by livestock and fauna	Minor change to surface water quality within the project area and downstream watercourses that does not affect its use by livestock and fauna.	Moderate change to surface water quality within the project area and downstream watercourses that affects its use by livestock and fauna in the short	Decline in surface water quality in the project area and downstream watercourses that prevents medium to long term use by livestock and fauna.	Decline in surface water quality on a regional scale that prevents long term use by livestock and fauna.
		Short term changes to local water volumes that do not affect beneficial uses, including livestock and fauna.	Medium term changes to local water volumes that do not affect beneficial uses, including livestock and fauna.	Short term changes to regional water volumes that affect beneficial uses, including livestock and fauna.	Medium term changes to regional water volumes that affect beneficial uses, including livestock and fauna.	Project causes permanent loss of surface water resources that affects livelihoods and/or survival of
	Ground Water	Minor, localised change to groundwater quality that does not change its ability to be used by beneficial uses, including livestock, fauna, groundwater dependent ecosystems and subterranean fauna.	Short term localised decline in groundwater quality that affects beneficial uses, including livestock, fauna, groundwater dependent ecosystems and subterranean fauna.	Medium term localised decline in groundwater quality that affects beneficial uses, including livestock, fauna, groundwater dependent ecosystems and subterranean fauna.	Short to medium term regional decline in water quality that prevents beneficial uses, including livestock, fauna, groundwater dependent ecosystems and subterranean fauna.	Long term regional decline in water quality that prevents beneficial uses, including livestock, fauna, groundwater dependent ecosystems and subterranean fauna.
		Minor changes to local groundwater levels/availability that do not affect beneficial uses, including livestock, fauna, groundwater dependent ecosystems and subterranean fauna.	Local changes to groundwater levels/availability that do not affect beneficial uses, including livestock, fauna, groundwater dependent ecosystems and subterranean fauna.	Local changes to groundwater levels/availability that affect beneficial uses, including livestock, fauna, groundwater dependent ecosystems and subterranean fauna in the short to	Regional changes to groundwater levels/availability that affect beneficial uses including livestock, fauna, groundwater dependent ecosystems and subterranean fauna in the medium term.	Regional changes to groundwater levels/availability that affect beneficial uses, including livestock, fauna, groundwater dependent ecosystems and subterranean fauna in the long term.
Landforms		Negligible impact to isolated area.	Contained low impact, not impacting on any environmental value.	Uncontained impact, able to be rectified in short term.	Extensive hazardous impact that will require long-term remedial works.	Uncontained hazardous impact with residual effects.
		Minimal land contamination within Development Envelope, easily treatable in short term and does not result in adverse impacts on associated environmental values	Minimal land contamination localised and treatable in medium term. Does not result in adverse impacts on associated environmental values.	Localised, low level land contamination that results in adverse impacts on associated environmental values in the short to medium term.	Low level land contamination on a regional scale resulting in adverse impacts on associated environmental values requiring medium to long term management.	Mid-level land contamination on a regional scale resulting in permanent damage with severe environmental and socioeconomic disruption.
		Loss of soil resources has short term impact on associated environmental values within Development Envelope.	Loss of soil resources has medium term impact on associated environmental values on a local scale.	Loss of soil resources has long term impact on associated environmental values on a local scale.	Loss of soil resources resulting in a short to medium term impact on associated environmental values on a	Loss of soil resources that has a permanent impact on associated environmental values on a regional
Mine Closure		Post mining landforms are consistent with their surroundings.	Post mining landforms are generally consistent with their surroundings with minor variations in elevation, profile and vegetation.	Post mining landforms are generally consistent with their surroundings but show distinguishable variation in elevation, profile and vegetation.	Post mining landforms are inconsistent with their surroundings with notable differences in elevation, profile and vegetation.	Post mining landforms are inconsistent with their surroundings, represented by significant differences in elevation, profile and vegetation.
		Post mining landforms are stable.	Post mining landforms are stable but may experience minor erosion, such as rilling.	Post mining landforms are generally stable, but may experience moderate erosion, such as limited gullying.	Post mining landforms are unstable, with significant erosion, such as tunnelling and gullying, and subsidence.	Post mining landforms fail (e.g. TSF embankment failure), with extensive ongoing management issues.
		Site is safe, stable and non-polluting. Post mining land use is not adversely affected.	The site is safe, all major landforms are stable, and any stability or pollution issues are contained and require no residual management. Post-mining land use is not adversely affected.	The site is safe, and any stability or pollution issues require minor, ongoing maintenance by end land-user.	The site cannot be considered safe, stable or non-polluting without long-term management or intervention. Agreed post mining land-use cannot proceed without ongoing management.	The site is unsafe, unstable and/ or causing pollution or contamination that will cause an ongoing residual affect. The post-mining land use cannot be achieved.
		Revegetation progress is slightly impeded. Achievement of species diversity, vegetation coverage, and plant survival approaches predicted levels (with consideration of natural variability and conditions).	Revegetation progress experiences minor impediment. Localised and isolated failure to reach species diversity, vegetation coverage, and plant survival targets.	Revegetation progress experiences moderate impediment. Localised and permanent, or widespread failure to reach species diversity, vegetation coverage, and plant survival targets.	Revegetation progress experiences major impediment. Widespread and permanent failure to reach species diversity, vegetation coverage, and plant survival targets.	Revegetation is deemed unsuccessful. Cleared land remains in a denuded state.
Heritage		No loss or disturbance of physical or cultural heritage within local area.	Loss or disturbance of non-significant physical or cultural heritage within local area in agreement with traditional owners and compliant with relevant legislation.	Loss or disturbance of significant physical or cultural heritage in agreement with traditional owners and compliant with relevant legislation.	Loss or disturbance of significant physical or cultural heritage that requires significant compensation compliant with relevant legislation.	Loss or disturbance of significant physical or cultural heritage not in agreement with traditional owners that requires significant compensation and is not compliant with relevant legislation.
Amenity		Minor, short term and infrequent loss of amenity within the local area. Total Suspended Particles (TSP) and dust deposition guideline levels are not exceeded for sensitive receptors.	Minor and short term, but frequent, loss of amenity within the local area. TSP and dust deposition guideline levels may be exceeded for sensitive receptors, but this rarely happens.	Medium term and frequent decreases in amenity within a local area. TSP and dust deposition guideline levels are exceeded occasionally for sensitive receptors.	Medium term decline in amenity within a regional area. TSP and dust deposition guideline levels are exceeded frequently for sensitive receptors.	Long term decline in amenity over a regional area. TSP and dust deposition guideline levels are exceeded almost constantly for sensitive receptors.
Noise		Noise levels remain below relevant guideline values at all locations.	Noise levels remain below relevant guideline values at most locations but some non-sensitive receptors impacted by minor exceedances.	Occasional exceedance of relevant guideline values at sensitive receptor locations.	Frequent exceedance of relevant guideline values at sensitive receptor locations.	Continuous exceedance of relevant guideline values at sensitive receptor locations.
Air Quality		Emission levels remain below relevant National Environmental Protection Measures (NEPM) values at all receptor locations (including onsite receptors).	Emission levels remain below relevant NEPM values at most onsite locations but some non-sensitive receptors impacted by minor exceedances.	Occasional exceedance of relevant NEPM values at local sensitive receptor locations.	Frequent exceedance of relevant NEPM values at local sensitive receptor locations.	Continuous exceedance of relevant NEPM values at local sensitive receptor locations.

Appendix 8 Exploration Environmental Checklist

Exploration Environmental Checklist

Project		**Date**	
Prospect		**Contractor**	
Tenements		**Rig ID (if applicable)**	
Exploration Project Geologist		**Representative**	

This checklist is to be completed by the Exploration Project Geologist in charge of the exploration program – exploration may only commence once all the following checklist items have been approved.

Please attach copies of any relevant documentation. The checklist can also be used to monitor environmental compliance throughout the program.

Place an X in the check box

TENURE & LAND ACCESS (see attached documentation)	**YES**	**NO**	**ACTION REQUIRED**
Does the program fall completely within Chalice-managed tenements?	☐	☐	☐
Are field personnel aware of the relevant tenement conditions?	☐	☐	☐
Has DMIRS approval (PoW) for the program been granted?	☐	☐	☐
Has 'Notification of Commencement' been provided to DBCA?	☐	☐	☐
Has the landowner been notified of the program, proposed access & schedule?	☐	☐	☐
Has information regarding any special environmental, access conditions and restrictions been circulated to all field personnel?	☐	☐	☐
Comments:			

HERITAGE MANAGEMENT	**YES**	**NO**	**ACTION REQUIRED**
Has a Heritage Survey been completed for the program area?	☐	☐	☐
Are there any registered heritage sites in the area?	☐	☐	☐
Has sampling in or near a heritage sites been avoided (buffer compliance)?	☐	☐	☐
Are heritage sites clearly demarcated on site maps?	☐	☐	☐
Is the reporting of suspected heritage artefacts/sites included in the induction?	☐	☐	☐
Comments:			

SITE ACCESS	YES	NO	ACTION REQUIRED
Do access or environmental restrictions apply?	☐	☐	☐
Are existing grids, roads and tracks being utilised?	☐	☐	☐
Are tracks off existing roads discrete or hidden?	☐	☐	☐
Are all field personnel aware of machinery/vehicle movement restrictions in the event of wet conditions?	☐	☐	☐
Will all field personnel drive to conditions of the site?	☐	☐	☐
Comments:			

FLORA & VEGETATION MANAGEMENT	YES	NO	ACTION REQUIRED
Does vegetation need to be cleared during the program?	☐	☐	☐
Has the appropriate level of flora surveys been completed?	☐	☐	☐
Have any conservation significant vegetation or flora been identified that need to be avoided?	☐	☐	☐
If so, have these been clearly marked for avoidance, including any buffer zone around these areas?	☐	☐	☐
Has the wheels and undercarriage of earthmoving equipment, heavy machinery and vehicles been washed, brushed or blown down prior to entering project area to remove weeds and seeds?	☐	☐	☐
Have access routes been planned to utilise existing tracks, fence lines or firebreaks as much as possible?	☐	☐	☐
Have entry points into the State Forest been minimised?	☐	☐	☐
Are branches being removed in favour of felling whole trees?	☐	☐	☐
Is topsoil being disturbed?	☐	☐	☐
If so, has topsoil been stockpiled for later use in rehabilitation?	☐	☐	☐
Comments:			

FAUNA MANAGEMENT	YES	NO	ACTION REQUIRED
Has the appropriate level of fauna surveys been completed?	☐	☐	☐
Are field personnel aware not to interact with fauna?	☐	☐	☐
Have any conservation significant habitats been identified that need to be avoided?	☐	☐	☐
If so, have these been clearly marked for avoidance, including any buffer zone around these areas?	☐	☐	☐
Are all field personnel aware of reporting requirements for fauna sightings, injury or death?	☐	☐	☐
Will all field personnel drive to conditions of the site?	☐	☐	☐
Will access to the State Forest be limited during dawn/dusk when fauna is most active?	☐	☐	☐
Is the fauna reporting process included in the induction?	☐	☐	☐

Comments:

WATER MANAGEMENT	YES	NO	ACTION REQUIRED
Is sampling in water courses and drainage channels required?	☐	☐	☐
If so, has the number of personnel entering the water course been restricted?	☐	☐	☐
Have crossing points for watercourses been designated?	☐	☐	☐
Where crossing of water channels is required will it be by foot?	☐	☐	☐
Are field personnel aware to restrict vehicle movements after rainfall events of >10mm (within a 24-hr period)?	☐	☐	☐
Comments:			

WASTE MANAGEMENT	YES	NO	ACTION REQUIRED
Are soil sampling bags plastic?	☐	☐	☐
Is responsible waste management included in the induction?	☐	☐	☐
Are any field markers being used (i.e. wooden stakes)	☐	☐	☐
Are there procedures in place for the disposal of all consumable/personal waste by field personnel?	☐	☐	☐
Comments:			

HYDROCARBON MANAGEMENT	YES	NO	ACTION REQUIRED
Will hydrocarbon storage be required? If so, is this outside of State Forest boundaries?	☐	☐	☐
If yes, is all storage bunded with adequate spill capacity?	☐	☐	☐
Is containment, remediation and reporting of hydrocarbon spills included in the induction?	☐	☐	☐
Do all vehicles carry a spill response kit?	☐	☐	☐
Are all field personnel aware of reporting requirements for certain hydrocarbon spills?	☐	☐	☐
Comments:			

FIRE MANAGEMENT	YES	NO	ACTION REQUIRED
Are fire extinguishers and emergency response measures available to field personnel?	☐	☐	☐
If so, are they stored appropriately?	☐	☐	☐
Are all vehicles fitted with an appropriately tagged and bagged (covered) fire extinguisher or fire suppression system?	☐	☐	☐
Will weather conditions and bushfire risks be checked daily for the program duration?	☐	☐	☐
Are field personnel aware of what to do and who to contact in an emergency?	☐	☐	☐
Are the contact details for the Fire Duty Officer from DBCA included in induction?	☐	☐	☐

Is there a fire ban or scheduled burn currently in place?	☐	☐	☐
Comments:			

DIEBACK MANAGEMENT

	YES	NO	ACTION REQUIRED
Has the Chalice Julimar Exploration Program Dieback Management Plan been updated for the relevant exploration program and approved by DMIRS (PoW)?	☐	☐	☐
Are works being undertaken in dry conditions?	☐	☐	☐
Are Dieback risk and management principles included in the induction?	☐	☐	☐
Do all vehicles carry a copy of the most recent Dieback Management Plan?	☐	☐	☐
Have designated vehicles been allocated to remain within the State Forest?	☐	☐	☐
Have sample locations been avoided in areas prone to ponding, flooding or permanently wet areas?	☐	☐	☐
Are field personnel aware to restrict vehicle movements after rainfall events of >10mm (within a 24-hr period)?	☐	☐	☐
Is there a designated area for vehicle and equipment wash down?	☐	☐	☐
Are field personnel aware of the wash down requirements?	☐	☐	☐
Are washdown points and dieback risk areas clearly identified (maps/signage)?	☐	☐	☐
Have all field personnel undertaken Greencard Training?	☐	☐	☐
Comments:			

PUBLIC ACCESS MANAGEMENT

	YES	NO	ACTION REQUIRED
Has signage been installed to notify of proposed works and/or no entry areas?	☐	☐	☐
Have key stakeholders been notified of the works?	☐	☐	☐
Has access to sampling locations considered interactions with the public?	☐	☐	☐
Are responsible interactions with the public included in the induction?	☐	☐	☐
Will EM cables be buried when deployed for periods over the weekend?	☐	☐	☐
Comments:			

ROLES AND RESPONSIBILITIES AND REPORTING

	YES	NO	ACTION REQUIRED
Are all field personnel aware of their individual roles and responsibilities as defined in Conservation Management Plan?	☐	☐	☐
Are all field personnel aware of Chalice exploration Stage 1 procedures?	☐	☐	☐
Have all field personnel completed the Chalice Induction specific to site?	☐	☐	☐
Comments:			

ENVIRONMENTAL AWARENESS	YES	NO	ACTION REQUIRED
Has a copy of the Chalice Julimar Exploration Project Conservation Management Plan been made available to and explained to all personnel and contractors on site?	☐	☐	☐
Has an overview of potential environmental impacts and management procedures been made available to all field personnel including;			
• Conservation significant flora and fauna.	☐	☐	☐
• Site preparation.	☐	☐	☐
• Surface water management.	☐	☐	☐
• Waste management.	☐	☐	☐
• Hydrocarbon management.	☐	☐	☐
• Fire management.	☐	☐	☐
• Weed management.	☐	☐	☐
• Dieback management	☐	☐	☐
• Heritage management.	☐	☐	☐
• Public access management	☐	☐	☐
Comments:			

Attachments:	*1)*
	2)
	3)
	4)
	5)

Comments:

Name & Signature: (Program Supervisor)	
Date:	

Appendix 9 PoW Rehabilitation Reporting Form

GUIDANCE
Programme of Work Rehabilitation Report

PoW Registration Number

Required Action Reference Number (if applicable)

RA – | | | | – | | | |

Report Stage: **PROGRESSIVE** ○ **FINAL** ○

This form should be used to report your Programme of Work (PoW) rehabilitation activities.

It is a requirement that rehabilitation of prospecting and exploration activities is undertaken within six months of completion of ground disturbance activities that have been approved under a PoW, or following an approved extension period.

Please include the following to complement the information provided in this form:

1) A map of disturbed and rehabilitated areas.
2) Before and after photos of your rehabilitation including a significant landmark for comparison purposes, with a brief description including location, date and photo content.
3) Other supporting information you consider relevant (e.g. areas to be rehabilitated, your own rehabilitation reports, etc.).

Completed forms can be submitted either:

Over the counter at any DMIRS Office

OR

Online via DMIRS Submissions
http://www.dmp.wa.gov.au/Environment/Programmes-of-Work-5966.aspx

or posted to the offices listed below:

PERTH INSPECTORATE DMIRS – Resource and Environmental Compliance Division Locked Bag 100 EAST PERTH WA 6892 TEL: (08) 9222 3535	**KALGOORLIE INSPECTORATE** DMIRS – Resource and Environmental Compliance Division Locked Bag 405 KALGOORLIE WA 6433 TEL: (08) 9021 9494

Operator Details

Operator Name			
Title	**Contact First Name**	**Contact Surname**	
Mailing Address		**State**	**Postcode**
Email		**Telephone / Mobile**	

PoW Details

Your Reference (if applicable)	Commencement Date	Completion Date

Tenement Number(s)

Hectares Approved	Hectares Disturbed	Hectares Rehabilitated

Disturbance and Rehabilitation Activities

Disturbance	Rehabilitation	Yes	No	NA
		If 'No', please provide reasons in the Comments section		
☐ **Scraping, Detecting, Dry blowing**	• Windrows, stockpiles and dumps levelled off.	○	○	○
☐ **Samples**	• Removed from surface of pad and buried. *Not required if material is non-hostile, similar colour to surrounds and not within Department of Biodiversity, Conservation and Attractions Managed Land or a water reserve.* • Sample bags/bag farm removed.	○ ○	○ ○	○ ○
☐ **Drill Holes**	• Plugged 400mm below ground level. • Backfilled above plug and mounded. • Drill spoil removed or scarified.	○ ○ ○	○ ○ ○	○ ○ ○
☐ **Drill Pads**	• Topsoil and vegetation re-spread. *Unless blade clean-up.* • Scarified if required.	○ ○	○ ○	○ ○
☐ **Alluvial Wet Plant**	• Infrastructure removed. • Tailings rehabilitated.	○ ○	○ ○	○ ○
☐ **Costean, Trenches, Sumps, Test Pits**	• Backfilled and mounded. • Topsoil/vegetation respread.	○ ○	○ ○	○ ○
☐ **Access Tracks, Gridlines**	• Access closed off. • Topsoil and vegetation re-spread. *Unless blade clean-up.* • Scarified if required.	○ ○ ○	○ ○ ○	○ ○ ○
☐ **Campsite**	• Concrete pads removed or broken and buried. • Other infrastructure removed. • Topsoil and vegetation re-spread. • Scarified if required.	○ ○ ○ ○	○ ○ ○ ○	○ ○ ○ ○
☐ **All Activities**	• Surface water drainage lines reinstated. • Erosion control implemented. • Survey pegs and marker tape removed. • Rubbish and temporary infrastructure removed. • Cut & fill pads/tracks re-profiled to original slope. • Pads revegetated with local provenance species. • Weeds/invasive species present? • Hydrocarbon spills/contaminated material removed and disposed of appropriately.	○ ○ ○ ○ ○ ○ ○ ○	○ ○ ○ ○ ○ ○ ○ ○	○ ○ ○ ○ ○ ○ ○ ○

Comments

Use this section to:

1) **Add comments to support your Disturbance and Rehabilitation Activities answers on page 14.**
2) **Detail alternative or additional measures that have been undertaken.**
3) **Enter a brief description of other supporting information included as an attachment.**

Tenement Holder/Operator Declaration

I confirm that all rehabilitation commitments outlined in the tenement conditions and within the approved Programme of Work application have been completed.

Attachment checklist:

☐ Rehabilitation map ☐ Photographic evidence ☐ Other supporting information

Signature	Name and Title	Date

Appendix 10 Chalice Incident Reporting Form

Have you read the Incident Reporting and Investigation Procedure

Incident Details – to be filled out by person reporting the incident

Site: _____ Incident Date: _____ Time: _____

Type of Incident (tick one): ☐ Hazard ☐ Near Miss ☐ Damage ☐ Injury ☐ Environment

Parties Involved (tick all involved): ☐ Company ☐ Contractor ☐ Public ☐ Other

Name of Person Reporting: _____ Job Title: _____

Date/Time Reported: _____ Area Supervisor: _____

Contractor Company (if applicable): _____ Supervisor: _____

Exact Location:

Clear Description of Incident Events:

Immediate Action Taken:

Initial Findings:

Corrective Actions:

Signature:

Supervisors Assessment

Review: **To be completed by Chalice Supervisor**.
Include review of Risk Rating assessment and any further investigation requirements.

Was the Activity Normal Duties? (if yes give details): ☐ YES ☐ NO
Was any Unsafe Condition or Practice Discovered? (if yes give details): ☐ YES ☐ NO

Use the Risk Rating Matrix (CHN-RSK-FOR - Risk Matrix) to identify the risk of the incident.

Consequence: ☐ Minimal ☐ Minor ☐ Moderate ☐ Major ☐ **Catastrophic**

Probability: ☐ Almost Certain ☐ Likely ☐ Probable ☐ Unlikely ☐ Rare

Risk Rating: ☐ **Extreme** ☐ **High** ☐ Medium ☐ Low

All incidents with a consequence of **Catastrophic** or a risk rating of **Extreme** or **High** must have an Incident Investigation completed

Supervisor's Assessment of Incident

Additional actions required **By Whom**

Is an Incident Investigation Required ☐ Yes ☐ No

If yes then complete the investigation section of the incident report form

Signature: _____

Management Sign off

Additional comments

Recommendations Approved: ☐ **Yes** ☐ **No**

Approved By (name)**:** _____ **Date:** _____

Expected Completion Date: _____

Incident Investigation

People Involved

Name: _____ Job Title: _____

Employer: _____ Started on Site (Date): _____

Time with Employer: _____ (*Yrs/Mths*) Last R&R Dates: _____ Last RDO: _____

Shift Start Time: _____ Expected Finish Time: _____

Site Induction: _____

Name: _____ Job Title: _____

Employer: _____ Started on Site (Date): _____

Time with Employer: _____ (*Yrs/Mths*) Last R&R Dates: _____ Last RDO: _____

Shift Start Time: _____ Expected Finish Time: _____

Site Induction: _____

Witnesses

Name: _____ Job Title: _____

Employer: _____ Started on Site (Date): _____

Time with Employer: _____ (*Yrs/Mths*) Last R&R Dates: _____ Last RDO: _____

Shift Start Time: _____ Expected Finish Time: _____

Site Induction: _____

Name: _____ Job Title: _____

Employer: _____ Started on Site (Date): _____

Time with Employer: _____ (*Yrs/Mths*) Last R&R Dates: _____ Last RDO: _____

Shift Start Time: _____ Expected Finish Time: _____

Site Induction: _____

Investigation Team

Name: _____ Job Title: _____

Employer: _____ Time with Employer: _____ (*Yrs/Mths*)

Name: _____ Job Title: _____

Employer: _____ Time with Employer: _____ (*Yrs/Mths*)

Name: _____ Job Title: _____

Employer: _____ Time with Employer: _____ (*Yrs/Mths*)

Injury Details

Injured Name: _____ Date of Birth: _____ Sex: Male / Female*

Treatment (*Tick all which apply*):

☐ At Workplace ☐ At site 1st Aid ☐ Refused Treatment

☐ At Local Doctor (Name): _____ (Location): _____

☐ In Hospital (Location): _____ (Time Departed): _____

☐ Medical Evacuation (Destination): _____ (Time Departed): _____

Result (Tick One):

☐ Returned to Work ☐ Alt. Duties Days / Weeks

☐ Hospitalised ☐ Unfit for Work Days / Weeks

* = strike out inapplicable

Part of Body Injured (mark all that apply)

☐ Eye/s	☐ Head (other than eyes, ears, or face)	☐ Neck	☐ Back
☐ Hips/Legs	☐ Trunk (other than back or internal)	☐ Feet/Toes	☐ Ear/s
☐ Face	☐ Internal Organs (Located in trunk)	☐ Shoulders/Arms	
☐ Hands/Fingers	☐ Multiple Locations	☐ General or Unspecified	

Nature of Injury (mark all that apply)

☐ Fracture/s	☐ Amputation/s	☐ Burn/s	☐ Nerve Injury
☐ Dislocation/s	☐ Open Wound/s	☐ Circulatory	☐ Sprain/Strain/s
☐ Concussion	☐ Superficial	☐ Poison	☐ Dermatitis
☐ Hernia	☐ Bruising	☐ Cancers	☐ Foreign Body
☐ Pain	☐ Respiratory	☐ General Illness	☐ Internal

Agency of Injury (mark one)

☐ Vehicle/s	☐ Equipment	☐ Hand/Power Tool/s	☐ Explosion/Explosives
☐ Chemical/s	☐ Electrical	☐ Radiation	☐ Noise
☐ Biological	☐ Fall	☐ Manual Handling	

Describe Extent of Injuries:

_____

_____

_____

_____

_____

HAZARD or NEAR MISS ONLY

Identified Causes:

How long has the hazard been present? Hrs / Days / Weeks *

How often does this occur? Regularly / Occasionally / 1st Time *

Full investigation recommended? Yes / No *

(* = strike out inapplicable)

PROPERTY DAMAGE ONLY

Description of Damage:

Estimate of damage repair / replacement value: $ _____

How often does this occur? Regularly / Occasionally / 1st Time *

Full investigation recommended? Yes / No *

(* = strike out inapplicable)

What Primary Factors Contributed to the Incident?

What Secondary Factors Contributed to the Incident?

What Training & Supervision was Provided to Those Involved?

Recommendations to Prevent Recurrence:

Recommendations Approved: ☐ **Yes** ☐ **No**

Approved By (name)**:** _____ **Date:** _____

Expected Completion Date: _____

Chalice Mining Limited

Addendum A

1. Revision to Drilling Program

This addendum (Addendum A) to the Conservation Management Plan - Hartog and Baudin Low Impact Exploration Drilling Program – Julimar State Forest – E70/5119 (Hartog-Baudin CMP) outlines changes to the wide-spaced, low-impact exploration drilling program undertaken by Chalice Mining Limited (Chalice) in the Julimar State Forest.

Seventy-one drill sites were approved on 29 December 2021 under the original Hartog-Baudin CMP. Chalice has completed drilling at 28 of these sites (at 6 October 2022) with another 15 sites yet to be tested as shown in **Figure 1**. Twenty-eight drill sites are unlikely to be drilled as the underlying geology is considered less prospective than originally thought.

Chalice wishes to revise the location of 16 drill sites as shown in **Figure 1** to enable further testing of drill targets immediately to the west of the original Hartog-Baudin drilling program.

The proposed amendments would result in 59 drill sites in total across the Hartog-Baudin CMP area which is 12 drill sites less than the 71 drill sites approved under the original Hartog-Baudin CMP.

All revised drill sites are located on or immediately adjacent to existing tracks and do not require the establishment of off-track access routes. This will therefore result in less impact to vegetation and reduced dieback risk than the drill sites that the revised drill site locations will replace.

All controls outlined in the CMP and associated Dieback Management Plan will be implemented for this drilling.

Level 3, 46 Colin Street, West Perth
WA 6005, Australia
PO Box 428, West Perth WA 6872
T: +61 8 9322 3960
info@chalicemining.com
www.chalicemining.com
@chalicemining
chalice-mining

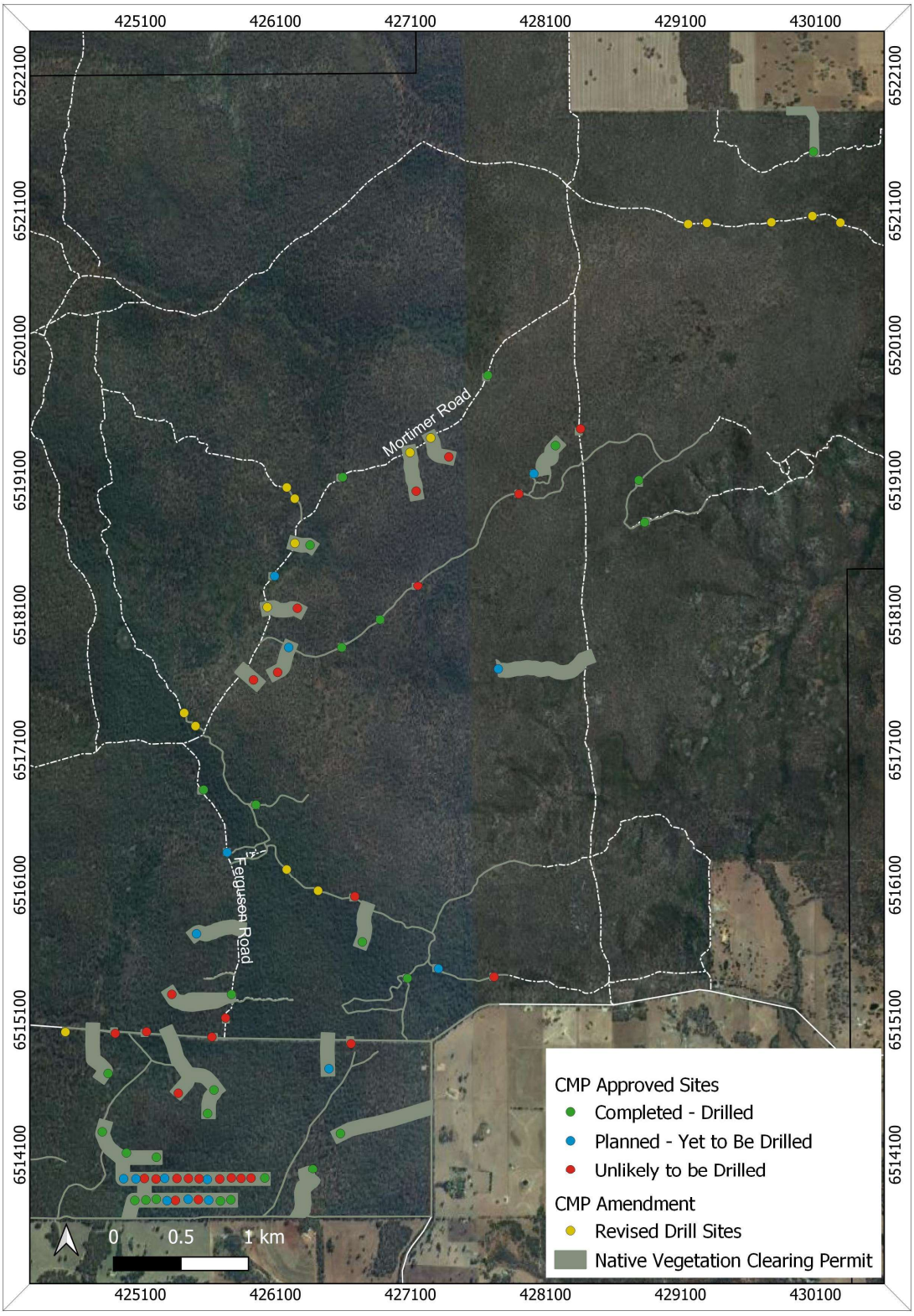


Figure 1: Original CMP drill sites and revised drill site locations

Proposed Site Layout – Cook's Road
Drilling rig and support vehicles aligned in tandem along existing track

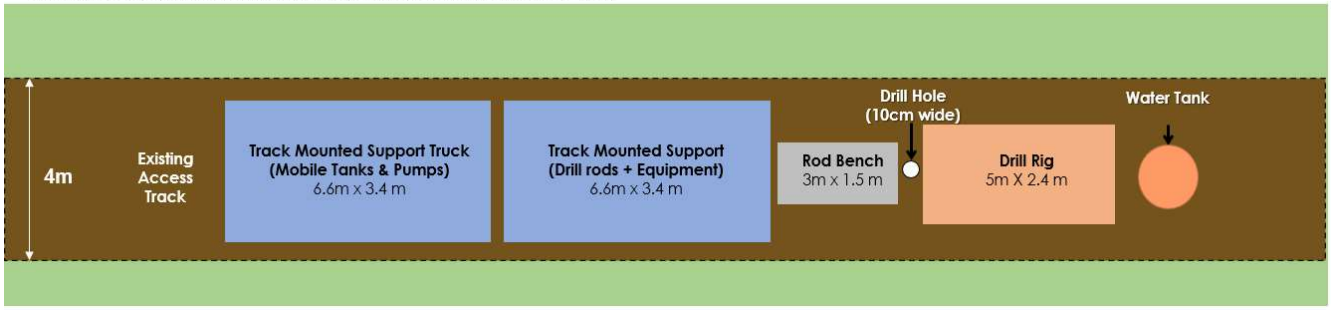


Figure 2: Cooks Road drill rig and support vehicle set up