Carabooda Quarry

Native Vegetation Clearing Permit - Supporting Document

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Carabooda Quarry

Native Vegetation Clearing Permit - Supporting Document

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	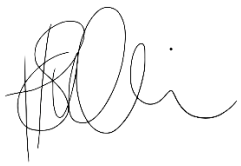	
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In accordance with the scope of services, WEPL has conducted environmental field monitoring and/or testing in the preparation of this report. The nature and extent of monitoring and/or testing conducted is described in this report.

On all sites, varying degrees of non-uniformity of vertical and horizontal conditions in media (soil, water, air, waste or other media as described in the report) are encountered. Hence no monitoring, common testing or sampling technique can eliminate the possibility that monitoring or testing results/samples are not totally representative of media conditions encountered. The conclusions are based on the data and the environmental field monitoring and/or testing actually undertaken, and are therefore merely indicative of the environmental condition of the site at the time of preparing this report, including the presence or otherwise of contaminants or emissions. It should be recognised that site conditions, including the extent and concentration of contaminants, can change.

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WEPL will not be liable to update or revise this report to take into account any events or circumstances or facts becoming apparent after the date of this report.

Executive Summary

Project Background

P.M.R Quarries Pty Ltd T/A WA Limestone Co (WA Limestone) are proposing to undertake clearing associated with the expansion of Carabooda Quarry. The proposed works will necessitate the clearing of 3.99 ha vegetation within the Disturbance Footprint of 4.55 ha. The proposed works will be undertaken within Mining Tenement M70/341, within the City of Wanneroo.

Impact Assessment

The Carabooda Quarry expansion will necessitate the clearing of 3.99 ha of remnant native vegetation and modified vegetation, which includes the following values:

- 3.63 ha of BsXp: *Banksia sessilis / Xanthorrhoea preissii* Tall Open Scrub over *Melaleuca systena / Hakea lissocarpha* Open Shrubland over *Jacksonia sericea* (P4) / *Hibbertia hypericoides* Low Open Shrubland. Out of that,
    - 0.02 ha is in Excellent to Very Good condition.
    - 3.61 ha is in Good to Degraded condition.
- 0.63 ha of Rehab: disturbed areas, with limestone substrate, that have undergone some rehabilitation of vegetation. No vegetation condition was allocated.
- One population of Priority 2 flora species *Acacia benthamii* (exact number of individuals is not known).
- Four populations of Priority 4 flora species *Jacksonia sericea* (exact number of individuals is not known).
- 3.99 ha of suitable foraging habitat for Carnaby's black cockatoo:
    - 3.63 ha of Moderate foraging value.
    - 0.36 ha of Low foraging value.

The Carabooda Quarry expansion was referred to the Department of Climate Change, Energy, the Environment and Water (DCCEEW), and was determined to be Not a Controlled Action on the 26th July 2024.

Avoidance and Mitigation

WA Limestone originally considered a 44.39 ha area for potential expansion, which was subject to detailed flora, vegetation, and fauna surveys in early and late spring 2009 and in early spring 2020. Based on the results of assessment, the expansion area was defined to avoid significant environmental values. Through

the EPBC Act referral process, an Environmental Management Plan (EMP) was developed to minimise direct and indirect impacts of the project. Through these processes, the following avoidance and mitigation measures were realised.

Avoidance

Based on the area originally considered for expansion, the Carabooda Quarry expansion will avoid impacting 39.84 ha of native vegetation that contains the following values:

- 33.20 ha Carnaby's black cockatoo foraging habitat.
- 11.65 ha Forest red-tailed black cockatoo foraging habitat.
- 5.66 ha Banksia woodlands of the Swan Coastal Plain (SCP) ecological community (Commonwealth-listed Threatened Ecological Community [TEC], State-listed Priority Ecological Community [PEC]).
- 10.10 ha of Tuart Woodlands and forests of the SCP ecological community (Commonwealth-listed TEC, State-listed PEC).
- One mature Tuart with a potentially suitable breeding hollow.
- Seven populations of Priority 2 flora species *Acacia benthamii* (exact number of individuals is not known).
- Eleven populations of Priority 4 flora species *Jacksonia sericea* (exact number of individuals is not known).

Mitigation

Potential indirect impacts will be avoided for the duration of the project through the implementation of an Environmental Management Plan (EMP) that provides for the following key mitigation measures:

- Clear demarcation of clearing areas with all on-site personnel to be informed of areas to be impacted and avoided.
- Application of an 8-metre buffer between the proposed action and instances of Banksia woodlands of the SCP TEC/PECand Tuart woodlands and forests of the SCP TEC/PEC to ensure they are not subject to disturbance and edge effects.
- Maintenance of a 2-metre buffer between excavation and the water table in accordance with Water Quality Protection Note 15 (WQPN 15) to ensure there are no direct or indirect impacts to groundwater and consequential impacts to groundwater dependent vegetation (DWER, 2019).
- Undertaking directional clearing from south (adjacent to existing quarry operations) to north in order to encourage fauna to move into adjacent vegetation.

- Application of dust suppression during all clearing activities to minimize dust emissions, particularly during windy conditions.
- Application of standard hygiene protocols to minimize the risk of introducing or spreading weeds or pathogens.

Rehabilitation

Revegetation is planned that will return suitable habitat for Carnaby's black cockatoo once operations have ceased. A Mine Closure Plan has been prepared for the Carabooda Quarry which outlines revegetation procedures. Revegetation will focus on establishing *Banksia sessilis* and other similar species to reinstate the current dominant overstorey and provide foraging habitat in the long term.

Offsets

The proposed clearing is not considered at variance with any of the clearing principles. As such, no offsets are currently proposed.

Assessment against Clearing Principles

The proposed action is not at variance to any of the ten clearing principles. A more detailed assessment is presented in section 6.

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Appendix D Targeted Survey for Threatened Flora (WEPL, 2024)
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1. Introduction

1.1 Project Background

P.M.R Quarries Pty Ltd T/A WA Limestone Co (WA Limestone) are proposing to undertake clearing associated with the Carabooda Quarry expansion The proposed quarry expansion will necessitate the clearing of 3.99 ha of native and modified vegetation within a 4.55 ha Disturbance Footprint. The balance of the Disturbance Footprint is comprised of cleared land.

Carabooda Quarry is located within M 70/341 on Hopkins Road Nowergup, WA, 6032 in the City of Wanneroo in Western Australia, approximately 40 km north of Perth (Figure 1). The purpose of the quarry expansion is to access additional sand and limestone resources.

Vegetation to be cleared is predominantly 3.63 ha being regenerated native vegetation and 0.36 ha is highly disturbed rehabilitated vegetation. The proposed clearing will facilitate construction of the following elements:

- Quarry pit extension.
- Stockpile, storage and laydown areas.
- Associated quarry infrastructure.

A broader Project Area was originally considered for the Carabooda Quarry expansion, as shown on Figure 1, which comprises portions of mining tenements M 70/345, M 70/346, M 70/339 and M 70/341. The Disturbance Footprint was identified to avoid impacting the majority of conservation significant values identified in the Project Area.

The Carabooda Quarry expansion was referred to the Department of Climate Change, the Environment and Water (DCCEEW) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) due to having direct impacts to Carnaby's black cockatoo and potential indirect impacts to Banksia TEC and Tuart TEC which are located adjacent to the proposed disturbance footprint. The expansion was determined to be Not a Controlled Action (EPBC 2023/09554).

1.2 Objectives

WA Limestone has commissioned Western Environmental Approvals Pty Ltd (WEPL) to prepare a Native Vegetation Clearing Permit application.

The scope of works included:

- Review of design previously developed documents.

- Review of the previously undertaken flora and vegetation survey (PGV Environmental, 2021; Coffey, 2010a; Coffey, 2010b).
- Review of the previously undertaken fauna survey (Bamford Consulting Ecologists, 2022).
- Desktop assessment of Black Cockatoo Habitat in accordance with Commonwealth referral guidelines for Threatened Black Cockatoos (DCCEEW, 2022).
- Preparation of a supporting technical report including results of the desktop and field surveys as well as an assessment against the clearing principles for native vegetation under Schedule 5 of the *Environmental Protection Act 1986* (EP Act).
- Preparation of a geospatial data package prepared in accordance with Index of Biodiversity Surveys for Assessments (IBSA) requirements.
- Preparation of a Native Vegetation Clearing Permit application form.

1.3 Previous Surveys

The assessment presented in this report has been undertaken based on previous biological surveys commissioned by WA Limestone. Details are summarised in Table 1.

Table 1: Previous Surveys

Survey Type	Survey Area	Survey Year	Contractor
Flora and Vegetation Survey	Whole Project Area: Portions of mining tenements M70/339, M70/341 and M70/345	2009	Coffey Environments (Coffey) (Appendix A)
Detailed Flora and Vegetation Survey	Eastern and northern portion of Project Area: portions of mining tenements M70/341, and M70/345. This survey covered the entire clearing permit application area.	spring 2020	PGV Environmental (Appendix B)
WA Limestone Carabooda Project Fauna Assessment	Disturbance Footprint within M70/341	June 2021	Bamford Consulting Ecologists (Appendix C)
Targeted Survey for Threatened Flora	Disturbance Footprint within M70/341	spring 2023	Western Environmental Approvals (WEPL) (Appendix D)

For the purpose of describing and quantifying avoidance measures, the data from the 2010 surveys has been used for the areas where no updated data was available.

1.4 Limitations

This report has been developed using information from previous environmental surveys and assessments.

Over the course of the planning and expansion history of the Carabooda quarry, several environmental assessments have been undertaken within the Project Area. Based on the identification of conservation significant environmental assets the area under consideration for future mine expansion was reduced in a step-by-step process until the Disturbance Footprint was identified as the area, where the lowest environmental impact would occur as a result from development.

The earliest survey was undertaken in 2009, which is now considered out of date. Areas that had been excluded from potential development were not subject to further investigations and were excluded from the survey effort in 2020. Portions of the data for the Project Area are therefore potentially inaccurate due to being out of date, however this does not affect accuracy of data within the Disturbance Footprint.

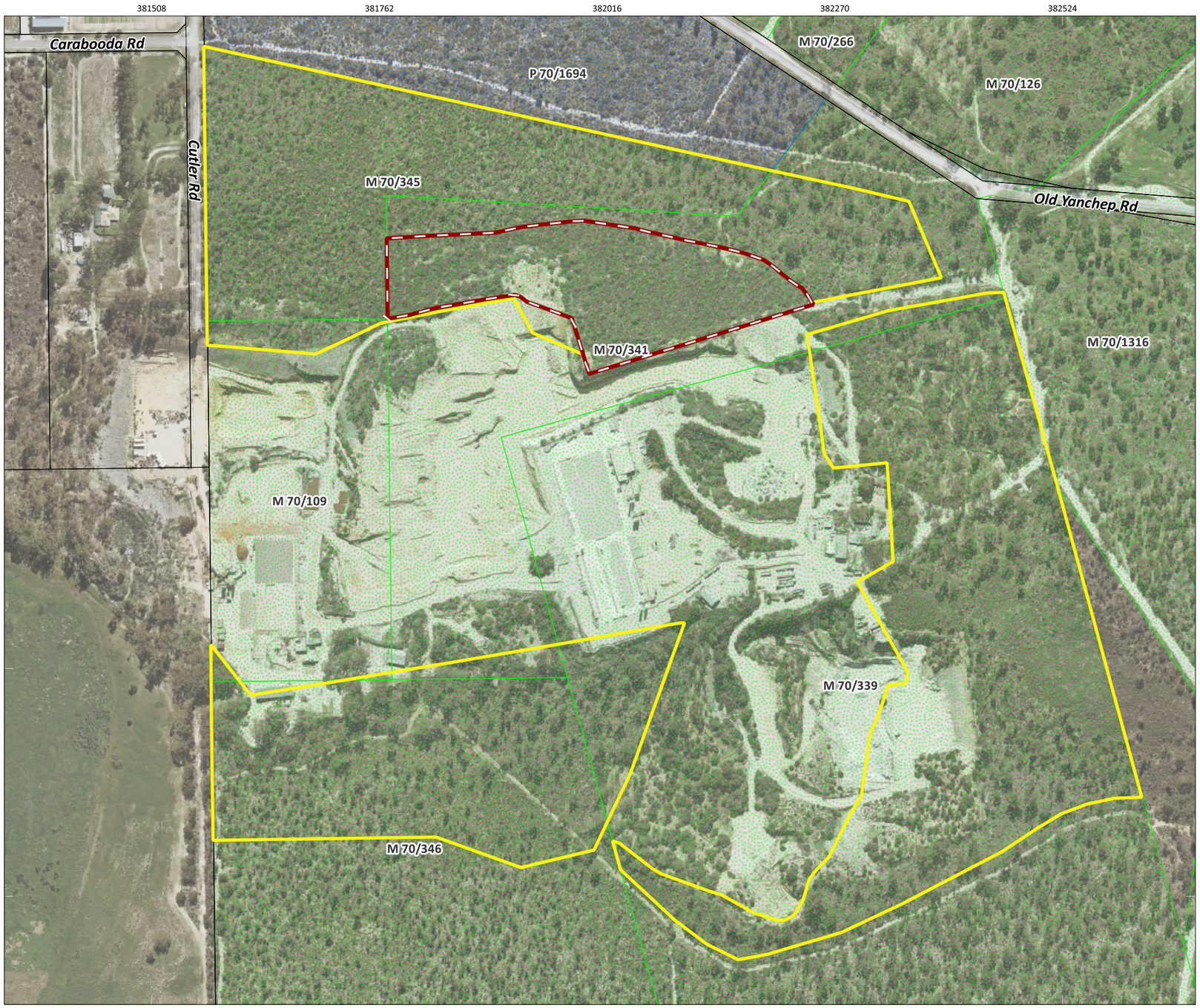
It is recognised that, given the detailed flora and vegetation assessments were undertaken in spring of 2020 (PGV, 2021), at the time of this assessment the data is approaching five years old. However, targeted searches for Threatened and Priority flora undertaken in spring of 2024 (WEPL, 2024) confirmed that the mapped ecological values within the Disturbance Footprint remain current.

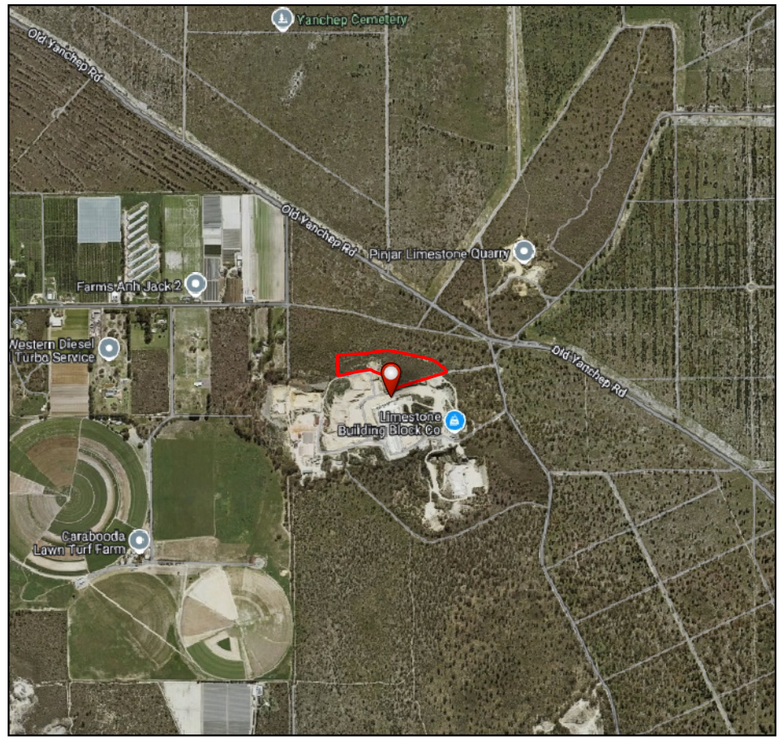
1.5 Legislation and Guidance

This environmental assessment was conducted in accordance with Commonwealth and State legislation, guidelines and advice:

- *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).
- *Western Australian Environmental Protection Act 1986* (EP Act).
- *Western Australian Biodiversity Conservation Act 2016* (BC Act).
- *Western Australian Biodiversity Conservation Regulations 2018*.
- Commonwealth Department of the Environment (DotE). (2013). Matters of National Environmental Significance. Significant Impact Guidelines 1.1 - *Environment Protection and Biodiversity Conservation Act 1999*.
- Commonwealth Department of the Environment and Energy (DotEE). (2016). Approved Conservation Advice (incorporating listing advice) for the Banksia Woodlands of the Swan Coastal Plain ecological community.
- Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW). (2022). Referral guidelines for 3 Threatened Black Cockatoo species.

- WA EPA. (2020). Technical Guidance – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment. Known herein as the 'Fauna Technical Guidance'.
- WA EPA. (2016). Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment. Known herein as the 'Flora and Vegetation Technical Guidance'.
- WA EPA. (2021). Statement of Environmental Principles, Factors and Objectives.





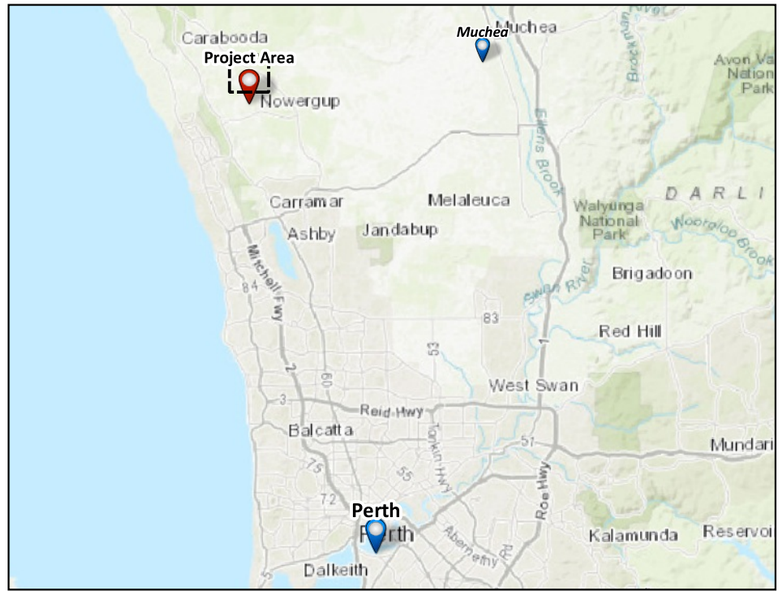


Figure 1: Project Area

0 70 140 210 280 m

N

PROJECT/REPORT NAME	Native Vegetation Clearing Permit – Carabooda Quarry Old Yanchep Road, Carabooda WA
SCALE	1:5,072
SHEET SIZE	A3 COLOUR
CLIENT	WA Limestone
COORDINATE REFERENCE SYSTEM	GDA2020 / MGA zone 50
PROJECT NUMBER	A24.310
VERSION	0
DATA SOURCE	LANDGATE AERIAL IMAGERY NOW
DRAWN BY / REVIEWED BY	MD/JB
DATE	23/1/2025

Legend

- Disturbance Footprint
- Project area
- Cadastre (No Attributes) (LGATE-001)

Road Network

- Local Road

Mining Tenements (DMIRS-003)

- Live
- Pending

No	Description	Drawn	Approved	Date
A	Original issue	MD	JB	23/1/2025

NOTES:

Cadastral boundary (LGATE-002). Base map ESRI Topo. Townsites (LGATE-248).

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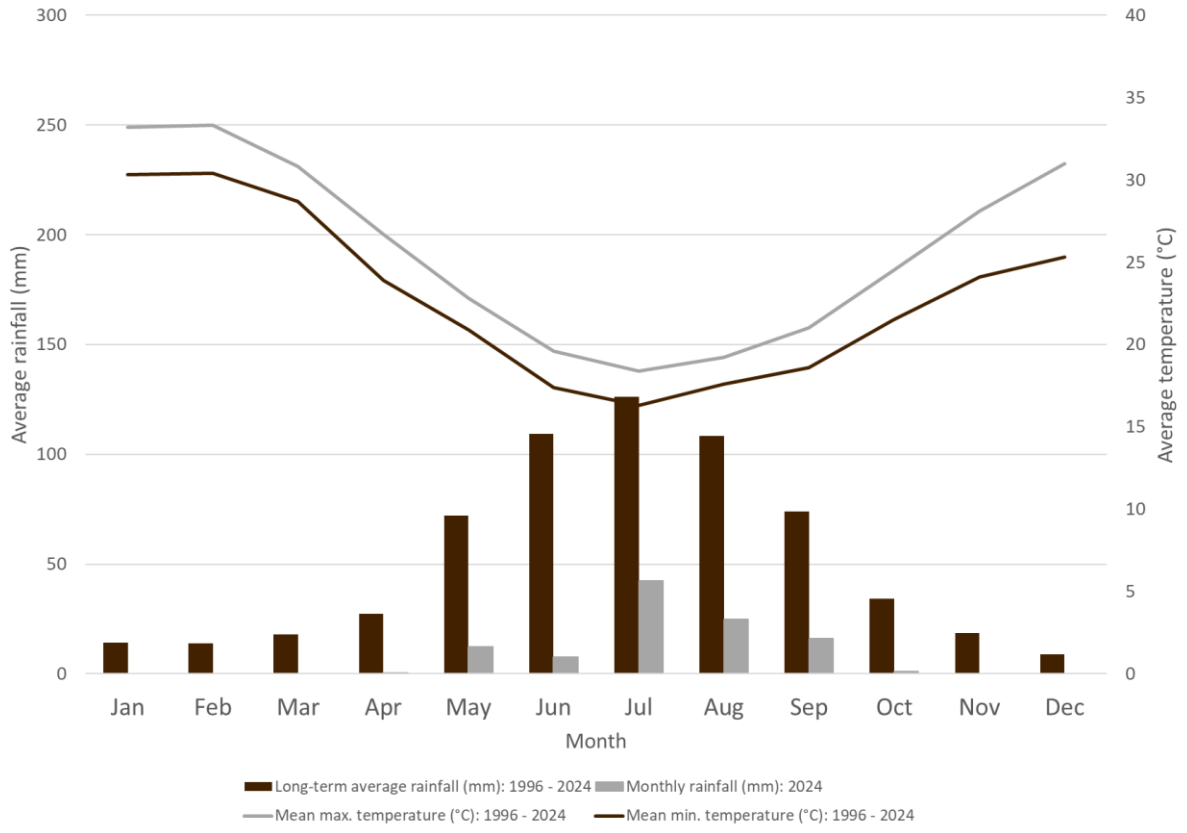
2. Existing Environment

2.1 Climate

The Project Area is located within the Perth (SWA02) subregion of the Swan Coastal Plain bioregion (Beard 1990). Beard (1990) described the climate of the area as warm Mediterranean, with cool wet winters (May to September) and warm dry summers.

The closest weather station to the Project Area is Gingin Aero. Rainfall recorded from the period of May to September is considered to be the most relevant in terms of promoting plant growth and flowering in the region. This data is incomplete for 2020 when the flora and vegetation survey was undertaken (July 2020 missing). The overall precipitation for the rest of 2020 however indicates that the rainfall during this period was below average. The long-term average (1996-2024) for May to September is 490 mm (Graph 1; Gingin Aero, Bureau of Meteorology [BoM], 2025).



Graph 1: Long Term and Monthly Total Rainfall, Maximum and Minimum Temperatures for Gingin aero (Station no: 9178) (BoM, 2025)

2.2 Historic Land Use

Partial clearing of the Project Area started in the 1970s. The area immediately south of the proposed Disturbance Area (within M 70/109, M 70/341, and M 70/339) has been previously cleared for mining. Mining lease M 70/109 was granted in 1985, M 70/339 in 1988.

The Disturbance Area is located within mining lease M 70/341, which was first granted on 21 December 1992. The current clearing extent was reached in 2018.

2.3 Geology and Soils

The Project Area is located within the Perth Coastal Soil-Landscape Zone of the Swan Province, and features:

- 'Coastal sand dunes and calcarenite. Late Pleistocene to Recent (Quindalup and Spearwood Systems). Calcareous and siliceous sands and calcarenite' (Schoknecht et al., 2004).

The Department of Primary Industries and Regional Development (DPIRD) mapped two soil units within the Project Area as summarised in Table 2 (*DPIRD-027*) and displayed in Figure 2.

Table 2: Soil-Landscape Units within Survey Area (*DPIRD-027*).

Soil-Landscape Unit	Unit Name	Description	Area (ha)
211Sp_Kls	Karrakatta shallow soils phase	Low hills and ridges. Bare limestone or shallow siliceous or calcareous sand over limestone.	22.75 ha 3.91 ha within Disturbance Footprint
211Sp_Ky	Karrakatta sand yellow phase	Low hilly to gently undulating terrain. Yellow sand over limestone at 1-2 m.	21.65 ha 0.64 ha within Disturbance Footprint

Figure 2: Surface Geology (Soils) and Topography

N

0 70 140 210 280 m

PROJECT/REPORT NAME	Native Vegetation Clearing Permit – Carabooda Quarry Old Yanchep Road, Carabooda WA
SCALE	1:5,112
SHEET SIZE	A3 COLOUR
CLIENT	WA Limestone
COORDINATE REFERENCE SYSTEM	GDA2020 / MGA zone 50
PROJECT NUMBER	A24.310
VERSION	0
DATA SOURCE	LANDGATE AERIAL IMAGERY NOW
DRAWN BY / REVIEWED BY	MD / JB
DATE	6/2/2025

Legend

Disturbance Footprint

Project area

2 metre contours (DPIRD-072)

2m Contour

10m Contour

Soil Landscape Mapping - Best Available (DPIRD-027)

211Sp__Kg

211Sp__Kls

211Sp__Ky

211Sp__Sp

No	Description	Drawn	Approved	Date
A	Original issue	MD	JB	6/2/2025

NOTES:

Cadastral boundary from LANDGATE 2022

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2.4 Topography

The Project Area ranges in elevation from 52 m Australian Height Datum (mAHD) along the eastern and southern site boundaries to 72 mAHD in the centre of the Project Area. The Disturbance Footprint ranges from 56-58 mAHD in the east to 64 mAHD in the east (Figure 2).

2.5 Hydrology

There are no wetlands or surface water features present within or surrounding the Project Area.

Groundwater contours mapped by DWER (*DWER-099*, *DWER-100*) indicate a groundwater table elevation ranging from 20 mAHD in the west to 25 mAHD in the east of the Project Area. Within the Disturbance footprint, groundwater table elevation ranges from 22 mAHD in the west to 23-24 mAHD in the east. The minimum depth to groundwater is 19m in the south-east of the Project Area ranging to 50 m in the north-western portion (*DWER-095*). The Disturbance Footprint shows a mapped minimum depth to groundwater of 35 m in the east to 47 m in the west. Groundwater generally flows to the west.

Figure 3: Groundwater Contours

N

0 80 160 240 320 m

SCALE: 1:5,771	SHEET SIZE: A3 COLOUR
COORDINATE REFERENCE SYSTEM: GDA2020 / MGA zone 50	
DATA SOURCE: LANDGATE AERIAL IMAGERY NOW	

PROJECT/REPORT NAME: Native Vegetation Clearing Permit – Carabooda Quarry
Old Yanchep Road, Carabooda WA

CLIENT: WA Limestone

PROJECT NUMBER	VERSION
A24.310	0
DRAWN BY / REVIEWED BY	DATE
MD / JB	14/2/2025

Legend

- Disturbance Footprint
- Project area
- Gnangara Jandakot Water Table Elevation (Contours) – 2019 Max (DWER-100)
- Gnangara Jandakot Depth to Groundwater (Contours) – 2019 Min (DWER-095)

No	Description	Drawn	Approved	Date
A	Original issue	MD	JB	14/2/2025

NOTES:
Cadastral boundary from LANDGATE 2022

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2.6 Pre-European Vegetation

During the 1970s, John Beard and associates conducted a systematic survey of native vegetation, describing the vegetation systems in Western Australia. Beard (1980) mapped the vegetation of the Swan Coastal Plain at 1:1,000,00 scale (Beard, 1980).

Beard's mapping attempted to depict the native vegetation as it was presumed to be at the time of settlement and is known as the pre-European vegetation type and extent. Beard's vegetation maps are maintained in digital form by DPIRD (*DPIRD-006*). Extents are updated periodically by Department of Biodiversity, Conservation and Attractions (DBCA) (Government of Western Australia, 2019a). This mapping indicates that the Project Area and Disturbance Footprint intersects one pre-European vegetation association, which is:

- Spearwood_949: Low woodland or open low woodland: banksia; acacia peppermint, cypress pine, casuarina, York gum

Regional vegetation for the Swan Coastal Plain region of Western Australia (at vegetation complex level) was mapped by Mattiske and Havel (1998) and are maintained in digital form by DBCA (*DBCA-046*). The mapping indicates that the Disturbance Footprint intersects one pre-European regional vegetation complex, which is:

- Cottesloe Complex-Central and South (52): Mosaic of woodland of *Eucalyptus gomphocephala* (Tuart) and open forest of *Eucalyptus gomphocephala* (Tuart) - *Eucalyptus marginata* (Jarrah) - *Corymbia calophylla* (Marri); closed heath on the Limestone outcrops.

The pre-European vegetation association and vegetation complex identified from the Disturbance Footprint, and its pre-European and current extents within the Northern Jarrah Forest bioregion, are listed in Table 3 (Government of Western Australia, 2019a; Government of Western Australia, 2019b). Mapped vegetation complexes are displayed in Figure 4.

Table 3: Per-European Vegetation Association and Complex Representation within the Disturbance Footprint

Vegetation	Original Extent (ha)	Current Extent (ha)	% Remaining	% Managed for Conservation	Extent within Disturbance Footprint (ha)
Spearwood_949 Association (Government of Western Australia, 2019a)	13,221.96	6,797.43	51.41	14.12	4.55
Cottesloe Complex-Central and South (Unit 52) (Government of Western Australia, 2019b)	45,299.61	14,567.87	32.16	9.51	4.55

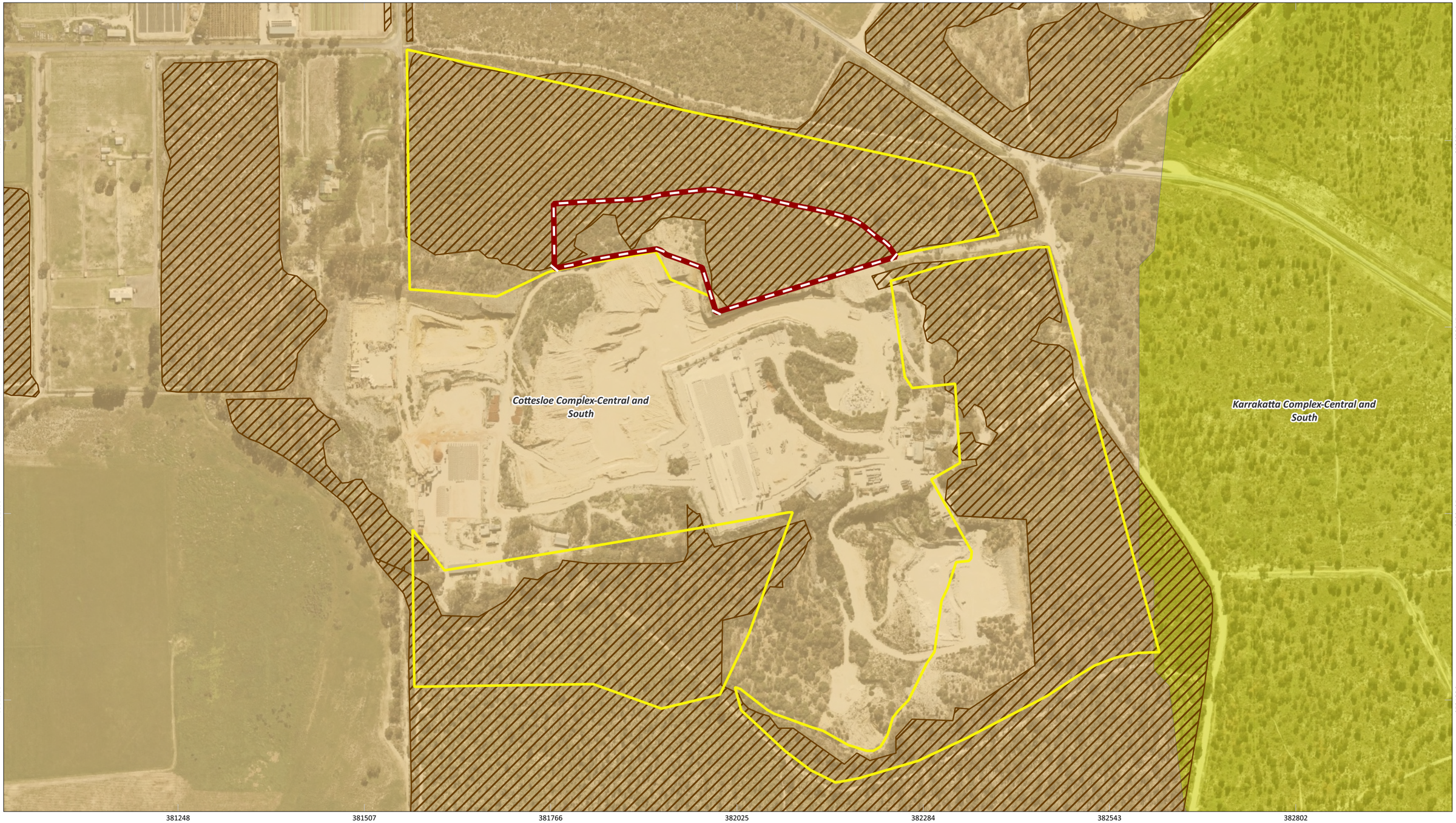

Figure 4: Vegetation Complexes

N

0 70 140 210 280 m

SCALE: 1:5,171	SHEET SIZE: A3 COLOUR
COORDINATE REFERENCE SYSTEM: GDA2020 / MGA zone 50	
DATA SOURCE: LANDGATE AERIAL IMAGERY NOW	

PROJECT/REPORT NAME: Native Vegetation Clearing Permit – Carabooda Quarry
Old Yanchep Road, Carabooda WA

CLIENT: WA Limestone

PROJECT NUMBER	VERSION
A24.310	0
DRAWN BY / REVIEWED BY	DATE
MD / JB	14/2/2025

Legend

- Disturbance Footprint
- Project area
- Native Vegetation Extent (DPIRD-005)

Vegetation Complexes - Swan Coastal Plain (DBCA-046)

- Karrakatta Complex-Central and South
- Cottesloe Complex-Central and South

No	Description	Drawn	Approved	Date
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NOTES:

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2.7 Conservation Estate, Bush Forever & Environmentally Sensitive Areas

The Project Area, including the majority of the Disturbance Footprint, intersects with Bush Forever site number 290: Hopkins Road Bushland, Nowergup (*DPLH-019*; Figure 5). As such, the area is also mapped as an Environmentally Sensitive Area (ESA) (*DWER-046*).

The entire Project Area is located within the Gnangara-Moore River State Forest under the *Conservation and Land Management Act 1984* (CALM Act), on crown land that is vested with the Conservation Commission of WA.

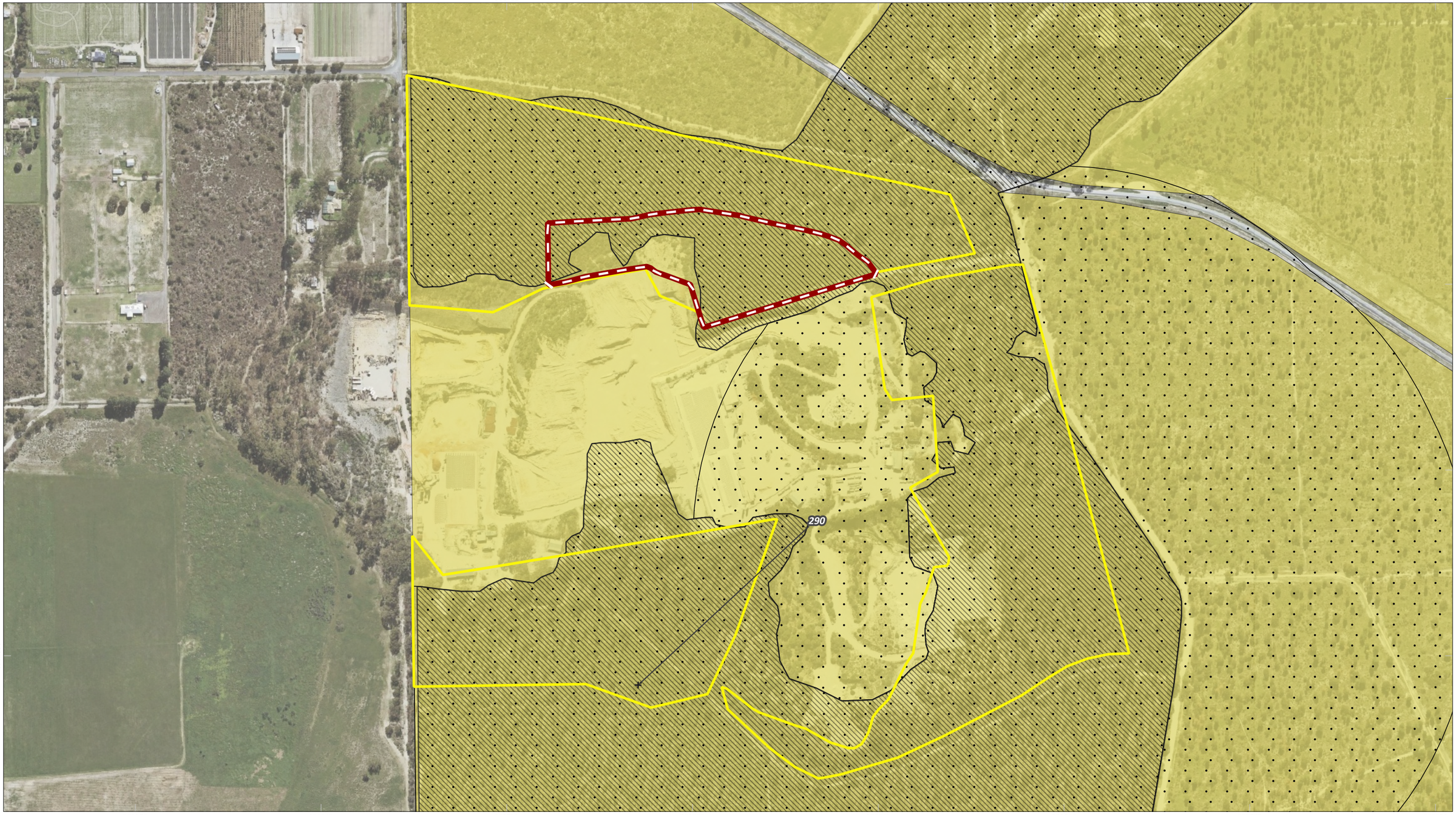

Figure 5: Conservation Areas and Bush Forever

N

0 80 160 240 320 m

SCALE: 1:5,389	SHEET SIZE: A3 COLOUR
COORDINATE REFERENCE SYSTEM: GDA2020 / MGA zone 50	
DATA SOURCE: LANDGATE AERIAL IMAGERY NOW	

PROJECT/REPORT NAME: Native Vegetation Clearing Permit – Carabooda Quarry
Old Yanchep Road, Carabooda WA

CLIENT: WA Limestone

PROJECT NUMBER	VERSION
A24.310	0
DRAWN BY / REVIEWED BY	**DATE**
MD / JB	6/2/2025

Legend

- Disturbance Footprint
- Project area

Conservation Areas

- Bush Forever Areas - 2000 (DPLH-019)
- Clearing Regulations - Environmentally Sensitive Areas (DWER-046)

DBCA - Legislated Lands and Waters (DBCA-011)

- State Forest

No	Description	Drawn	Approved	Date
A	Original issue	MD	JB	6/2/2025

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3. Biological Environment

3.1 Flora and Vegetation

A summary of flora and vegetation within the Project Area and Disturbance Footprint is detailed in the following subsections, based on the surveys detailed in Table 1.

3.1.1 Flora

A total of 188 plant species have been recorded within the entire Project Area (Coffey, 2010; PGV, 2021).

3.1.2 Vegetation Condition

Vegetation within the Disturbance Footprint is in Degraded to Good condition as depicted in Figure 6 (PGV Environmental, 2021). Vegetation condition within the Disturbance Footprint is poorer than in the areas surrounding, as all vegetation was previously cleared in the year 2000 and has since regenerated (PGV Environmental, 2021). Weed cover within the Disturbance Footprint is higher than in the surrounding Project Area, which ranges from Good to Excellent condition (Coffey, 2010; PGV Environmental, 2021). A summary of vegetation condition extents for the entire Project Area is presented in Table 4 and Figure 6.

Table 4: Vegetation Condition within Project Area

Vegetation Condition	Total Extent (ha)	Percentage of the Project Area	Extent within Disturbance Footprint (ha)	Percentage of Extent within DF of Total Condition Extent within Project Area	Percentage of Extent within DF of Total Project Area
Excellent	2.24	5.1%	-	-	-
Excellent to Very Good	18.53	42.3%	0.02	0.1%	0.05%
Very Good	2.22	5.1%	-	-	-
Very Good to Good	5.87	13.4%	-	-	-
Good	1.93	4.4%	-	-	-
Good to Degraded	6.29	14.4%	3.61	57.4%	8.2%
Degraded	0.14	0.3%	-	-	-
Degraded to Completely Degraded	2.41	5.5%	-	-	-
Completely Degraded	0.87	2.0%	0.56	64.4%	1.3%
Cleared	2.57	5.9%	-	-	-
Rehab	0.71	1.6%	0.36	50.7%	0.8%
Total	43.78	100%	4.55	N/A	10.4%

3.1.3 Vegetation Types

One native vegetation type was described and mapped within the Disturbance Footprint as shown in Figure 7 (PGV Environmental, 2021):

- BsXp: *Banksia sessilis* / *Xanthorrhoea preissii* Tall Open Scrub over *Melaleuca systena* / *Hakea lissocarpha* Open Shrubland over *Jacksonia sericea* / *Hibbertia hypericoides* Low Open Shrubland.

An area of highly disturbed vegetation was also recorded within the Disturbance Footprint, referred to as Rehab (PGV Environmental, 2021). This vegetation was described by Bamford as "disturbed areas, with limestone substrate, that have undergone some rehabilitation of vegetation" (Bamford, 2022).

A summary of vegetation types present within the surrounding Project Area is presented in Table 5 and Figure 7.

Table 5: Vegetation Types within Project Area

Vegetation Type	Description	Total Area (ha)	Extent within Disturbance Footprint (ha)	Percentage of Extent within Project Area
PGV Environmental (2021) - Flora and Vegetation Survey				
BsXp	*Banksia sessilis/ Xanthorrhoea preissii* Tall Open Scrub over *Melaleuca systena/Hakea lissocarpha* Open Shrubland over *Jacksonia sericea/Hibbertia hypericoides* Low Open Shrubland. *Banksia sessilis* and *Xanthorrhoea preissii* are 3-3.5m high and around 30-40% cover. Typical understorey species include *Melaleuca systena, Hakea lissocarpha, Jacksonia sericea, Hibbertia hypericoides, Acanthocarpus preissii* and *Desmocladus flexuosus*. Soil type is yellow-brown sand with some surface limestone.	6.92	3.63	52.5%
Rehab	Disturbed areas, with limestone substrate, that have undergone some rehabilitation of vegetation.	0.85	0.36	42.4%
BaAfBm	*Banksia attenuata/Allocasuarina fraseriana/B. menziesii* Low Open Forest over *Xanthorrhoea preissii* Tall Open Shrubland over *Hibbertia hypericoides/ Allocasuarina humilis* Open Low Heath. The Banksia and *Allocasuarina fraseriana* trees are 3-8m high and a density of around 40%. Common understorey species include *Xanthorrhoea preissii, Hibbertia hypericoides, Allocasuarina humilis, Mesomelaena pseudostygia, Desmocladus flexuosus* and *Acacia benthamii*. Soil type is yellow-brown sand.	2.22	-	-
BaAf	*Banksia attenuata/Allocasuarina fraseriana* Low Woodland over *Xanthorrhoea preissii/ Hakea prostrata* Tall Shrubland over *Hibbertia hypericoides* Low Open Shrubland over *Tetraria octandra/Mesomelaena pseudostygia* Very Open Sedgeland. Similar to the BaAfBm vegetation type but without *B. menziesii* in the tree canopy and with a slightly different understorey composition. Common species include	3.41	-	-

Vegetation Type	Description	Total Area (ha)	Extent within Disturbance Footprint (ha)	Percentage of Extent within Project Area
	Xanthorrhoea preissii, Hakea prostrata, Hibbertia hypericoides, Tetraria octandra, Mesomelaena pseudostygia, Desmocladus flexuosus. Soil type is yellow-brown sand.			
EmBa	*Eucalyptus marginata* Woodland over *Banksia attenuata* Open to Low Woodland over *Xanthorrhoea preissii* Open Shrubland over *Hibbertia hypericoides* Low Shrubland to Closed Low Heath over *Mesomelaena pseudostygia* Very Open Sedgeland. Jarrah (*Eucalyptus marginata*) is the main tree species up to 10m high with occasional Tuart (*E. gomphocephala*) over a sparse canopy of *Banksia attenuata* to 7m and generally less than 10% cover. Common understorey species include *Xanthorrhoea preissii, Hibbertia hypericoides, Mesomelaena pseudostygia, Desmocladus flexuosus* and *Hakea lissocarpha*. Soil type is yellow-brown sand.	3.47	-	-
EgEm	*Eucalyptus gomphocephala/ E. marginata* Low Woodland over *Jacksonia sternbergiana/Macrozamia riedlei* Shrubland over *Hibbertia hypericoides* Open Low Heath over *Mesomelaena pseudostygia* Very Open Sedgeland. Jarrah and Tuart are in equal proportion at around 10% cover each. Banksia trees are absent. Common understorey species include *Xanthorrhoea preissii, Macrozamia riedlei, Hibbertia hypericoides, Mesomelaena pseudostygia, Jacksonia sericea* and *Cassytha racemosa*. The soil type is orange-brown sand.	9.54	-	-
Coffey (2010) - Flora and Vegetation Survey				
LWEm	*Euclayptus marginata, Allocasuarina fraserina* and *Banksia attenuata* Low Woodland over *Xanthorrhoea preissii* Tall Open Shrubland over *Hakea lissocarpha* Open Shrubland over *Hibbertia hypericoides* Low Shrubland over *Mesomelaena pseudostygia* Very Open Sedgeland. Jarrah and *Allocasuarina fraseriana* are up to 7m with scattered Tuart. The soil type is yellow-brown sand.	3.51	-	-

Vegetation Type	Description	Total Area (ha)	Extent within Disturbance Footprint (ha)	Percentage of Extent within Project Area
OHMs	*Melaleuca systena* and *Acacia rostellifera* Open Heath over *Grevillea preissii* Low Open Shrubland over *Desmocladus asper* Very Open Herbland. Tall trees are absent. Most common midstorey species are *Melaleuca systena* and *Acacia rostellifera* with scattered *Banksia sessilis* up to 2m. The soil type is brown-loamy sand over limestone.	0.66	-	-
OHEg	*Eucalyptus gomphocephala* Open Woodland over *Acacia rostellifera* and *Banksia sessilis* Tall Shrubland over Xanthorrhoea preissii Open Shrubland over Phyllanthus calycinus, Banksia nivea and *Jacksonia sericea* Low Open Shrubland over *Lepidosperma ?pubisquarneum* Open Sedgeland over *Desmocladus flexuosus* and **Urospermum picroides* Very Open Herbland. The soil type is yellow-brown sand.	5.09	-	-
TOSXp	*Xanthorrhoea preissii, Acacia rostellifera* and *Banksia sessilis* Tall Open Scrub over *Dodonaea aptera* Open Shrubland over *Jacksonia sericea* (P4) Low Open Shrubland over *Desmocladus flexuosus* and **Urospermum picroides* Herbland. Tall trees are absent. The soil type is yellow-brown sand over limestone.	0.74	-	-
TSMs	*Melaleuca systena* Tall Shrubland over *Acacia lasiocarpa* and *Melaleuca huegelii* Open Shrubland over *Desmocladus flexuosa* Very Open Herbland. Scattered *Grevillea preissii*. The soil type is brown loamy sand over limestone. The VT has been identified as potentially being FCT26a.	1.37	-	-
WEg	*Eucalyptus gomphocephala* Woodland over *Xanthorrhoea preissii* Open Shrubland with scattered Banksia grandis. The soil type is brown loamy sand.	2.12	-	-
TOTAL VEGETATION		40.43	3.99	9.9%
Cleared	Cleared land, mined areas	3.35	0.56	16.7%
TOTAL		43.78	4.55	10.4%

3.1.4 Threatened and Priority Flora

Based on a desktop assessment utilising the DCCEEW Protected Matters Search Tool (PMST) with a 10 km buffer, and an assessment of habitat types present within the Project Area, two conservation significant species were found to potentially occur within the Project Area (PGV Environmental, 2021):

- *Eucalyptus argutifolia* (Yanchep Mallee) – Vulnerable under the EPBC Act and BC Act.
- *Melaleuca* sp. Wanneroo (G.J. Keighery 16705) - Endangered under the EPBC Act and BC Act.

A targeted survey for Threatened flora with the potential to occur within the Disturbance Footprint was undertaken by WEPL in 2023 (WEPL, 2024). Both target species display a very strong habitat association with limestone ridges (*Melaleuca* sp. Wanneroo) (TSSC, 2019) and gullies close to the summits of limestone ridges (*Eucalyptus argutifolia*) (DEWHA, 2008). WEPL (2024) covered the entirety of the Disturbance Footprint (see Appendix D) and did not record any individuals. Neither species is likely to occur due to the absence of suitable habitat (WEPL, 2024).

Similarly, neither species was recorded by PGV Environmental (2021) or Coffey (2010) within the broader Project Area. These surveys also noted that neither species is likely to occur given they are found on areas with more outcropping limestone that occurs within the Project Area. Therefore, no suitable habitat for either species occurs.

Two Priority flora species were recorded within the Disturbance Footprint (Figure 8):

- *Acacia benthamii* (Priority 2) - one population.
- *Jacksonia sericea* (Priority 4) - four populations.

Acacia benthamii was recorded as occurring abundantly in the north-eastern portion of the Project Area by Coffey (2010). The presence of the P2 species was confirmed in the 2020 PGV Environmental survey. The report recorded the presence of seven populations outside the Disturbance Footprint. *Acacia benthamii* is known to occur from Gosnells to Dandaragan, typically on limestone breakaways (PGV Environmental, 2021.

Coffey Environments (2010) recorded over 700 *Jacksonia sericea* plants occurring in all vegetation types in the north-eastern portion of the Project Area, outside of the Disturbance Footprint. PGV Environmental (2021) recorded *J. sericea* as common in the Tuart woodland vegetation. The two surveys recorded a total of 14 populations outside the Disturbance Footprint.

PGV Environmental (2021) reported that advice from the Department of Biodiversity, Conservation and Attractions (DBCA) on a nearby clearing permit application had indicated that the form of *J. sericea* in Carabooda is an intergrade between the more typical form of *Jacksonia sericea* (P4) and *Jacksonia calcicola*, a commonly occurring species on limestone soil. The Carabooda form of *J. sericea* also occurs abundantly in the portion of Bush Forever Site 290 to the north of Old Yanchep Road (PGV Environmental, 2021).

3.1.5 Threatened and Priority Ecological Communities

One patch of Banksia Woodlands of the Swan Coastal Plain ecological community, which is a Threatened Ecological Community (TEC) at Commonwealth level (Endangered) and a Priority Ecological Community (PEC) at State level (Priority 3) immediately adjacent to the Disturbance Footprint (PGV Environmental, 2021). The ecological community is hereafter referred to as Banksia TEC/PEC.

Banksia TEC/PEC is found within M70/345 and M70/341, outside of the northern boundary of the Disturbance Footprint, separated by approximately 8 m as shown in Figure 7. The Disturbance Footprint has been specifically designed to avoid directly or indirectly impacting Banksia TEC/PEC. Additional measures to avoid indirect impacts will be applied to ensure this is the case, including the maintenance of a 2-metre buffer between extraction activities and the water table to avoid groundwater impacts (see section 5.3).

Two patches of Tuart Woodlands and Forests of the Swan Coastal Plain ecological community, which is a TEC at Commonwealth level (Critically Endangered) and PEC at State level (Priority 3) occur immediately adjacent to the Disturbance Footprint (PGV Environmental, 2021). The ecological community is hereafter referred to as Tuart TEC/PEC.

Tuart TEC/PEC is found within M70/345, M70/341, and M70/436. Patches 1 and 2 are situated nearest to the Disturbance Footprint, both approximately 8 m from the eastern boundary. Patch 3 is separated from the Disturbance Footprint by existing quarry operations. The Disturbance Footprint has specifically been designed to avoid directly or indirectly impacting any patch of Tuart TEC/PEC. Additional measures to avoid indirect impacts will be applied to ensure this is the case, including the maintenance of a 2-metre buffer between extraction activities and the water table to avoid groundwater impacts (see section 5.3).

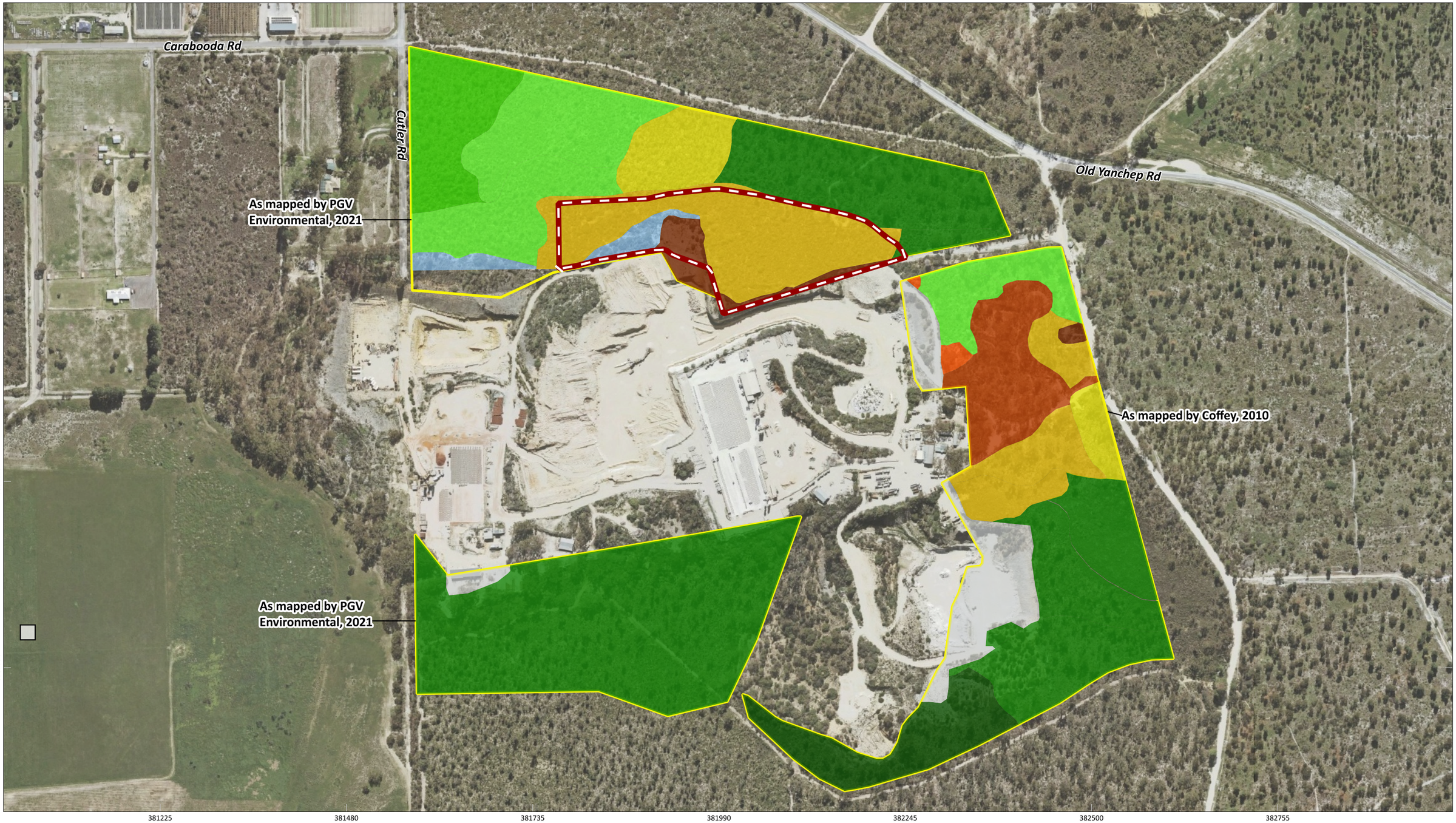

Figure 6: Vegetation Condition

N

0 70 140 210 280 m

SCALE: 1:5,094	SHEET SIZE: A3 COLOUR
COORDINATE REFERENCE SYSTEM: GDA2020 / MGA zone 50	
DATA SOURCE: LANDGATE AERIAL IMAGERY NOW	

PROJECT/REPORT NAME: Native Vegetation Clearing Permit – Carabooda Quarry Old Yanchep Road, Carabooda WA		
CLIENT: WA Limestone		
PROJECT NUMBER: A24.310	VERSION: 0	
DRAWN BY / REVIEWED BY: MD / JB	DATE: 6/2/2025	

Legend

- Disturbance Footprint
- Project area

Vegetation Condition

- Excellent
- Excellent - Very Good
- Very Good
- Very Good - Good
- Good
- Good - Degraded
- Degraded
- Degraded - Completely Degraded
- Completely Degraded
- Cleared
- Rehab

No	Description	Drawn	Approved	Date
A	Original issue	MD	JB	6/2/2025

NOTES:

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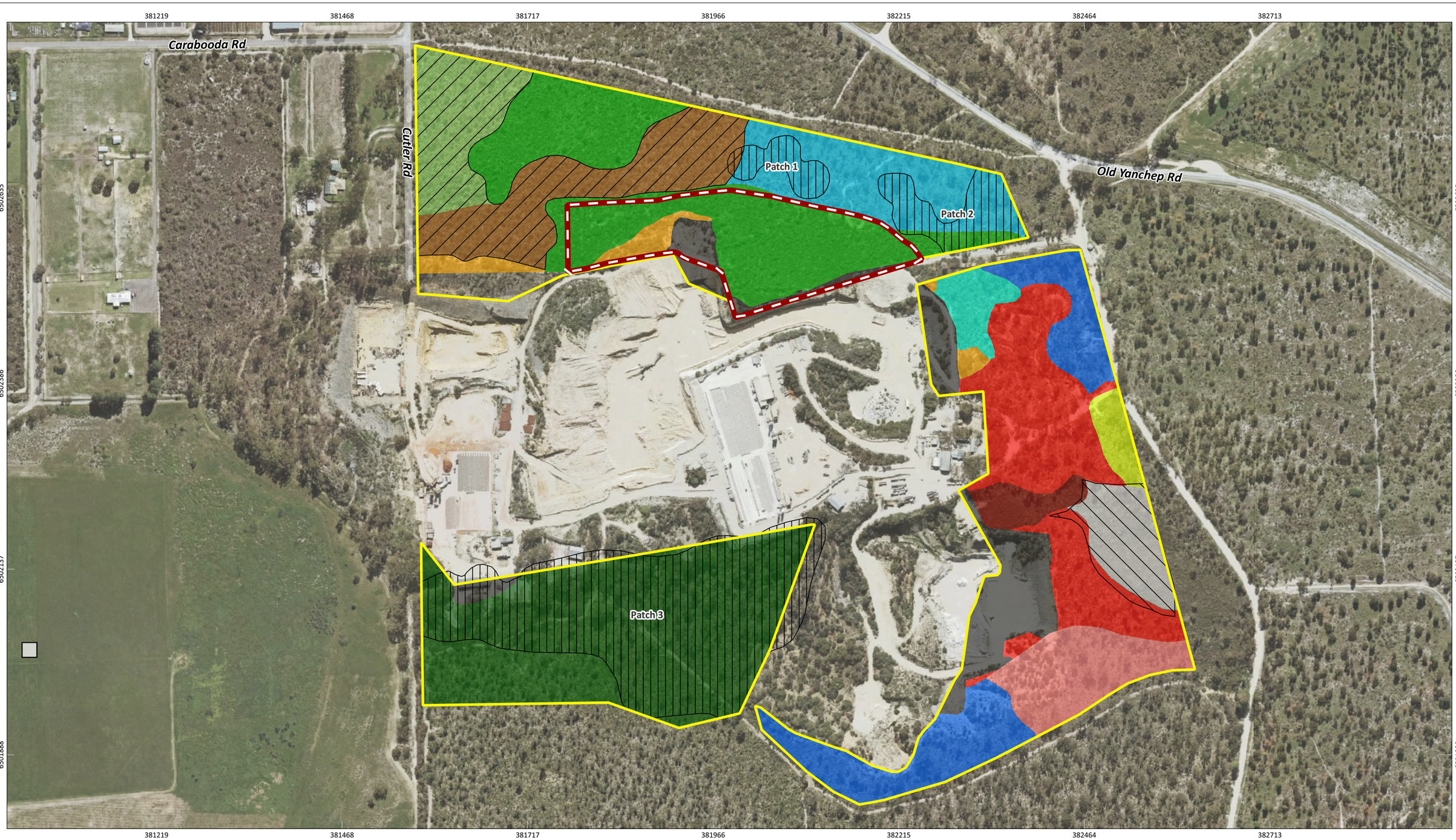

Figure 7: Vegetation Types and Threatened Ecological Communities

N

0 70 140 210 280 m

PROJECT/REPORT NAME	Native Vegetation Clearing Permit – Carabooda Quarry Old Yanchep Road, Carabooda WA
SCALE	1:4,979
SHEET SIZE	A3 COLOUR
CLIENT	WA Limestone
COORDINATE REFERENCE SYSTEM	GDA2020 / MGA zone 50
PROJECT NUMBER	A24.310
VERSION	0
DATA SOURCE	LANDGATE AERIAL IMAGERY NOW
DRAWN BY / REVIEWED BY	MD / JB
DATE	14/2/2025

Legend

- Disturbance Footprint
- Project area

Vegetation Types mapped by PGV Environmental, 2021

- BaAf
- BaAfBm
- BsXp
- EgEm
- EmBa

Vegetation Types mapped by Coffey, 2010

- LWEm
- OHMs
- OWEg
- WEg
- TOSXp
- TSMs
- WEm
- Rehabilitation Area
- Cleared

Threatened Ecological Communities

- Banksia Woodlands of the Swan Coastal Plain TEC
- Tuart Woodlands and Forests of the Swan Coastal Plain TEC
- Potential FCT 26a - Honeymyrtle shrubland on limestone ridges of the Swan Coastal Plain Bioregion (State TEC and nominated Commonwealth TEC)

No	Description	Drawn	Approved	Date
A	Original issue	MD	JB	14/2/2025

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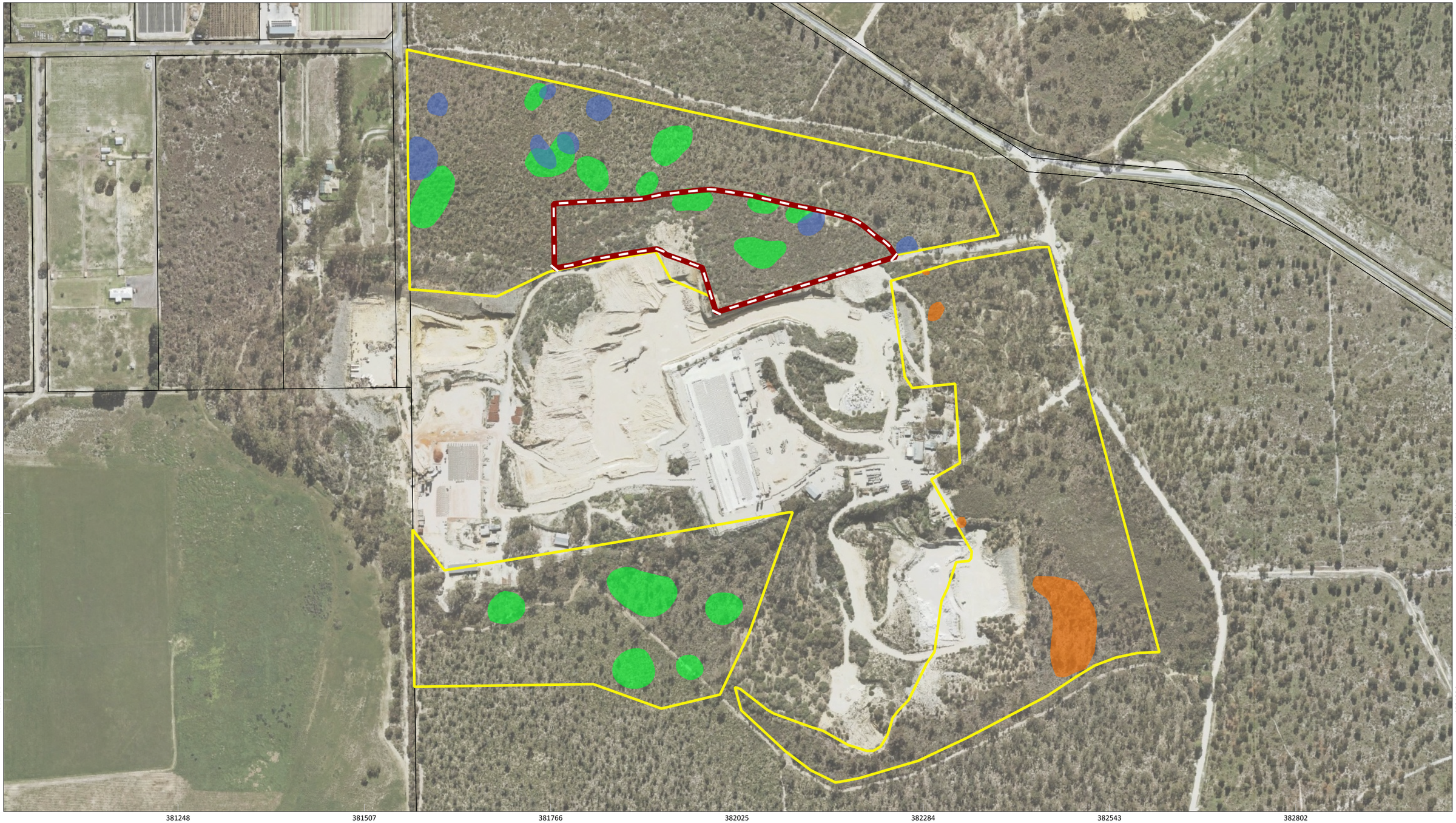

Figure 8: Threatened and Priority Flora

N

0 70 140 210 280 m

PROJECT/REPORT NAME	Native Vegetation Clearing Permit – Carabooda Quarry Old Yanchep Road, Carabooda WA
SCALE: 1:5,171	SHEET SIZE: A3 COLOUR
CLIENT: WA Limestone	
COORDINATE REFERENCE SYSTEM: GDA2020 / MGA zone 50	PROJECT NUMBER: A24.310 — VERSION: 0
DATA SOURCE: LANDGATE AERIAL IMAGERY NOW	DRAWN BY / REVIEWED BY: MD / JB — DATE: 6/2/2025

Legend

- Disturbance Footprint
- Project area

Flora Survey PGV Environmental, 2021

- Acacia benthamii
- Jacksonia sericea

Flora Survey Coffey, 2010

- Jacksonia sericea

No	Description	Drawn	Approved	Date
A	Original issue	MD	JB	6/2/2025

NOTES:

Cadastral boundary from LANDGATE 2022. UFID stands for Unique Identifier

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3.2 Fauna

The Disturbance Footprint was assessed to provide suitable habitat for one conservation significant species:

- Carnaby's black cockatoo (*Zanda latirostris*) – Endangered under the EPBC Act and the BC Act.

Outside the Disturbance Footprint, the Project Area has been assessed to provide limited habitat for the following conservation significant species:

- Forest red-tailed black cockatoo (*Calyptorhynchus banksii naso*) - Vulnerable under the EPBC Act and the BC Act.
- Chuditch (*Dasyuris geoffroii fortis*) – Vulnerable under the EPBC Act and the BC Act.

Chuditch (*Dasyurus geoffroii fortis*) is considered potentially vagrant within the Disturbance Footprint, as it is a wide-ranging species. Whilst the Disturbance Footprint contains habitat that may be suitable for the species, the closest known occurrence is10 km east (record from Bamford, 2004) and the species is therefore highly unlikely to be impacted by the proposed clearing. The species is therefore not further considered in this report.

3.2.1 Forest Red-tailed Black Cockatoo

Forest red-tailed black cockatoo (*Calyptorhynchus banksii naso*) is expected to be an irregular visitor to the area surrounding the Disturbance Footprint, however the Disturbance Footprint itself does not provide any foraging habitat for the species. Given that the Disturbance Footprint is at the limit of the species' range, and there is a complete absence of vegetation that provides foraging, breeding, and roosting habitat for the species, clearing will not directly impact Forest red-tailed black cockatoos. Further, whilst there is foraging habitat present within surrounding vegetation to the northeast and to the south of existing quarry operations (11.65 ha of foraging habitat - vegetation unit WEm), the extension of quarry operations is considered unlikely to cause an increase in indirect impacts to the species. Forest red-tailed black cockatoo is therefore highly unlikely to experience direct or indirect impacts from the proposed clearing.

Suitable habitat for Forest red-tailed black cockatoo within the Project Area is presented in Figure 9.

3.2.2 Carnaby's Black Cockatoo

Within Disturbance Footprint

Carnaby's black cockatoo (*Zanda latirostris*) is known to occur within the Disturbance Footprint. Two individuals were sighted north of the Disturbance Footprint, within the Project Area, during the 2021 survey (Bamford, 2022).

The Disturbance Footprint contains up to 3.99 ha of foraging habitat for Carnaby's black cockatoo, of which 3.63 ha (91%) is of moderate quality and 0.36 ha (9%) is of low quality as shown in Figure 9. The dominant native vegetation type providing habitat was described as Mixed Shrubland (3.63 ha), which is comprised of

Banksia sessilis and *Xanthorrhoea preissii* with mixed other shrub species on orange-brown sands with some limestone outcropping Bamford, 2022). The primary foraging species within the habitat type is *Banksia sessilis* found in moderate density. Foraging evidence for the species was found within the Disturbance Footprint, which was entirely comprised of *B. sessilis*. The habitat type was identified as providing 'moderate' quality foraging habitat for Carnaby's black cockatoo (Bamford, 2022).

An additional 0.36 ha of highly disturbed rehabilitated vegetation within the Disturbance Footprint was assessed to provide 'low' quality foraging habitat for the species. This area was subject to clearing just over 20 years ago (around 2000) and is immediately adjacent to an existing quarry (Figure 9).

The Disturbance Footprint does not contain any large trees suitable for roosting or breeding by the species. The nearest confirmed roost site is approximately 4.9 km east of the Disturbance Footprint (HF 15) which supports an estimated average of 200 birds per night (Figure 10). The next closest are approximately 6.6 km (HF 18) and 6.7 km (HF 17) southeast of the Disturbance Footprint, supporting an estimated average of 604 and 29 birds per night, respectively (DWER-050). The nearest unconfirmed roost site is situated approximately 2.9 km northwest of the Disturbance Footprint, with another two unconfirmed roosts situated 3.6 km to the southwest and 5.3 km to the southeast (Figure 10). There are large trees within the Project Area, surrounding the Disturbance Footprint that provide more suitable habitat for roosting (Bamford, 2022).

The proposed Disturbance Footprint falls within the buffer area of a known breeding location for Carnaby's black cockatoo, however there is no existing habitat suitable for breeding given the absence of mature trees of a suitable species (such as jarrah, marri, or tuart) that could develop hollows suitable for nesting. The nearest potentially suitable breeding habitat is one Tuart with a potentially suitable hollow situated outside of the proposed Disturbance Footprint to the north.

Within Project Area Surrounding the Disturbance Footprint

The following habitat values for Carnaby's black cockatoo have been identified outside the Disturbance Footprint but within the wider Project Area and will be avoided by the proposed clearing, as presented in Figure 9:

- One Tuart tree with a DBH > 500 mm.
- 33.2 ha of suitable foraging habitat*.

* This assessment was based on vegetation type descriptions as assessed by PGV Environmental (2021) and Coffey (2010). Vegetation types which contain suitable foraging species were identified as suitable foraging habitat.

Regional Black Cockatoo Habitat

There are approximately 31,280 ha of remnant native vegetation (as mapped in *DPIRD-005*) within 15 km of the Disturbance Footprint as presented in Figure 10. With 3.63 ha of native vegetation, the Disturbance Footprint comprises an estimated 0.01% of the native vegetation within the local area.

Given the presence of Tuart forests in the region, it is likely that Carnaby's black cockatoo breeds within the local area as indicated by the mapped breeding area (Figure 10).

The closest buffered black cockatoo roosting site (1 km buffer radius) is located 1.2 km west of the Disturbance Footprint (*DBCA-064*).

The closest known black cockatoo breeding site is 14 km south of the Disturbance Footprint (*DBCA-063*).

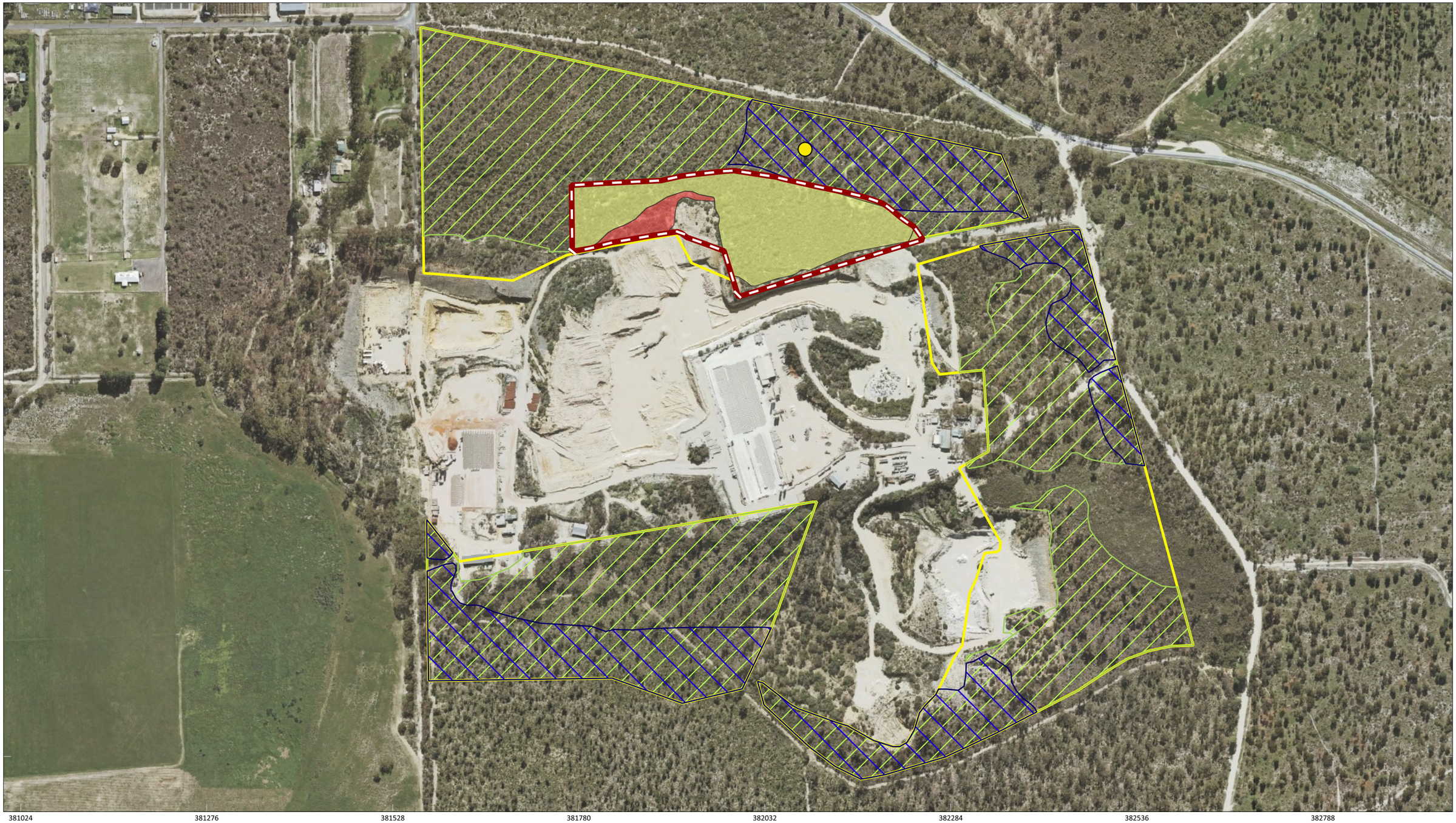

Figure 9: Black Cockatoo Habitat

N

0 70 140 210 280 m

SCALE: 1:5,041	SHEET SIZE: A3 COLOUR
COORDINATE REFERENCE SYSTEM: GDA2020 / MGA zone 50	
DATA SOURCE: LANDGATE AERIAL IMAGERY NOW	

PROJECT/REPORT NAME: Native Vegetation Clearing Permit – Carabooda Quarry
Old Yanchep Road, Carabooda WA

CLIENT: WA Limestone

PROJECT NUMBER	VERSION
A24.310	0
DRAWN BY / REVIEWED BY	DATE
MD / JB	6/2/2025

Legend

- Disturbance Footprint
- Project area
- Carnaby's Cockatoo Habitat
- Forest Red-tailed Black Cockatoo Habitat

Carnaby's Cockatoo Foraging Habitat within Disturbance Footprint

- Low Quality
- Moderate Quality

Potential Black Cockatoo Breeding Tree

- Tuart DBH > 500mm

No	Description	Drawn	Approved	Date
A	Original issue	MD	JB	05/06/2023

NOTES:

Cadastral boundary from LANDGATE 2022. Label corresponds to the vegetation association number.

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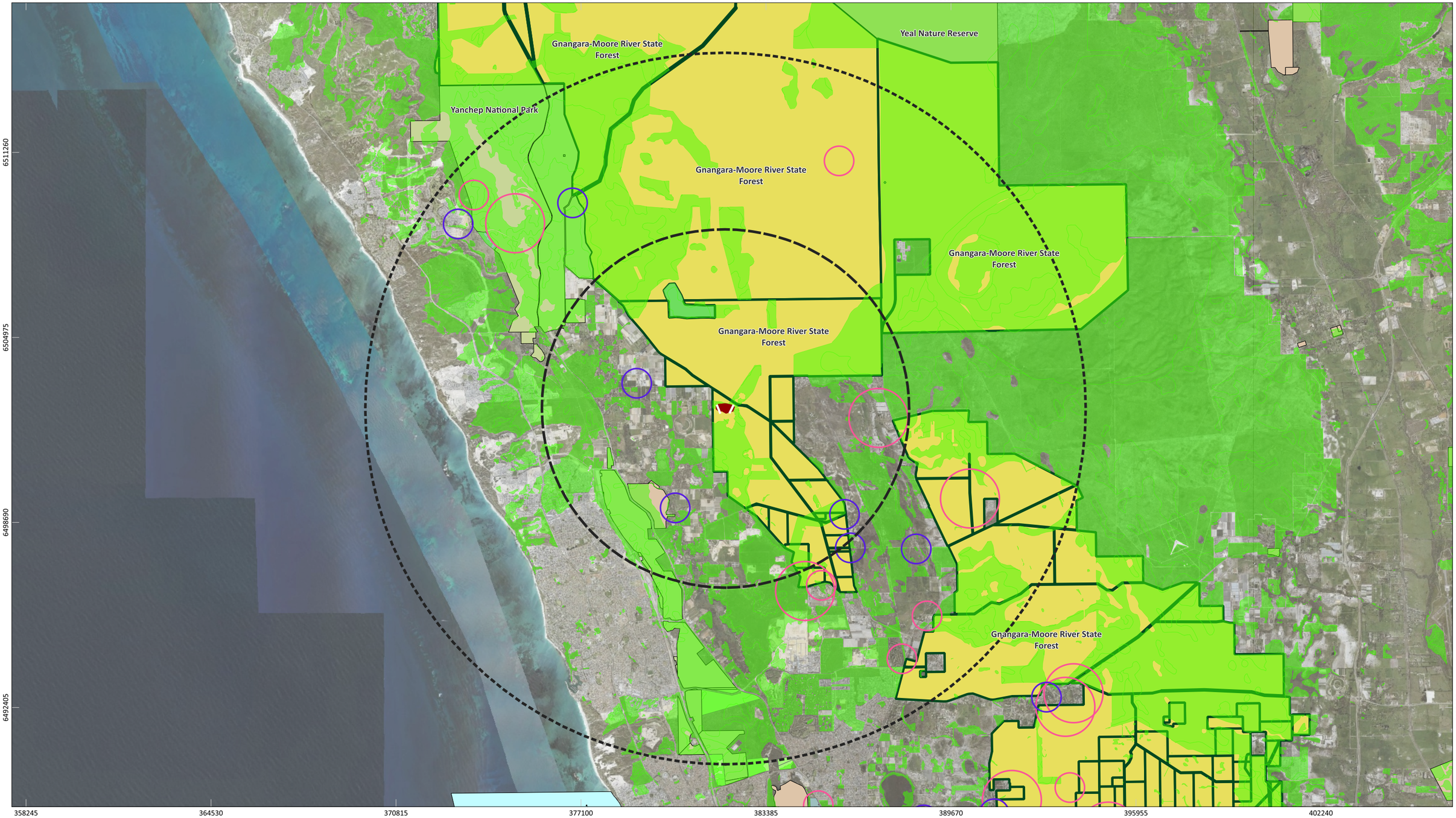

Figure 10: Regional black Cockatoo Habitat

N

0 1,800 3,600 5,400 7,200 m

PROJECT/REPORT NAME: Native Vegetation Clearing Permit – Carabooda Quarry Old Yanchep Road, Carabooda WA		
SCALE: 1:125,692	SHEET SIZE: A3 COLOUR	CLIENT: WA Limestone
COORDINATE REFERENCE SYSTEM: GDA2020 / MGA zone 50	PROJECT NUMBER: A24.310	VERSION: 0
DATA SOURCE: LANDGATE AERIAL IMAGERY NOW	DRAWN BY / REVIEWED BY: MD / JB	DATE: 6/2/2025

Legend

- Disturbance Footprint
- 6 km buffer
- 12 km buffer
- Carnabys Cockatoo Areas requiring investigation as feeding habitat in the Swan Coastal Plain (SCP) IBRA Region (DBCA-057)
- Carnabys Cockatoo Unconfirmed Roost Sites (DBCA-051)
- Carnabys Cockatoo Confirmed Roost Sites (DBCA-050)

DBCA - Legislated Lands and Waters (DBCA-011)

- National Park
- Nature Reserve
- Section 5(1)(g) Reserve
- Section 5(1)(h) Reserve
- State Forest
- Marine Park
- Crown Freehold - Dept Managed

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4. Summary of Proposed Impacts

4.1 Direct Impacts

4.1.1 Flora and Vegetation

The Carabooda Quarry expansion will necessitate the clearing of 3.99 ha of native vegetation pursuant to section V of the EP Act. This vegetation is comprised of:

- 3.63 ha of BsXp: *Banksia sessilis / Xanthorrhoea preissii* Tall Open Scrub over *Melaleuca systena / Hakea lissocarpha* Open Shrubland over *Jacksonia sericea* (P4) / *Hibbertia hypericoides* Low Open Shrubland. Out of that,
    - 0.02 ha is in Excellent to Very Good condition.
    - 3.61 ha is in Good to Degraded condition.
- 0.63 ha of Rehab: disturbed areas, with limestone substrate, that have undergone some rehabilitation of vegetation. No vegetation condition was allocated.

The following Priority flora species will be impacted:

- One population of Priority 2 flora species *Acacia benthamii*.
- Four populations of Priority 4 flora species *Jacksonia sericea*.

4.1.2 Fauna

The Carabooda Quarry expansion will necessitate the clearing of habitat for Carnaby's black cockatoo, including:

- 3.63 ha of Moderate foraging value.
- 0.36 ha of Low foraging value.

The Disturbance Footprint is located directly adjacent to an existing quarry. Therefore, no fragmentation of habitat occurs as a result of the clearing and quarry extension.

The proposed action is therefore considered to have a minor impact on Carnaby’s cockatoo.

4.2 Indirect and Consequential Impacts

Two patches of Tuart Woodlands TEC/PEC are located within M70/345 and M70/341 (Patches 1 and 2), approximately 8 m from the eastern boundary of the Disturbance Footprint. Further, a patch of Banksia Woodlands TEC is located 8 m from the northern and western boundary of the Disturbance Footprint.

Clearing within the Disturbance Footprint could potentially lead to the following indirect impacts to TEC/PEC patches if left unmitigated:

- Unintentional clearing of TEC/PEC vegetation.
- Introduction of weed species and/or pathogens.
- Indirect impacts to groundwater and consequential impacts to groundwater dependent vegetation.
- Erosion and dust development.
- Stormwater run-off and nutrient loading.

Mitigation measures are outlined in section 5.3. Further, an Environmental Management Plan (EMP) (WEPL, 2024b) has been prepared (Appendix F).

5. Include Impact Avoidance and Mitigation

5.1 Consideration of Alternatives

There are no feasible alternatives due to the geology and distribution of the Tamala Limestone, planning restrictions, conservation and economic factors.

State Planning Policy 2.4 Planning for basic raw materials (SPP 2.4) identifies the Tamala limestone deposit at M70/341 (including the proposed Disturbance Footprint) as a Significant Geological Source (SGS) for high grade limestone (GeoVIEW.WA, 2025). SGS are identified as the highest priority extraction areas for BRM. SGS are BRM identified by DMIRS that represent strategic, long-term supplies of BRM which are critical to the future development needs of the state and the community.

Exclusion Areas, which came into effect under SPP 2.4 in 2021, have sterilised significant amounts of alternative limestone and further reduced alternative sources. This included virtually all of WA Limestone's existing future reserves. This significantly reduces the area available for future limestone extraction and the remaining volume of limestone resource for the future development needs of the state.

The objectives of SPP 2.4 are to identify and protect significant limestone and other BRM resources required by the community and future development. SPP 2.4 identifies the subject site as both a "Priority Resource Location" and "Key Extraction Area". This is the highest level of significance able to be given to a BRM site. Limestone deposits occurring at Wanneroo/Yanchep area remain the only SGS left in the Perth Metropolitan Area and represent the last economically viable high-quality deposits not sterilised by conservation and planning policies.

The location and quality of the Tamala limestone in the north metro area is critical to the economic viability of public amenity projects. Its proximity to the north metro area makes the limestone a valuable economic material for Main Roads and Development WA. The next nearest alternative limestone deposits are located at Guilderton and Seabird, around 50 kilometres to the north. However, these limestone deposits are typically shallow and of low quality, unsuitable for construction use, and due to the additional transport costs are not economically feasible.

Transport costs are a significant component of any public development. The further out limestone is the higher costs of construction increasing pressure on public infrastructure project costs to entities like Development WA and Main Roads. Carbon emissions will rise from hauling from further away, impacting WA's net zero emissions targets.

The only feasible alternative construction to limestone in the Neerabup/Carabooda region is granite from the Darling Scarp. Granite is substantially more expensive to extract and transport, and the granite quarries are similarly constrained by environmental factors.

The clearing at M 70/341 represents some of the last remaining limestone available for extraction that can still be accessed that is not under conservation, in an exclusion zone under SPP 2.4 or residential development.

5.2 Avoidance Measures

The Disturbance Footprint has been minimised as far as possible to allow for the safe and economical extraction of the limestone resource present within the mining tenements whilst avoiding impacts to the most significant ecological values in the Project Area. In designing the Disturbance Footprint, impacts have been avoided to approximately 39.84 ha native vegetation in Good to Excellent condition which supports the following conservation significant values (Figure 11):

- 33.20 ha Carnaby's black cockatoo foraging habitat.
- 11.65 ha Forest red-tailed black cockatoo foraging habitat.
- 5.66 ha Banksia TEC/PEC.
- 10.10 ha of Tuart TEC/PEC.
- Mature Tuart with a potentially suitable breeding hollow.
- Seven populations of Priority 2 flora species *Acacia benthamii*.
- Over eleven populations of Priority 4 flora species *Jacksonia sericea*.

5.3 Mitigation Measures

Direct impacts of the proposed clearing are limited to the removal of 3.99 ha low to moderate quality foraging habitat for Carnaby's black cockatoo, of which 3.63 ha are considered native vegetation. This impact will be temporary, with rehabilitation activities undertaken following extraction operations that will re-establish native vegetation including Proteaceous species across the proposed action area to provide suitable foraging habitat for the species.

Potential indirect impacts can occur from clearing and extraction operations which will be avoided for the duration of the proposed clearing through the application of mitigation measures. Key measures include:

- Clear demarcation of clearing areas with all on-site personnel to be informed of areas to be impacted and avoided.
- Application of an 8-metre buffer between the Disturbance Footprint and patches of Banksia TEC/PEC and Tuart TEC/PEC to ensure they are not subject to disturbance and edge effects.

- Maintenance of a 2-metre buffer between excavation and the water table in accordance with Water Quality Protection Note (WQPN) 15 to ensure there are no direct or indirect impacts to groundwater and consequential impacts to groundwater dependent vegetation (DWER, 2019).

- Undertaking directional clearing from south (adjacent to existing quarry operations) to north in order to encourage fauna to move into adjacent vegetation.

- Application of dust suppression during all clearing activities to minimize dust emissions, particularly during windy conditions.

- Application of standard hygiene protocols to minimize the risk of introducing or spreading weeds or pathogens.

5.4 Rehabilitation

Revegetation is planned that will return suitable habitat for Carnaby's black cockatoo once operations have ceased and as required by Mine Closure Plan (Appendix E) commitments. A Mine Closure Plan has been prepared for the Carabooda Quarry that is currently awaiting formal review by DMIRS. Revegetation will focus on re-establishing locally native species with a focus on Proteaceous species that provide foraging resources for black cockatoos of equal or greater quality than that being impacted by the proposed action. Revegetation will focus on establishing *Banksia sessilis* and other similar species to reinstate the current dominant overstorey and provide foraging habitat in the long term.

5.5 Offsets

Not offsets are currently proposed for the proposed clearing, as an assessment determined that the clearing is not likely to be at variance with any of the Ten Cleaning Principles (see section 6).

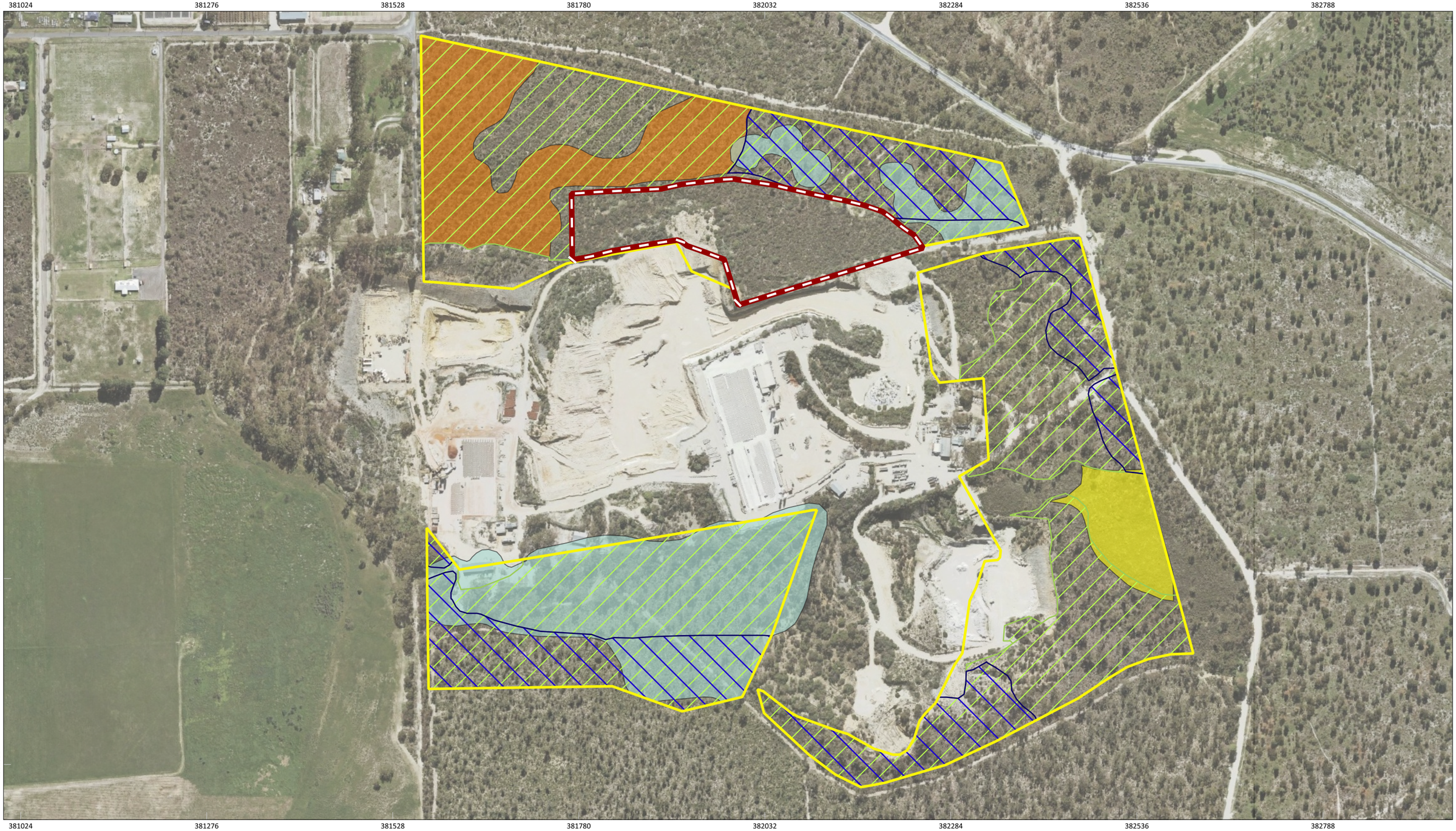

Figure 11: Avoidance Measures

N

0 70 140 210 280 m

SCALE: 1:5,041	SHEET SIZE: A3 COLOUR
COORDINATE REFERENCE SYSTEM: GDA2020 / MGA zone 50	
DATA SOURCE: LANDGATE AERIAL IMAGERY NOW	

PROJECT/REPORT NAME: Native Vegetation Clearing Permit – Carabooda Quarry
Old Yanchep Road, Carabooda WA

CLIENT: WA Limestone

PROJECT NUMBER	VERSION
A24.310	0
DRAWN BY / REVIEWED BY	DATE
MD / JB	6/2/2025

Legend

- Disturbance Footprint
- Project area
- Forest Red-tailed Black Cockatoo Habitat
- Carnaby's Cockatoo Habitat
- Banksia Woodlands of the Swan Coastal Plain TEC
- Tuart Woodlands and Forests of the Swan Coastal Plain TEC
- Potential FCT 26a - Honeymyrtle shrubland on limestone ridges of the Swan Coastal Plain Bioregion (State TEC and nominated Commonwealth TEC)

No	Description	Drawn	Approved	Date
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NOTES:

Cadastral boundary from LANDGATE 2022. Label corresponds to the vegetation association number.

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6. Assessment of Against Clearing Principles

An assessment of the 3.99 ha of native vegetation clearing against the Ten Clearing Principles contained in Schedule 5 of the EP Act is provided in Table 6.

The proposed clearing is considered unlikely to be at variance with any Clearing Principles.

Table 6: Assessment against Ten Clearing Principles

Principle (Schedule 5 of the EP Act)	Assessment	Outcome
(a) Native vegetation should not be cleared if it comprises a high level of biological diversity	The Disturbance Footprint was reported to have a significantly lower diversity than the broader Project Area, given the presence of only one vegetation type and the majority of the Disturbance Footprint being in lower condition (79% Good to Degraded). Species richness was lower than in the surrounding area with less populations of Priority flora. The Disturbance Footprint was previously cleared of native vegetation in 2000 and has regrown, meaning it displays a higher degree of disturbance and higher proportion of weeds than the surrounding area. Areas of native vegetation which require clearing were assessed to be in Degraded to Excellent condition with • 0.02 ha Very Good to Excellent condition • 3.61 ha Good to Degraded condition 0.36 ha were assessed as Rehabilitation area, described as disturbed areas, that have undergone some rehabilitation of vegetation. 0.56 ha were assessed as Cleared (Completely Degraded).	Proposed clearing is unlikely to be variance to this Principle.
(b) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.	A flock was observed flying over the area during the survey undertaken by Bamford (2022) and foraging evidence was recorded within the Disturbance Footprint. The Disturbance Footprint contains 3.63 ha of Moderate quality foraging habitat for Carnaby's black cockatoo. The Disturbance Footprint is however surrounded by an additional 33.2 ha of suitable foraging habitat contained within the overall Project Area, which will be avoided. There are no potential breeding trees present within the Disturbance Footprint and no trees suitable for roosting. The closest buffered black cockatoo roosting site (1 km buffer radius) is located 1.2 km west of the Disturbance Footprint. The closest known black cockatoo breeding site is 14 km south of the Disturbance Footprint. There are approximately 31,280 ha of remnant native vegetation within 15 km of the Disturbance Footprint. With 3.63 ha of native vegetation, the	Proposed clearing is unlikely to be variance to this Principle.

Principle (Schedule 5 of the EP Act)	Assessment	Outcome
	Disturbance Footprint comprises an estimated 0.01% of the native vegetation within the local area. Habitat values within the Disturbance Footprint are likely to contribute to a network of foraging habitat in the surrounding 15 km. However, the extent of the impact is limited to 3.63 ha (0.01% of regional foraging habitat) and is located immediately adjacent to existing quarry operations. Having been subject to previous clearing and showing increased disturbance, the foraging habitat within the Disturbance Footprint is of lesser quality to that in the broader project area, which will be retained. Given the above it is highly unlikely that Carnaby's black cockatoo is dependent on the Disturbance Footprint and whilst the proposed clearing will cause temporary localised disturbance, the impact will be of small scale and temporary. In accordance with the existing Mine Closure Plan, cleared habitat will be restored within 20 years of disturbance. Additionally, the area of existing quarry operations will also to be progressively revegetated once mining activities cease. The proposed impact is therefore considered highly unlikely to constitute a significant impact to black cockatoo.	
(c) Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.	No Threatened flora pursuant the Commonwealth EPBC Act or the State BC Act were recorded (PGV, 2021; WEPL, 2024) or are expected to occur within the Disturbance Footprint.	Proposed clearing is not at variance to this Principle.
(d) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a threatened ecological community.	No TEC occurs within the Disturbance Footprint. Patches of Tuart Woodland TEC/PEC and Banksia Woodland TEC/PEC occur adjacent to the Disturbance Footprint. Indirect impacts will be avoided through the implementation of an 8-metre buffer between the TEC/PEC patches and the Disturbance Footprint and a 2-metre buffer between excavation and the water table. Further mitigation measures are outlined in section 5.3 and the Environmental Management Plan in Appendix F.	Proposed clearing is not at variance to this Principle.
(e) Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.	The Disturbance Footprint is located with the Cottesloe Complex - Central and South, which has 32.16% remaining. The National Objectives and Targets for Biodiversity Conservation 2001-2005 (Commonwealth of Australia, 2001) recognises that the retention of 30% or more of the pre-clearing extent of each ecological community is necessary if	Proposed clearing is not at variance to this Principle.

Principle (Schedule 5 of the EP Act)	Assessment	Outcome
	Australia's biodiversity is to be protected. Below this level, species loss appears to accelerate exponentially (EPA, 2000). *State Planning Policy 2.8: Bushland Policy for the Perth Metropolitan Region* recognises a target of at least 10 per cent of the original extent of each vegetation complex (as representative of ecological communities at the regional scale) for the Swan Coastal Plain portion of the Perth Metropolitan Region, which is recognised as a constrained area. The proposed clearing of 3.63 ha of native vegetation considered to represent the Cottesloe Complex-Central and South comprises 0.025% of the current extent (14,567.87 ha as per Government of Western Australia, 2019b). The clearing reduces the remaining extent to 32.15%. The proposed clearing is therefore not considered to impact the maintenance of the vegetation complex.	
(f) Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.	The proposed clearing area does not intersect any wetlands or watercourses. Therefore, no impacts are proposed to vegetation growing in, or in association with an environment associated with a water or wetland, and the proposed clearing is not at variance to this principle.	Proposed clearing is not at variance to this Principle.
(g) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.	The Disturbance Footprint shows a relatively flat topography with only slight slopes across the area. It is located on the Karrakatta shallow soils phase, which is characterised by bare limestone and shallow siliceous or calcareous sands over limestone. These soils can be mildly water repellent. WA Limestone is experienced in quarry operation and has soil stabilisation and erosion control measures in place within current quarry areas. These measures will also be implemented in the extension area as described in the Environmental Management Plan developed by WEPL in 2023 (Appendix E). A Mining Closure Plan is in place to ensure that all areas where mining has ceased will be revegetated immediately (see Appendix D). This will further prevent long-term erosion.	Proposed clearing is not at variance to this Principle.
(h) Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.	The Disturbance Footprint is located within Bush Forever site no. 290, which is associated with the Gnangara-Moore River State Forest.	Proposed clearing is unlikely to be a variance to this Principle.

Principle (Schedule 5 of the EP Act)	Assessment	Outcome
	The vegetation within the Disturbance Footprint (*Banksia sessilis/Xanthorrhoea preissii* Tall Open Scrub) is however not considered representative of the Gnangara-Moore River forest vegetation. Conservation significant vegetation has been avoided by the project, such as Banksia Woodland TEC and Tuart Woodlands TEC within the surrounding Project Area. Impacts to black cockatoo have been minimised as far as possible by avoiding impacts to trees within the Project Area and only impacting moderate quality foraging habitat. Impacts to high quality foraging habitat and potential breeding trees have been avoided. The Strategic Assessment of the Perth and Peel Region (SAPPR) Tengraph FNA 12231, is anticipated to lead to changes to Bush Forever Sites. The northern portion of Bush Forever Site No. 290, where the Disturbance Footprint is located, has been identified in SPP 2.4 as SGS area for high grade limestone. The resource is considered vital for future community needs and public amenity projects. immediately adjacent portions of the Bush Forever site have been cleared for quarry operation previously. Further, the values present within the planned Disturbance Footprint provide lower ecological value in comparison with the surrounding area within Bush Forever Site No. 290 and a mining tenement has been approved over the area. Therefore, clearing of the Disturbance Footprint is not considered to significantly impact Bush Forever Site No. 290.	
(i) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.	Depth to groundwater within the Disturbance Footprint is 35-47m. A 2-metre buffer between excavation and the water table will be maintained in accordance with Water Quality Protection Note (WQPN) 15 to ensure there are no direct or indirect impacts to groundwater and consequential impacts to groundwater dependent vegetation (DWER, 2019). Limestone extraction has been deemed to have a low risk of impact to groundwater resources, which is recognised by DWER in allowing BRM extraction (conditions apply) within P1 Public drinking water source areas (PDWSAs). The vegetation within the Disturbance Footprint was assessed to be *Banksia sessilis / Xanthorrhoea preissii* Tall Open Scrub, which is not considered deep	Proposed clearing is not at variance to this Principle.

Principle (Schedule 5 of the EP Act)	Assessment	Outcome
	rooted vegetation directly regulating groundwater levels. No wetlands or surface water features are present. It is therefore unlikely that the removal of 3.99 ha of will result in a significant impact to the underground water quality of this area.	
(j) Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.	As described above the proposed clearing activities have no significant impact on the natural surface and groundwater processes. The underlying geology is comprised by limestone which is characterised by naturally high permeability and the pit will therefore be internally draining. Given the porosity and permeability of the limestone, all stormwater will collect on the porous floor of the pit and infiltrate into the ground, as per all limestone pits. The proposal is therefore not likely to cause, or exacerbate, the incidence or intensity of flooding.	Proposed clearing is not at variance to this Principle.

7. Conclusions

This Environmental Impact Assessment has identified that the proposed Carabooda Quarry expansion requires a Native Vegetation Clearing Permit under Part V of the EP Act for the clearing of 3.99 ha of native vegetation. This vegetation is comprised of:

- 3.63 ha of BsXp: *Banksia sessilis / Xanthorrhoea preissii* Tall Open Scrub over *Melaleuca systena / Hakea lissocarpha* Open Shrubland over *Jacksonia sericea* (P4) / *Hibbertia hypericoides* Low Open Shrubland. Out of that,
    - 0.02 ha is in Excellent to Very Good condition.
    - 3.61 ha is in Good to Degraded condition.

  This vegetation type is considered to provide moderate foraging value to Carnaby's black cockatoo.
- 0.63 ha of Rehab: disturbed areas, with limestone substrate, that have undergone some rehabilitation of vegetation. No vegetation condition was allocated. This vegetation type is considered to provide low foraging value to Carnaby's black cockatoo.

Two Priority Flora species are impacted by the proposed clearing:

- *Acacia benthamii* - Priority 2: One population of the species will be impacted. Seven populations within the Project Area are avoided by the proposed clearing.
- *Jacksonia sericea* - Priority 4: Four populations of the species will be impacted. The remaining11 populations within the Project Area will be avoided by the proposed clearing.

The proposed clearing is not considered at variance with any of the Ten Clearing Principles, due to:

- Having a low level of biological diversity in the context of the surrounding area (with particular reference to values mapped within the Project Area).
- Having no Threatened or Priority Ecological Communities present within the Disturbance Footprint and no impacts being expected to adjacent TEC/PEC areas due to an 8-metre buffer being implemented between excavations and TEC/PEC patches.
- No impact to the maintenance of a vegetation complex.
- No impact to Threatened flora species.
- Having limited habitat values for Threatened Carnaby's cockatoo (3.63 ha of moderate foraging value, 0.63 ha of low foraging value).

- No impact to watercourses or wetlands due to a 2-metre buffer between excavations and groundwater table being maintained.
- No long-term land degradation being expected.
- No expected impacts to groundwater quality or hydrological regime.

The Carabooda Quarry expansion was referred to DCCEEW under the EPBC Act on the basis of potential impacts to Threatened species and communities, and was determined to be not a controlled action ((EPBC 2023/09554).

8. References

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Appendix A
Flora and Vegetation Survey (Coffey, 2010)

coffey environments
SPECIALISTS IN ENVIRONMENTAL, SOCIAL AND SAFETY PERFORMANCE

50 YEARS AN EXTRAORDINARY JOURNEY

11 March 2010

Limestone Building Block Co. Pty Ltd
PO Box 60
Applecross WA 6953

Attention: [redacted]

Dear [redacted]

RE: Flora and Vegetation Assessment, M70/339 Hopkins Road, Nowergup

Please find enclosed Coffey Environments Report No. EP 2010/16, V1, *Flora and Vegetation Assessment, M70/339 Hopkins Road, Nowergup.*

If you have any queries, please do not hesitate to contact either myself or [redacted] on [redacted]

For and on behalf of Coffey Environments Pty Ltd

[redacted]

[redacted]
Senior Environmental Scientist - Botany

cc [redacted]

Attachment A: Coffey Environments Report No. EP 2009/16, V1

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ABBREVIATIONS

°C	Degrees Celsius
AHD	Australian Height Datum
APB	Agriculture Protection Board
ARRP	Agriculture and Related Resources Protection
Co.	Company
DEC	Department of Environment and Conservation
DoE	Department of Environment
DRF	Declared Rare Flora
EPA	Environmental Protection Authority
EPBC	Environment Protection and Biodiversity Conservation
FCT	Floristic Community Type
Govt	Government
GPS	Global Positioning System
ha	Hectares
IBRA	Interim Biogeographic Regionalisation for Australia
km	Kilometres
m	Metres
MGA	Map Grid of Australia
mm	Millimetres
PATN	Pattern analysis
PEC	Priority Ecological Community
PF	Priority Flora
PMR	Perth Metropolitan Region
PTY LTD	Proprietary Limited
SCP	Swan Coastal Plain
TEC	Threatened Ecological Community
WA	Western Australia
WAH	Western Australian Herbarium
WAPC	Western Australian Planning Commission
WGS84	World Geodetic System 1984

EXECUTIVE SUMMARY

Introduction/Background

Coffey Environments was commissioned by Landform Research on behalf of Limestone Building Block Co. Pty Ltd to undertake a detailed flora and vegetation assessment of the un-mined, vegetated portion of Mineral Lease M70/339 Nowergup, to satisfy the requirements of the Department of Environment and Conservation. Information was required by way of a Level 2 early and late Spring assessment with numerical (computer) analysis of the floristic data. The study area is located in the City of Wanneroo, approximately 40 kilometres (km) north-northwest of the Perth Central Business District and 15km north of Joondalup. The study area covers approximately 17 hectares consisting of bushland and is proposed for limestone extraction.

Ms Bethea Loudon, a botanist from Coffey Environments, conducted a flora and vegetation assessment of the study area over two phases in early Spring (i.e. September/October 2009) and again (Phase 2) in late Spring (i.e. November 2009). This was in accordance with Environmental Protection Authority (EPA) guidance statement recommendations to enable the capture of ephemeral and late flowering species. The assessment was undertaken to provide a description of the dominant vegetation types, vegetation condition and flora species present, including any significant species. Floristic data collected were analysed by PATN computer analysis to determine the Floristic Community Types on the subject land and whether any of these were a Threatened Ecological Community.

Results

The vegetation occurring within the study area is mapped as consisting of the *Cottesloe – Central and South* and the *Karrakatta – Central and South* vegetation complexes of which 36% and 18% respectively, remains in the Perth Metropolitan Region of the Swan Coastal Plain. These complexes are well reserved as they are above the recommended minimum 10% retention threshold.

Six vegetation types were identified within the study area. In general the vegetation types represented *Eucalyptus marginata* (Jarrah) Low Woodland, *Eucalyptus gomphocephala* (Tuart) Woodland to Open Woodland and *Xanthorrhoea preissii* Tall Open Scrub with *Banksia sessilis* on sand over limestone, and *Melaleuca systena* Open Heath to Tall Shrubland and on limestone substrate. The vegetation condition ranged from Excellent to Degraded-Completely Degraded, the latter condition as a result of sand extraction and weed invasion.

Results of the PATN analysis showed that the vegetation has similarities to Floristic Community Types FCT 24 'Northern Spearwood shrublands and woodlands', a Priority 3 Priority Ecological Community (PEC); FCT 26a 'Limestone ridges: *Melaleuca huegelii - Melaleuca acerosa* (currently *M. systena*) shrublands on limestone ridges', an Endangered Threatened Ecological Community (TEC); and FCT 28 'Spearwood *Banksia attenuata* or *Banksia attenuata-Eucalyptus* woodlands', a common floristic community type considered to be well reserved and at low risk of extinction.

The PATN analysis was not definitive with the areas represented by Quadrats 1 and 2 being similar to the PEC SCP 24 (FCT 24) and the TEC SCP 26a (FCT 26a) (vegetation types OHMs and TSMs), and Quadrats 5 and 6 similar to FCT 24 and FCT 28 (vegetation types OWEg and TOSXp). The vegetation of the remainder of the study area was more easily identified as FCT 28 (vegetation types LWEm and WEg), a common FCT (Quadrats 3 and 4). The PEC and the TEC are not recognised under the Commonwealth's *Environment Protection and Biodiversity Conservation (EPBC) Act 1999.*

A total of 135 flora species were recorded from the study area. This included 98 native and 37 non-native, introduced (weed) species.

Two Priority species (*Stylidium maritimum* – Priority 3 and *Jacksonia sericea* – Priority 4) were recorded from the study area during the flora and vegetation assessment along with three other species, possibly

EXECUTIVE SUMMARY

five, that have been identified as significant flora of the Spearwood dunes under Bush Forever (*Petrophile axillaris, Conospermum triplinervium*, *Glischrocaryon aureum, Astroloma microcalyx* and *Conostylis aculeata* subsp. *cygnorum*, the latter two of which their identification to species and subspecies level is not certain). All significant flora species identified in the DEC database searches would have been identifiable during the dual-phased assessment if present.

A registered Bush Forever Site (No. 290 - 'Hopkins Road Bushland, Nowergup') occurs over the entire study area.

Discussions with the Department of Environment and Conservation and the Department of Planning are required in regards to potential impacts on the conservation significant flora and vegetation, and the Bush Forever site. It is unlikely that the Commonwealth *EPBC Act 1999* will have effect on the proposed development of the study area with regard to flora or vegetation. Impacts on fauna species protected under the *EPBC Act 1999* have not been addressed in this report.

1 INTRODUCTION

1.1 Background

Coffey Environments was commissioned by Landform Research on behalf of Limestone Building Block Co. Pty Ltd to undertake a detailed flora and vegetation assessment of the un-mined, vegetated portion of Mineral Lease M70/339, Nowergup. The study area covers approximately 17 hectares (ha) and is proposed for limestone extraction.

The current assessment was undertaken to satisfy the requirements of the Department of Environment and Conservation (DEC) in the provision of information by way of a Level 2 early and late Spring assessment with numerical (computer) analysis of the floristic data.

1.2 Scope of Works

The scope of works for the vegetation assessment was as follows:

- Sample permanent 10m x 10m quadrats located within representative vegetation types on two occasions, one (Phase 1) in early Spring (i.e. September/October) and again (Phase 2) in late Spring (i.e. November) to record late flowering species;
- Map and describe the vegetation types based on Muir (1977) and Aplin's (1979) classification for structural units in Government of Western Australia (Govt of WA) (2000b), using a combination of recent aerial photography and field survey to ground-truth;
- Map vegetation condition using the Bush Forever condition rating;
- Provide a list of all native and non-native plant species recorded within the study area;
- Conduct a site walkover to search for conservation significant species and record any other species not found within quadrats;
- Review the DEC's threatened species (i.e. Declared Rare Flora (DRF) and Priority Flora (PF) and Threatened Ecological Communities (TEC) database, incorporating a list of significant species and communities recorded on the databases as occurring in the vicinity of the study area;
- Identify and record the location of any significant plant species or ecological communities recorded within the study area during the survey;
- Undertake PATN analysis of floristic data recorded to determine the presence of any TECs or Priority Threatened Ecological Communities (PECs);
- Discuss the conservation significance of flora and vegetation identified within the study area in a local, regional context and national context; and
- Discuss the potential flora and vegetation constraints associated with the development of the site and implications of the Commonwealth's *Environment Protection and Biodiversity Conservation (EPBC) Act 1999*.

2 EXISTING INFORMATION

2.1 Location

The study area is located in the City of Wanneroo within the suburb of Nowergup, approximately 40km north-northwest of the Perth Central Business District and 15km north of Joondalup (Figure 1). The study area is bounded by Hopkins Road to the east, Limestone Resources Australia Pty Ltd mineral lease to the north, Limestone Building Block Co. Pty Ltd's existing quarry to the west and bushland to the south. The study area is covered by mineral lease M70/339.

2.2 Existing Land Use

The study area is currently vegetated bushland covered by an existing mineral lease (M70/339), abutting an active limestone quarry (part of M70/339) and is managed by Limestone Building Block Co. Pty Ltd. A section through the centre and a small area in the north of the study area are comprised of limestone substrate with vegetation characteristic of limestone formations (vegetation type TOSXp, OHMs and TSMs, see Figure 2).

2.3 Geological and Physiographic Context of the Subject Land

2.3.1 Climate

The study area is located on the Swan Coastal Plain (SCP) which experiences a Mediterranean climate with cool wet winters and warm dry summers.

The annual mean daily minimum and maximum temperatures for nearby Beenyup (approximately 16km from Nowergup) are 12.3°C and 24.1°C respectively. The annual mean rainfall for Beenyup is approximately 760 millimetres (mm) per year with the majority of precipitation falling between April/May and September/October. Rainfall data for Beenyup was incomplete for 200, however Tamala Park (Mindarie), situated approximately 8km from Nowergup, received approximately 550mm of rainfall during 2009 (Bureau of Meteorology, 2010).

2.3.2 Topography

The topography of the study area ranges from 50m Australian Height Datum (AHD) in the south to 66m AHD in the north (high spoil/overburden mound), with a low limestone ridge through the centre to 60-62m AHD and a shorter, low limestone ridge in the north to 62-64m AHD. The southern portion of the study area consists of a gentle slope (56m AHD to 50m AHD over 200m) (Department of Environment (DoE), 2004).

2.3.3 Hydrology

No surface water or natural drainage lines occur within the study area. The depth to groundwater ranges from 30m in the west to 23m in the east and 38m in the north to 24m in the south of the study area (DoE, 2004).

There are no wetlands within the immediate vicinity of the study area however Carabooda Lake, a Resource Enhancement sumpland, is situated approximately 2.9km to the southwest of the study area, Nowergup Lake is approximately 3km to the south-southwest, a Resource Enhancement dampland approximately 3.5km to the south-southeast and a Multiple Use sumpland approximately 2km to the east (northern part of Lake Pinjar) (Landgate, 2010).

2.3.4 Landform, Soils and Geology

Landform and Soils

The majority of the study area consists of the *Cottesloe* landform and soil unit, comprised of a low hilly landscape with shallow brown sands over limestone with exposed limestone, with a very narrow strip of the *Karrakatta* landform and soil unit along the eastern side of the study area. The latter unit consists of an undulating landscape of deep yellow sands over limestone (Churchward and McArthur, 1980).

Geology

The geology of the study area is mainly comprised of Limestone (*Ls* – light yellowish brown, fine to coarse-grained, sub-angular to well rounded quartz, a trace of feldspar, shell debris, variably lithified. Surface kankar of eolion origin), with a narrow section along the eastern and southern side of the study area consisting of Sand (S_7 – pale and olive yellow, medium to coarse-grained, sub-angular quartz and a trace of feldspar, moderately sorted, of residual origin) (Gozzard, 1982).

The study area is situated on the Spearwood Dunes geomorphological unit (Gozzard, 1982).

2.4 Biological Context of the Subject Land

2.4.1 Bioregional Data

The Australian environment has been categorised into biogeographic regions (based on geology, landform, vegetation, fauna and climate) known as IBRA (Interim Biogeographic Regionalisation for Australia) regions.

Based on IBRA mapping, the study area lies within the Perth Sub-region of the Swan Coastal Plain Bioregion. The Swan Coastal Plain Bioregion is comprised mainly of woodlands dominated by *Banksia* species or *Eucalyptus gomphocephala* (Tuart) on low-lying sandy soils, with *Casuarina obesa* (Swamp Sheoak) on outwash plains and *Melaleuca* species (Paperbarks) in swampy areas. The eastern side is dominated by *Eucalyptus marginata* (Jarrah) woodlands on higher elevations of duricrusted Mesozoic sediments, while three sets of dune formations line the coastal area (Thackway and Cresswell, 1995).

The Perth Sub-region is composed of heath and/or *Eucalyptus gomphocephala* (Tuart) woodlands on limestone or younger sands, *Banksia* and *Banksia-Eucalyptus marginata* (Jarrah) woodlands on older dune systems and *Corymbia calophylla* (Marri) on colluvial and alluvial soils. The Perth Sub-region includes a complex series of seasonal wetlands (DEC, 2002).

2.4.2 Beard's Vegetation Mapping

According to Beard (1990) the vegetation of the study area is located within the Drummond Botanical Sub-district of the Swan Coastal Plain Sub-region. The Drummond Botanical Sub-district is mainly comprised of *Banksia* low woodland on leached sands with *Melaleuca* swamps where ill-drained; woodland of *Eucalyptus gomphocephala* (Tuart), *Eucalyptus marginata* (Jarrah) and *Corymbia calophylla* (Marri) on less leached soils.

Beard (1981) maps the vegetation type of the study area as consisting of *Banksia* (*attenuata* and *menziesii*) Low Woodland on Limestone.

Beard's mapping of phytogeographic regions are based on natural delineations in vegetation and landscape, divisible in to regions and further broken down in to Botanical districts - the boundaries of Western Australia's IBRA regions are broadly compatible with those of Beard's phytogeographic regions (DEC, 2010).

2.4.3 Vegetation Complexes

According to mapping of the Swan Coastal Plain by Heddle *et al.* (1980), the majority of the study area falls within the *Cottesloe – Central and South* Vegetation Complex. The pre-European structure of this complex is described as consisting of a mosaic of *Eucalyptus gomphocephala* (Tuart) - *Eucalyptus marginata* (Jarrah) - *Corymbia calophylla* (Marri) woodland, with closed heath on limestone outcrops. A very narrow strip of the *Karrakatta – Central and South* vegetation complex occurs along the eastern side of the study area. This complex is characterised by a predominantly open forest of *Eucalyptus gomphocephala* (Tuart) - *Eucalyptus marginata* (Jarrah) - *Corymbia calophylla* (Marri) and *Eucalyptus marginata* (Jarrah) – *Banksia* spp. woodland (Heddle *et al.*, 1980).

2.4.4 Bush Forever

The Bush Forever Strategy is a ten year strategic plan which formally commenced in 2000 to protect approximately 51,200ha of regionally significant bushland within approximately 290 Bush Forever Sites, representing where achievable, a target of at least 10 percent of each of the original 26 vegetation complexes of the Swan Coastal Plain portion of the Perth Metropolitan Region (Govt of WA, 2000a).

The *Directory of Bush Forever Sites* (Bush Forever Volume 2, Government of Western Australia) indicates that part of Bush Forever Site 290 'Hopkins Road Bushland, Nowergup' covers the entire study area (Figure 3). Site 290 in its entirety covers 406.9ha of bushland, providing a linkage to bushland to the south (including Bush Forever Site 293) and to the west. It was selected for its representation of ecological communities and rarity (the DRF taxon *Eucalyptus argutifolia* occurs elsewhere in Site 290 which is subject to protection under the *EPBC Act 1999*). Bush Forever Site 290 contains vegetation representing the *Karrakatta – Central and South* and the *Cottesloe - Central and South* vegetation complexes. Quenda (*Isoodon obesulus fusciventer*), also known as the Southern Brown Bandicoot, is a significant mammal species listed as occurring in Site 290 (Govt of WA, 2000b). Quenda are listed under the DEC's Priority Fauna List as *Priority 5 – taxa in need of monitoring.*

The Department of Environmental Protection (1999 - edge inspection), Mattiske Consulting Pty Ltd (1997) and Water Authority of Western Australian (1995) conducted limited flora and vegetation surveys for Bush Forever Site 290 (Govt of WA, 2000b). Structural units were described as:

- Sands derived from Tamala Limestone -
    - Woodlands dominated by *Eucalyptus marginata, Banksia attenuata* and *B. grandis*;
    - Banksia species Woodland with emergent *Eucalyptus gomphocephala*;
    - Banksia species Woodland with scattered *Eucalyptus todtiana* and *E. marginata.*

- Tamala Limestone –
    - Closed Heath dominated by *Xanthorrhoea preissii, Dryandra [Banksia] sessilis* var. *cygnorum, Melaleuca huegelii* and *M. systena.*

Vegetation condition was considered to be Excellent by Mattiske Consulting Pty Ltd (1997). FCT 26b and FCT 28 were inferred as occurring within Bush Forever Site 290. No sampling was undertaken and the site was not assessed for the occurrence of TECs, however the site was listed as a Bush Forever site for its 'Representation of ecological communities, Rarity'. Significant flora included *Eucalyptus argutifolia,* a rare species, and typical Tamala Limestone taxa – *Melaleuca huegelii* (Govt of WA, 2000b).

3 FLORA AND VEGETATION SURVEY METHODOLOGY

3.1 Survey Methodology

Ms Bethea Loudon, an experienced botanist from Coffey Environments, conducted a Level 2 flora and vegetation assessment of the study area in early Spring (2 and 12 October 2009) and late Spring (24 November 2009). The assessment was undertaken to provide a description of the dominant vegetation types, vegetation condition and flora species present, including any significant species. Floristic data collected were analysed by PATN computer analysis to determine the Floristic Community Types (FCTs) on the subject land and whether any of these were a Threatened Ecological Community (TEC).

The field assessment involved sampling from permanent quadrats of 10m x 10m dimension within representative vegetation types. A site walkover was also undertaken to record all plant species present at the time of the assessment (i.e. those species not recorded from within quadrats) and to search for significant flora (i.e. DRF and Priority taxa, significant flora of the Spearwood Dunes as identified in Bush Forever (Govt of WA, 2000b)). This method complies with Coffey Environments' interpretation of the Environmental Protection Authority (EPA) guidelines for flora surveys as outlined in Guidance Statement No. 51 - *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (EPA, 2004) and *Terrestrial Biological Surveys as an Element of Biodiversity Protection Position Statement No. 3* (EPA, 2002). The timing of the surveys in the two-phased assessment was considered optimal for the region for the identification of annual and ephemeral species occurring within the study area.

The study area was accessed by vehicle along existing tracks and on foot. The major vegetation types and associated flora were surveyed and delineated using a combination of colour aerial photography and ground-truthing, with quadrats recorded in areas of representative vegetation types. Two quadrats were placed in each vegetation type that was intact, in good condition and covered a large area. Where these factors were less, only one quadrat was placed in that vegetation type.

Common species that were well known to the botanist were identified in the field. Specimens of all unknown species were collected, assigned a unique number to facilitate tracking and pressed that day. These specimens were then identified using various taxonomic identification resources on return from the field and by comparing against specimens held at the Western Australian Herbarium where required.

The following data were collected from permanent 10m x 10m quadrats:

Location – Map Grid of Australia (MGA) coordinates (equivalent of World Geodetic System (WGS) 84) were taken from the northwest corner of each quadrat using a hand-held Magellan Global Positioning System (GPS) to an accuracy of 5m;

Vegetation Description - Vegetation was described and mapped according to the structure and species composition of the dominant stratum using the system adapted from Muir (1977) and Aplin (1979) in Govt of WA (2000b);

Disturbance Details - Vegetation condition was assessed using the condition rating scale adapted from Bush Forever (Govt of WA, 2000b);

Habitat - Habitat was described based on landform, aspect and slope;

Percentage Foliage Cover and Height - Cover and height were estimated visually for each species recorded within a quadrat. Estimates were made to the nearest percentage and height where possible; and

Soil - Colour and soil texture within each quadrat was recorded.

3.1.1 Floristic Community Types

Floristic analysis (i.e. the analysis of variation in vegetation based on the species present, rather than a description of structural variation and dominance) is a significant component of the understanding of the variation present in the native vegetation of the Swan Coastal Plain (Gibson *et al.* 1994).

The species composition of each quadrat sampled during a survey are compared against the results of Gibson *et al.*, (1994) (on a presence/absence basis) to determine FCTs occurring in a study area. The PATN analysis involves four modules of classification. These are:

- ASO (calculation of similarity matrix);
- FUSE (classification based on the results on the results of ASO);
- DEND (Dendrogram - representation of classification); and
- NNB (Nearest Neighbour – determination of sites most similar to each site).

In this case, PATN analysis of the quadrat data collected from the Limestone Building Block Co. Pty Ltd Nowergup study area was conducted independently by E.A. Griffin and Associates.

3.2 Database Searches

Prior to conducting the field survey, a desktop search for significant flora and vegetation communities was undertaken to identify significant flora or TEC that could potentially occur in the study area. This investigation encompassed a review of the following databases:

- The DEC 'Threatened Flora' database;
- The DEC 'Declared Rare and Priority Flora List' which contains species that are Declared Rare (Conservation code R or X for those presumed to be extinct), poorly known (Conservation codes 1, 2 or 3) or require monitoring (Conservation code 4);
- The Western Australian Herbarium (WAH) specimen database; and
- The DEC 'Threatened Ecological Community' database.

3.2.1 Vegetation

The results of the TEC database search are presented in Table 1 (DEC, 2009b). Several occurrences of one TEC and three PECs are recorded as occurring in the vicinity of the study area, however there are no known occurrences of TECs or PECs recorded within the study area.

TABLE 1

THREATENED & PRIORITY ECOLOGICAL COMMUNITIES RECORDED IN THE VICINITY OF THE STUDY AREA (DEC, 2009b)

Community ID	Description	DEC Conservation Category	Commonwealth Conservation Category*
SCP 22#	*Banksia ilicifolia* woodlands	PEC (Priority 2)	Not listed
SCP 23b#	Northern *Banksia attenuata - Banksia menziesii* woodlands	PEC (Priority 3)	Not listed
SCP 24	Northern Spearwood shrublands and woodlands	PEC (Priority 3)	Not listed

Community ID	Description	DEC Conservation Category	Commonwealth Conservation Category*
SCP 26a	Limestone ridges: *Melaleuca huegelii - Melaleuca acerosa* (currently *M. systena*) shrublands on limestone ridges	TEC (Endangered)	Not listed

**Category under the Commonwealth EPBC Act 1999 (DEWHA, 2010a)*
 # Occur within approximately 5km of the study area (other TECs/PECs listed were beyond this range)

Ecological communities are defined as 'naturally occurring biological assemblages that occur in a particular type of habitat' (English and Blythe, 1997). TECs are communities that have been assessed and assigned one of three categories under the *EPBC Act 1999* - Critically Endangered, Endangered and Vulnerable (DEWHA, 2010), or a fourth category as classified by English and Blyth (1997), Presumed Totally Destroyed. PECs are possible threatened ecological communities that have been assessed but do not meet survey criteria or are not adequately defined are listed as Priority 1, 2 or 3; communities that are adequately known, are rare but not threatened, meet criteria for Near Threatened, or have been removed from the threatened list are listed as Priority 4; and Conservation Dependent communities as Priority 5 (DEC, 2007). TECs may be recognised at both the State and Commonwealth level however PECs are only recognized at the State level.

Commonwealth legislation protects native vegetation communities classified as Threatened under Schedule 2 of the *EPBC Act 1999*, while TECs at the State level have no statutory protection under the *Environmental Protection Act 1986* or the *Wildlife Conservation Act 1950.*

3.2.2 Flora

The results of the flora database search are presented below in Table 2 (DEC, 2009a). Based on the database results, no significant flora has been recorded from within the study area.

TABLE 2

DEC LISTED DECLARED RARE AND PRIORITY FLORA PREVIOUSLY RECORDED IN THE VICINITY OF THE STUDY AREA (DEC, 2009a)

Species	DEC Status	EPBC Act Status	Preferred Habitat	Flowering Period
Acacia benthamii	P2	-	Sand, typically on ironstone breakaways	Aug-Sep
Eucalyptus argutifolia	R - Vulnerable	Vulnerable	Shallow soils over limestone, slopes or gullies of limestone ridges, outcrops	Mar-Apr
Jacksonia sericea	P4	-	Calcareous and sandy soils	Dec-Feb
Leucopogon sp. Yanchep (M. Hislop 1986)	P3	-	Light grey-yellow sand, brown loam, limestone, laterite, granite, coastal plain, breakaways, valley slopes, low hills	Apr-Jun/Sep
Melaleuca sp. Wanneroo (G.J. Keighery 16705)	P1	-	Limestone ridges, Melaleuca thickets	Dec
Stylidium maritimum	P3	-	Sand over limestone, dune slopes and flats, coastal heath and shrubland, open Banksia woodland	Sep-Nov

Note: (Conservation codes as defined by the DEC)

R Declared Rare Flora - extant, taxa which have been adequately searched for, and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such.

P1 Priority One - Poorly known taxa, which are known from one or a few (<5) populations which are under threat. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need for further survey.

P2 Priority Two - Poorly known taxa, which are known from one or a few (<5) populations, at least some of which are not believed to be under immediate threat. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

P3 Priority Three - Poorly known taxa, which are known from several populations, at least some of which are not believed to be under immediate threat. Such taxa are under consideration for declaration as 'rare flora', but are in need of further survey.

P4 Priority Four - Rare taxa, which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5-10 years.

3.3 Limitations

The potential limitations of the Spring 2009 flora and vegetation assessment within the study area are presented below in Table 3. Fungi and nonvascular flora (e.g. algae, mosses and liverworts) were not specifically surveyed for during the survey.

TABLE 3

STATEMENT OF BOTANICAL SURVEY LIMITATIONS

POTENTIAL LIMITATIONS	CONSTRAINTS (YES/NO); SIGNIFICANT, MODERATE OR NEGLIGIBLE	COMMENT
Competency/experience of the consultant conducting the survey	No constraints	Botanist with extensive survey experience and taxonomic skills.
Proportion of the flora identified	No constraints	Approximately one and a half days spent in study area.
Sources of information (historic/recent or new data)	No constraints	Relatively well documented.
Proportion of the task achieved and further work that may need to be undertaken	No constraints	All objectives of the task achieved.
Timing/weather/season/cycle	No constraint	The timing was considered optimal, with adequate seasonal rainfall preceding the survey.
Intensity of survey (e.g. In retrospect was the intensity adequate)	No constraints	The vegetation of the entire study area was mapped and comprehensively surveyed.
Completeness (e.g. was relevant area fully surveyed)	No constraints	

POTENTIAL LIMITATIONS	CONSTRAINTS (YES/NO); SIGNIFICANT, MODERATE OR NEGLIGIBLE	COMMENT
Resources (e.g. degree of expertise available for plant identification)	No constraints	An experienced botanist undertook plant identifications using relevant plant identification resources, including the WAH reference collection.
Remoteness and/or access problems	No constraints	Site accessible by vehicle and on foot.
Availability of contextual (e.g. bioregional) information for the survey area.	No constraints	Beard (1981, 1990), Churchward and McArthur (1980), DoE (2004), Gozzard (1982), Heddle *et al.* (1980).

4 FLORA AND VEGETATION RESULTS

4.1 Vegetation

4.1.1 Vegetation Types

Vegetation types were described using the species composition, density and structure of the dominant stratum. The structure was classified according to the system based on Muir (1977) and Aplin (1979) (Table 4) in Govt of WA (2000b).

TABLE 4

VEGETATION STRUCTURAL CLASSES

Life Form/Height Class	Canopy Cover (percentage)			
	70-100%	**30-70%**	**10-30%**	**2-10%**
Trees over 30m	Tall Closed Forest	Tall Open Forest	Tall Woodland	Tall Open Woodland
Trees 10-30m	Closed Forest	Open Forest	Woodland	Open Woodland
Trees under 10m	Low Closed Forest	Low Open Forest	Low Woodland	Low Open Woodland
Tree Mallee	Closed Tree Mallee	Tree Mallee	Open Tree Mallee	Very Open Tree Mallee
Shrub Mallee	Closed Shrub Mallee	Shrub Mallee	Open Shrub Mallee	Very Open Shrub Mallee
Shrubs over 2m	Closed Tall Scrub	Tall Open Scrub	Tall Shrubland	Tall Open Shrubland
Shrubs 1-2m	Closed Heath	Open Heath	Shrubland	Open Shrubland
Shrubs under 1m	Closed Low Heath	Open Low Heath	Low Shrubland	Low Open Shrubland
Grasses	Closed Grassland	Grassland	Open Grassland	Very Open Grassland
Herbs	Closed Herbland	Herbland	Open Herbland	Very Open Herbland
Sedges	Closed Sedgeland	Sedgeland	Open Sedgeland	Very Open Sedgeland

Six vegetation types were identified within the study area during the 2009 survey. In addition a small area in the north of the study area, situated on a high spoil/overburden mound and its associated slopes, consisted of regrowth or rehabilitation of native species. These vegetation types are described below and mapped in Figure 2:

LWEm - Low Woodland of *Eucalyptus marginata, Allocasuarina fraseriana* and *Banksia attenuata* to 7m over Tall Open Shrubland of *Xanthorrhoea preissii* to 2.1m over Open Shrubland of *Hakea lissocarpha* to 1.2m over Low Shrubland of *Hibbertia hypericoides* to 0.7m over Very Open Sedgeland of *Mesomelaena pseudostygia* to 0.6m with scattered *Eucalyptus gomphocephala.* Vegetation type LWEm occurred in yellow-brown sand in the southwest section and along the northern portion of the

eastern boundary of the study area. The south-western area was in Excellent condition with little weed presence and good understorey cover. The north-eastern area of this vegetation type ranged from Completely Degraded to Very Good-Good with lower vegetation condition scores resulting from significant disturbance (sand extraction, clearing and weed presence). Floristic data representative of this vegetation type was collected from Quadrat 4 (see Appendix C).

OHMs - Open Heath of *Melaleuca systena* and *Acacia rostellifera* to 1.8m over Low Open Shrubland of *Grevillea preissii* to 0.8m over Very Open Herbland of *Desmocladus asper* and **Galium divaricatum* to 0.2m with occasional *Banksia sessilis* to 2m. This vegetation type occurred in brown-loamy sand over limestone through the centre of the study area. The vegetation was in Good-Degraded condition with high occurrence of weed species. Floristic data representative of this vegetation type was collected from Quadrat 1 (see Appendix C).

OWEg - Open Woodland of *Eucalyptus gomphocephala* to 20m over Tall Shrubland of *Acacia rostellifera* and *Banksia sessilis* to 3.5m over Open Shrubland of *Xanthorrhoea preissii* to 1.8m over Low Open Shrubland of *Phyllanthus calycinus, Banksia nivea* and *Jacksonia sericea* to 0.8m over Very Open Sedgeland of *Lepidosperma ?pubisquameum* to 0.3m over Very Open Herbland of *Desmocladus flexuosus* and **Urospermum picroides* to 0.3m. This vegetation type occurred in yellow-brown sand in the centre of study area, either side of the limestone ridge. The vegetation was in Excellent-Very Good condition south of the ridge and Good-Degraded to Degraded-Completely Degraded north of the ridge as a result of clearing, sand extraction, weed presence, rubbish dumping and recreational vehicle activity. Floristic data representative of this vegetation type was collected from Quadrat 5 (see Appendix C).

Reg – Regrowth/rehabilitated vegetation including *Melaleuca huegelii, Olearia axillaris* and *Acacia rostellifera*. This area occurred in the northwest corner of the study area on a high limestone hill (possibly overburden) and was in a Degraded condition with high weed occurrence. Floristic data representative of this vegetation type was not collected.

TOSXp - Tall Open Scrub of *Xanthorrhoea preissii, Acacia rostellifera* and *Banksia sessilis* to 3.5m over Open Shrubland of *Dodonaea aptera* to 1.6m over Low Open Shrubland of *Jacksonia sericea* to 0.7m over Herbland of *Desmocladus flexuosus, *Urospermum picroides* and **Anagallis arvensis* to 0.35m. This vegetation type occurred along the northern boundary of the study area in yellow-brown sand over limestone. The vegetation was in Very Good-Good condition with the area having been ripped in the past and a moderate level of weed species present. Floristic data representative of this vegetation type was collected from Quadrat 6 (see Appendix C).

TSMs - Tall Shrubland of *Melaleuca systena* to 2.5m over Open Shrubland of *Acacia lasiocarpa* and *Melaleuca huegelii* to 1.5m over Very Open Herbland of *Desmocladus flexuosa* to 0.3m with scattered *Grevillea preissii.* This vegetation type occurred in brown loamy sand over limestone along the eastern side of the study area in association with the limestone ridge. The vegetation was in Excellent-Very Good condition with minimal weed presence. Floristic data representative of this vegetation type was collected from Quadrat 2 (see Appendix C).

WEg - Woodland of *Eucalyptus gomphocephala* to 20m over Open Shrubland of *Xanthorrhoea preissii* to 2m over with scattered *Banksia grandis*. This vegetation type occurred in the southeast of the study area along the southern boundary in brown loamy sand. The vegetation was in Excellent-Very Good condition with minimal weed presence and good understorey cover. Floristic data representative of this vegetation type was collected from Quadrat 3 (see Appendix C).

4.1.2 Vegetation Condition

The condition of the vegetation was assessed using the vegetation condition rating scale of Keighery as published in Bush Forever (Govt of WA, 2000b) and is mapped in Figure 2. Keighery's condition rating scale ranges from Pristine (where the vegetation exhibits no visible signs of disturbance) to Completely

Degraded (where the vegetation structure is no longer intact and without native plant species). A description of the vegetation condition ratings applicable to the study area are outlined below in Table 5.

TABLE 5

VEGETATION CONDITION RATING SCALE

EX = Excellent Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species
VG = 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
G = Good Vegetation structure significantly altered by very obvious signs of multiple disturbance. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by frequent very fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing
Deg = Degraded Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing
CD = Completely Degraded Vegetation structure 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.

The vegetation condition within the study area ranged from Excellent to Degraded-Completely Degraded. The southern half of the study area was in Excellent-Very Good condition with minor weed invasion. The northern portion of the study area (vegetation type OHMs northward) was in poorer condition having undergone sand excavation/extraction (Deg-CD OWEg) or ripped in the past (VG-G TOSXp) with higher levels of weed invasion. The latter area has since regenerated with native species.

The southern boundary of the study area has been prone to minor cases of dumping of household refuse in the past and recreational vehicle activity (quad/motor bikes) along the existing track. The semi-cleared, degraded areas of Deg-CD OWEg have also experienced these activities.

Evidence of rabbit activity (faecal matter, ground scratching and holes) was noted, particularly in the areas of Quadrats 3, 5 and 6.

4.1.3 Floristic Community Types and Threatened Ecological Communities

Computer floristic analysis (PATN) was undertaken by E.A. Griffin and Associates using the quadrat data to determine the presence of FCTs within the study area. Appendix A provides the results of the analysis (quadrats relating to this study area are represented by 'AB1' through 'AB6' in Figure 1 and Table 1 and 2 in the report).

The results of the PATN analysis showed that the vegetation has similarities to three FCTs as follows:

- FCT 24 - 'Northern Spearwood shrublands and woodlands' with characteristic species including *Desmocladus flexuosus, Melaleuca systena, Xanthorrhoea preissii, Phyllanthus calycinus, Hardenbergia comptoniana, Conostylis aculeata, Lomandra maritima* and *Austrostipa flavescens*;
- FCT 26a - 'Limestone ridges: *Melaleuca huegelii - Melaleuca acerosa* (currently *M. systena*) shrublands on limestone ridges' with characteristic species including *Melaleuca huegelii, Melaleuca systena, Acacia lasiocarpa, Banksia nivea, Banksia sessilis, Grevillea preissii, Austrostipa flavescens, Leucopogon parviflorus, Templetonia retusa, Hydrocotyle hispidula* and *Desmocladus flexuosus*'; and
- FCT 28 - 'Spearwood *Banksia attenuata* or *Banksia attenuata-Eucalyptus* woodlands' with characteristic species including *Banksia attenuata, Xanthorrhoea preissii, Hibbertia hypericoides, Mesomelaena pseudostygia, Burchardia congesta, Desmocladus flexuosus, Gompholobium tomentosum, Petrophile linearis, Acacia pulchella* and *Conostephium pendulum*.

However the PATN analysis was not definitive. Based on the analysis, the areas represented by Quadrats 1 and 2 were similar to FCT 24 and FCT 26a (vegetation types OHMs and TSMs), and Quadrats 5 and 6 were similar to FCT 24 and FCT 28 (vegetation types OWEg and TOSXp). The vegetation of the remainder of the study area was more easily identified as FCT 28 (vegetation types LWEm and WEg), a common FCT (Quadrats 3 and 4) (see Figure 2).

FCT 24 is a recognised PEC (SCP 24, Priority 3) and FCT 26a is a recognised TEC (SCP 26a, Endangered) at the State level (SCP 26a is not a Commonwealth listed TEC).

4.1.4 Conservation Significance of Vegetation

Vegetation Complex

Bush Forever recommends a minimum retention and protection of at least 10% of the pre-European extent of vegetation complexes within the Perth Metropolitan Region (PMR) in at least five geographically separated areas and a minimum of 400ha. The percentage remaining of the *Cottesloe – Central and South* and the *Karrakatta – Central and South* vegetation complexes within the Perth Metropolitan Region portion of the Swan Coastal Plain is 36% and 18% respectively (Govt of WA, 2000a). Therefore the vegetation complexes in the study area are well represented in the PMR.

Floristic Community Types

A portion of the study area is represented by the well reserved FCT 28, which is considered to be at low risk of extinction (Gibson *et al.*, 1994). However, the majority of the study area contains either the Priority 3 PEC SCP 24 or the Endangered TEC SCP 26a in association with a limestone substrate.

SCP 24 (FCT 24) is considered to be well reserved in the PMR of the SCP however it is susceptible to modification or destruction by human activities, or vulnerable to new threatening processes. SCP 26a (FCT 26a) is considered to be poorly reserved and susceptible to modification or destruction by human activities, or vulnerable to new threatening processes (Gibson *et al.*, 1994). Therefore those parts of the study area that are representative of SCP 24 are of low to moderate conservation significance and the limestone ridge possibly supporting SCP 26a is of high conservation significance. Although the PEC and the TEC are not protected by State legislation, any potential impacts of the development on SCP 24 and SCP 26a within the study area will require discussion with DEC. As the PEC and TEC are not listed by the Commonwealth the vegetation of the study area is not of national significance.

The areas containing either the Priority 3 PEC SCP 24 or the Endangered TEC SCP 26a are at risk from potential development of the site for limestone extraction.

Bush Forever

The entire study area is located within Bush Forever Site 290 – 'Hopkins Road Bushland, Nowergup'. Bush Forever Site 290 is 406.9ha in size and supports *Karrakatta Complex – Central* and South and *Cottesloe Complex – Central and South* vegetation complexes. Any potential impacts of the development on the Bush Forever Site will require discussion with the Department of Planning.

4.2 Flora

4.2.1 General

A total of 157 flora species were recorded from the study area during the two-phased flora assessment. This included 122 native species and 35 non-native (introduced) species including one Declared Weed. The dominant families represented were the Proteaceae (Banksia family - 13 native species), Papilionaceae (Pea family - 11 native and two introduced species), Asteraceae (Daisy family - six native and six introduced species) and Poaceae (Grass family - four native and seven introduced species).

A complete list of the flora species recorded within the study area during the survey is provided in Appendix B. The floristic data collected from each quadrat, including photographs of the representative vegetation types, are provided in Appendix C.

One species declared as a weed under the *Agriculture and Related Resources Protection (ARRP) Act 1976* was recorded within the study area during the Spring 2009 survey (Quadrats 1, 2, 3 and 6). Bridal Creeper (*Asparagus asparagoides*) is listed as P1 under the Act (Agriculture Protection Board of WA (APB), 2008).

P1 prohibits the movement of plants or their seeds within the State via contaminated machinery and produce that may contain parts of the plants (including livestock). The guideline for the control for P1 species aims to prevent infestation spreading beyond the existing boundaries of infestation. The movement of plants or their seeds, contaminated machinery, produce, livestock and fodder is prohibited within the State (APB, 2008).

4.2.2 Conservation Significance of Flora

Two Priority flora species, *Stylidium maritimum* (Priority 3) and *Jacksonia sericea* (Priority 4) were recorded from the study area during the Spring 2009 survey. The location of these species is shown in Figure 3.

Fifteen plants of *Stylidium maritimum* were observed on the limestone ridge associated with vegetation type TSMs within the study area, with 11 plants recorded from Quadrat 2. An additional eight plants were located on the same ridge outside the boundary of the study area (see Figures 2 and 3). *Stylidium maritimum* is also a significant species of the Spearwood dunes under the Bush Forever program, considered to be poorly reserved and a significant population (Govt of WA, 2000b).

Approximately 113 plants of *Jacksonia sericea* were observed scattered or in dense patches across the study in vegetation types WEg, OWEg, OHMs and TOSXp. In addition, approximately 80 plants were observed outside the study area, with a high density (70 plants) observed between the entrance track into Limestone Resources Australia Pty Ltd site and the northern boundary of the study area, likely as a result of disturbance. Nine plants were also recorded in road verge vegetation between Hopkins Road and the eastern boundary of the study area (see Figures 2 and 3). It is possible that further in-depth traversing of the study area would locate more plants of *Jacksonia sericea*, particularly in the southern portion. This species appears to be a disturbance opportunist. *Jacksonia sericea* is also a significant species of the Spearwood dunes under the Bush Forever program, considered to be poorly reserved, a significant population and taxa endemic to the SCP in the PMR (Govt of WA, 2000b).

Three other species listed as Bush Forever significant flora species of the Spearwood Dunes, *Petrophile axillaris* (opportunistic record from the near southern boundary), *Conospermum triplinervium* (opportunistic record from north of Quadrat 3 in WEg) and *Glischrocaryon aureum* (Quadrat 3) (Govt of WA, 2000b), were also recorded from the study area. Two other significant Bush Forever species, *Astroloma microcalyx* and *Conostylis aculeata* subsp. *cygnorum*, possibly occur within the study area (recorded opportunistically from near the southern boundary and in Quadrats 3 and 4 respectively), however their identity as subsp. *cygnorum* and species *microcalyx* are not definitive due to difficulty in correctly identifying to subspecies/species level.

No DRF was recorded during the survey.

All significant flora species identified in the DEC database searches would have been identifiable during the survey if present. Table 6 provides a summary of the conservation significant flora recorded from the study area, with information including a map of distribution (collection records) in Western Australia and photographs in Appendix D.

TABLE 6

SIGNIFICANT FLORA RECORDED FROM THE STUDY AREA BY COFFEY ENVIRONMENTS

Species	DEC Status	EPBC Act Status	Bush Forever Status	Identification Confirmed / Determined By	Voucher Specimen*	Places of Known Occurrence	Preferred Habitat
Jacksonia sericea	P4	-	Poorly reserved Significant population Endemic to SCP in PMR	[redacted] Coffey Environments	Yes Coffey Environments	Gnangara Karnup Koondoola Landsdale Malaga Mandurah Mullaloo Neerabup Wanneroo	Calcareous and sandy soils
Stylidium maritimum	P3	-	Poorly reserved Significant population	[redacted] Coffey Environments	Yes Coffey Environments	Alkimos Butler Carabooda Cervantes Eglinton Jurien Bay Lancelin Seabird Two Rocks Yalgorup Yanchep	Sand over limestone, dune slopes and flats, coastal heath and shrubland, open Banksia woodland
Astroloma microcalyx	-	-	Poorly reserved Significant population	[redacted] Coffey Environments	-	Cottesloe North Beach Ocean Reef Seabird Two Rocks Yalgorup Yanchep	White or brown sand or loam, limestone, laterite, coastal areas
Conospermum triplinervium	-	-	Poorly reserved Significant population	[redacted] Coffey Environments	-	Bindoon Boyup Brook Carramar Gingin	White, grey or yellow sand, laterite, sandplains,

Species	DEC Status	EPBC Act Status	Bush Forever Status	Identification Confirmed / Determined By	Voucher Specimen*	Places of Known Occurrence	Preferred Habitat
						Highbury Kewdale Mogumber Neerabup Secret Harbour Tambellup Wagin Welshpool Yalgorup Yanchep	sometimes winter-wet depressions
Conostylis aculeata subsp. *cygnorum*	-	-	Endemic to SCP	[redacted] Coffey Environments	-	Alexander Hts Bayswater Burns beach Ellenbrook Girrawheen Gnangara Henley Brook Koondoola Lake Pinjar South Perth Swan View Warrick	White-grey sand, limestone
Glischrocaryon aureum	-	-	Poorly reserved	[redacted] Coffey Environments	-	Bolgart Calingiri Corrigin Cuballing Esperance Gillingara Greenmount Jurien Bay Kalbarri Kukerin Mullewa Mundaring Perenjori Perup Serpentine Wattle Grove York	Grey, yellow or red sand, loam or clay soils, laterite, undulating plains, sand dunes, low ridges
Petrophile axillaris	-	-	Poorly reserved Significant population At limit of known geographical range	[redacted] Coffey Environments	-	Cervantes Coogee Gingin Jurien Bay Lancelin Mindarie Stake Hill Yalgorup Wanneroo	Red, yellow or grey sand over limestone, sandy loams and gravel, sandplains, gentle slopes, ridges

5 POTENTIAL IMPACTS

The areas within the study area that are associated with a limestone substrate contain vegetation representing either the Priority 3 PEC (SCP 24 'Northern Spearwood shrublands and woodlands') or the Endangered TEC (SCP 26a 'Limestone ridges: *Melaleuca huegelii - Melaleuca acerosa* (currently *M. systena*) shrublands on limestone ridges'). PECs and TECs are not protected under State law however any potential impact on these areas of vegetation requires discussion with DEC.

The entire study area is covered by Bush Forever Site 290 'Hopkins Road Bushland, Nowergup', a regionally significant area. *Bush Forever* is a non-statutory regional policy under the Western Australian Planning Commission's (WAPC) policy framework and is endorsed by the Western Australian Government, the WAPC, the EPA and other key environmental agencies (WAPC, 2004a). However the *Draft Statement of Planning Policy No. 2.8: Bushland Policy for the Perth Metropolitan Region* and the *Metropolitan Region Scheme Amendment No. 1082/33 Bush Forever and Related Lands* give statutory effect to *Bush Forever* (WAPC, 2004b) to ensure bushland protection and appropriate address of management issues (WAPC, 2004a). The draft Policy states that further development or land use proposals should be consistent with the policy measures in Section 5.1 and 5.2 of the Policy to ensure all reasonable steps are taken to avoid, minimise or mitigate any likely adverse impacts (direct or indirect) on the regionally significant bushland. Policy measures apply to any proposal that is likely to have an adverse impact, direct or indirect, on a regionally significant bushland within a Bush Forever Protection Area (WAPC, 2004b). If the study area comes under the *Bush Forever Protection Area* implementation category of *Urban, Industrial or Resource Development* (Section 5.2.2 of the draft Policy), a balance between conservation and development or resource extraction, having regard for the specific conservation values involved, will be sought and may involve a Negotiated Planning Solution with strategic outcomes that will facilitate bushland protection and development requirements (WAPC, 2000a).

Govt of WA (2000b) also states that Bush Forever Site 290 is subject to protection under the Commonwealth *EPBC Act 1999* due to the presence of the listed species *Eucalyptus argutifolia*. As the DEC and Commonwealth listed *Eucalyptus argutifolia* is not present within the study area, the *EPBC Act 1999* may not apply to this section of Site 290 with respect to flora and vegetation. Any potential impacts on the Bush Forever site will require discussion with the Department of Planning, particularly as Site 290 is considered as a site with some existing protection under the proposed 'Gnangara Park' with the existing care, control and management of the Site endorsed (Govt of WA, 2000b).

Two Priority flora species, *Stylidium maritimum* (Priority 3) and *Jacksonia sericea* (Priority 4), were recorded from the study area along with three, possibly five, Bush Forever significant species - *Petrophile axillaris*, *Conospermum triplinervium, Glischrocaryon aureum, Astroloma microcalyx* (*?microcalyx*) and *Conostylis aculeata* subsp. *cygnorum* (?subsp. *cygnorum*). Although these species are not protected by State or Commonwealth law with the latter five species being common, any potential impact on these species requires discussion with DEC.

The vegetation of the study area is mapped as the *Cottesloe – Central and South* and the *Karrakatta – Central and South* vegetation complexes. As 36% and 18%, respectively, of these vegetation complexes remain in the PMR of the SCP, the vegetation complexes of the study area are well reserved. Therefore, any development of the study area will have minimal impact on the *Cottesloe – Central and South* and the *Karrakatta – Central and South* vegetation complexes as a whole.

As there is no Commonwealth listed conservation significant flora or ecological communities present within the study area, referral under the *EPBC Act 1999* is not required with regard to flora and vegetation impacts. Impacts on fauna species protected under the *EPBC Act 1999* have not been addressed in this report.

6 CONCLUSIONS

Based on the results of the flora and vegetation assessment of the study area, the following conclusions have been made:

- The vegetation within the study area is mapped as consisting of the *Cottesloe – Central and South* and the *Karrakatta – Central and South* vegetation complexes, of which 36% and 18% respectively, remains within the Perth Metropolitan Region of the Swan Coastal Plain (Govt of WA, 2000). These vegetation complexes are well reserved as they are above the minimum 10% retention threshold;
- A section of a registered Bush Forever Site (No. 290 - 'Hopkins Road Bushland, Nowergup') occurs over the entire study area. Site 290 in its entirety covers 406.9ha of bushland and is a regionally significant bushland having particular conservation value for its representation of ecological communities and rarity (the DRF taxon *Eucalyptus argutifolia* occur and the Priority 5 Southern Brown Bandicoot occur within Site 290) and in providing linkage to bushland to the south (including Bush Forever Site 293) and to the west (Govt of WA, 2000b);
- Six vegetation types were identified within the study area. In general the vegetation types represented *Eucalyptus marginata* (Jarrah) Low Woodland, *Eucalyptus gomphocephala* (Tuart) Woodland to Open Woodland and *Xanthorrhoea preissii* Tall Open Scrub with *Banksia sessilis* on sand over limestone, and *Melaleuca systena* Open Heath to Tall Shrubland and on limestone substrate;
- The results of the PATN analysis showed that the vegetation has similarities to three FCTs as follows:
    - FTC 24 - 'Northern Spearwood shrublands and woodlands';
    - FCT 26a - 'Limestone ridges: *Melaleuca huegelii* - *Melaleuca acerosa* (currently *M. systena*) shrublands on limestone ridges'; and
    - FCT 28 - 'Spearwood *Banksia attenuata* or *Banksia attenuata-Eucalyptus* woodlands'
- The PATN analysis of the quadrat data was not definitive. Based on the analysis, the areas represented by Quadrats 1 and 2 were similar to the PEC SCP 24 (FCT 24) and the TEC SCP 26a (FCT 26a) (vegetation types OHMs and TSMs), and Quadrats 5 and 6 were similar to FCT 24 and FCT 28 (vegetation types OWEg and TOSXp);
- The vegetation of the remainder of the study area was more easily identified as FCT 28 (vegetation types LWEm and WEg), a common FCT (Quadrats 3 and 4);
- The Priority 3 PEC, SCP 24 (FCT 24) 'Northern Spearwood shrublands and woodlands' is considered to be well reserved however it is susceptible to modification or destruction by human activities, or threatening processes (Gibson *et al.*, 1994);
- The Endangered TEC, SCP 26a (FCT 26a) 'Limestone ridges: *Melaleuca huegelii* - *Melaleuca acerosa* (currently *M. systena*) shrublands on limestone ridges' is considered to be poorly reserved and susceptible to modification or destruction by human activities, or vulnerable to new threatening processes;
- FCT 28 is not listed as a TEC or PEC by the DEC and is considered to be well reserved on the Swan Coastal Plain and at low conservation status risk (Gibson *et al.*, 1994);
- The vegetation condition within the study area ranged from Excellent to Degraded-Completely Degraded;

- A total of 157 flora species were recorded from the study area of which 35 were non-native, introduced (weed) species;
- The following conservation significant species were recorded from the study area:
    - *Stylidium maritimum* - Priority 3, Bush Forever significant flora;
    - *Jacksonia sericea* - Priority 4, Bush Forever significant flora;
    - *Petrophile axillaris* - Bush Forever significant flora;
    - *Conospermum triplinervium* - Bush Forever significant flora;
    - *Glischrocaryon aureum* - Bush Forever significant flora;
    - Possibly *Astroloma microcalyx* - Bush Forever significant flora; and
    - Possibly *Conostylis aculeata* subsp. *cygnorum* - Bush Forever significant flora.
- No Declared Rare Flora as defined by the *EPBC Act 1999* were recorded from the study area;
- One declared weed under the *ARRP Act 1976*, *Asparagus asparagoides* (Bridal Creeper), was recorded within the study area; and
- Discussions are required with DEC and DoP due to the presence of the Bush Forever site, the PEC and TEC, and conservation significant flora.

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8 DISCLAIMER

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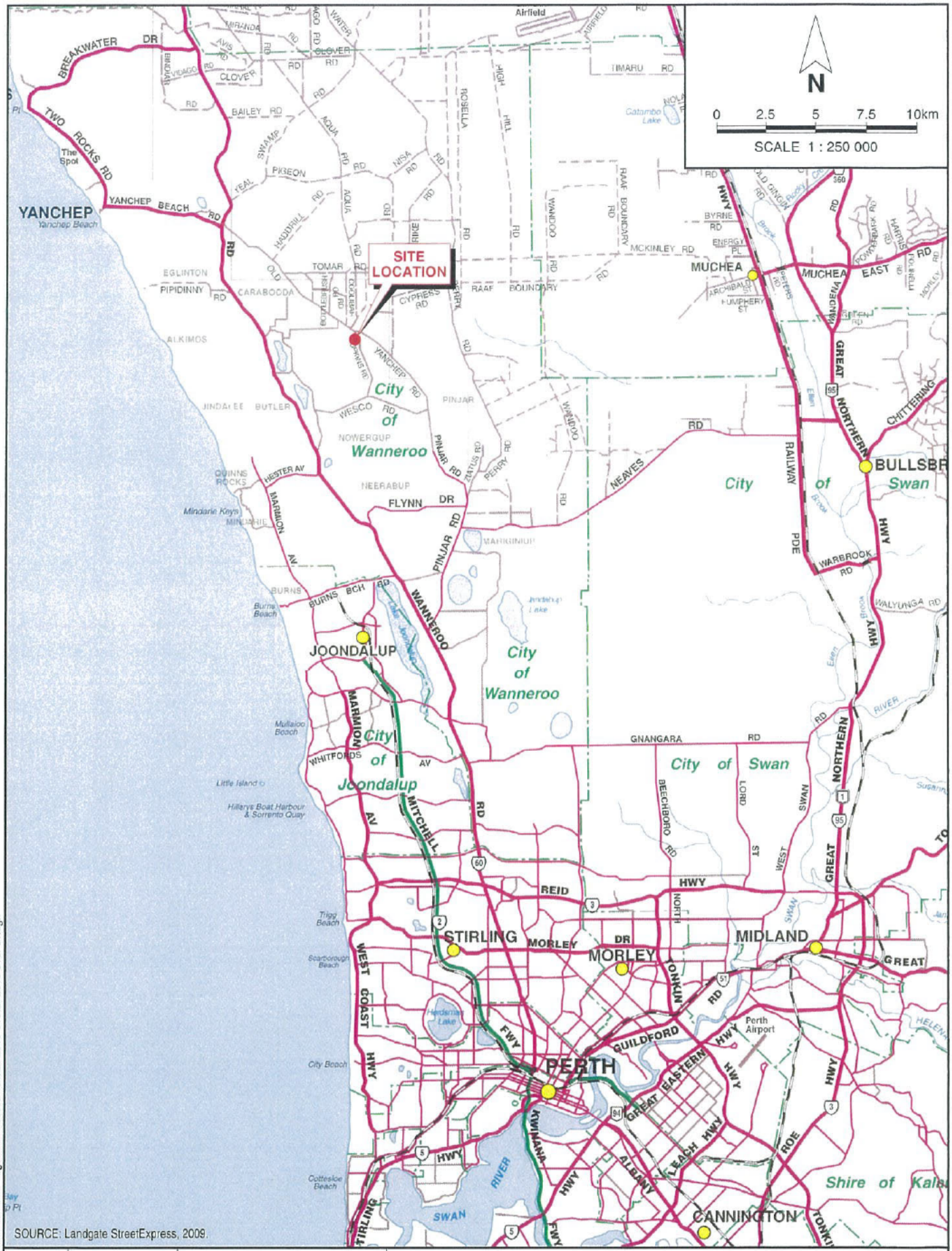
Figures

Flora and Vegetation Assessment
M70/339 Hopkins Road, Nowergup



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FLORA AND VEGETATION ASSESSMENT - LIMESTONE BUILDING BLOCK COMPANY M70/339 HOPKINS ROAD, CARABOODA

REGIONAL LOCATION

Figure 1

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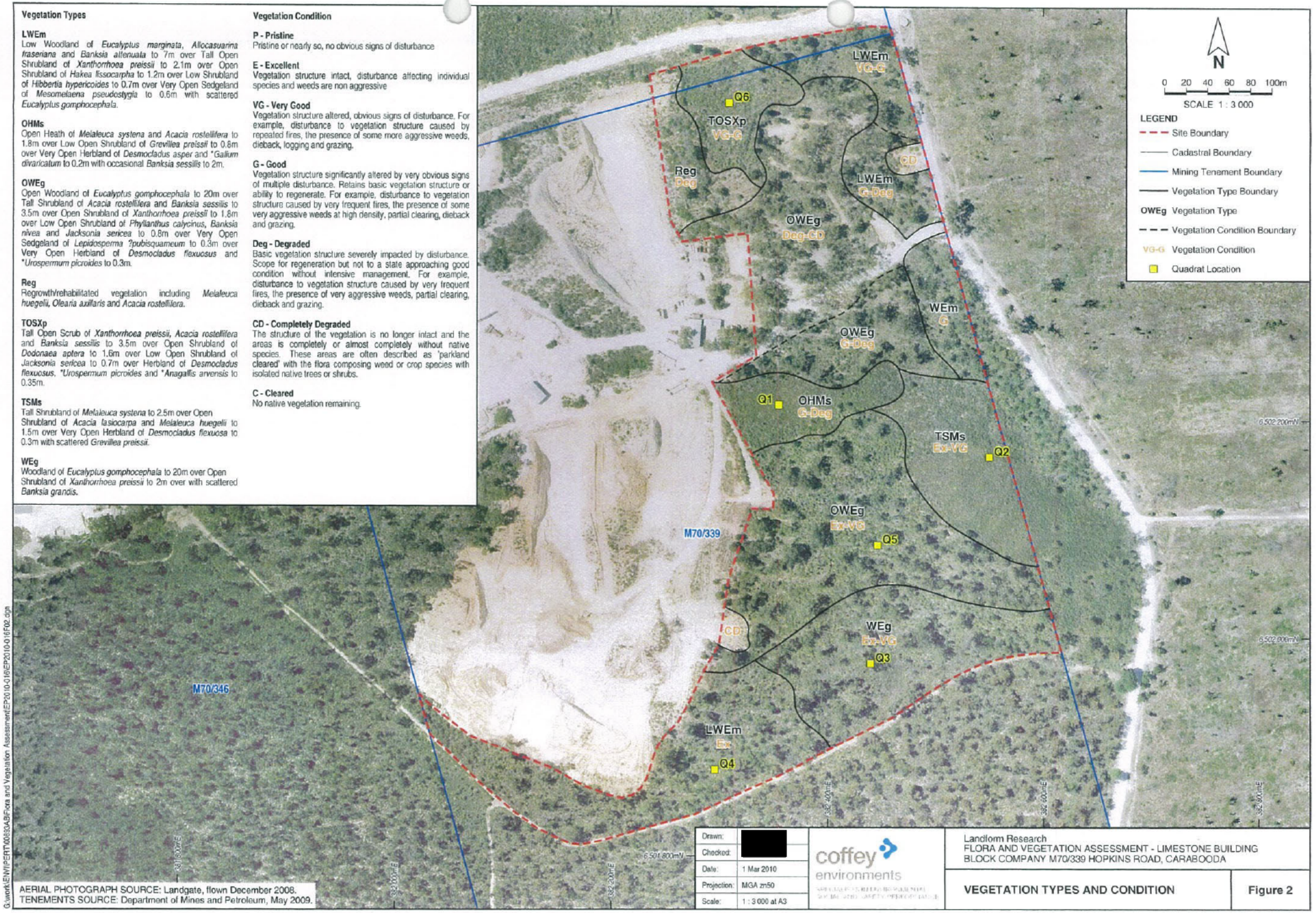
Vegetation Types
LWEm
Low Woodland of Eucalyptus marginata, Allocasuarina fraseriana and Banksia attenuata to 7m over Tall Open Shrubland of Xanthorrhoea preissii to 2.1m over Open Shrubland of Hakea lissocarpha to 1.2m over Low Shrubland of Hibbertia hypericoides to 0.7m over Very Open Sedgeland of Mesomelaena pseudostygia to 0.6m with scattered Eucalyptus gomphocephala.
OHMs
Open Heath of Melaleuca systena and Acacia rostellifera to 1.8m over Low Open Shrubland of Grevillea preissii to 0.8m over Very Open Herbland of Desmocladus asper and *Galium divaricatum to 0.2m with occasional Banksia sessilis to 2m.
OWEg
Open Woodland of Eucalyptus gomphocephala to 20m over Tall Shrubland of Acacia rostellifera and Banksia sessilis to 3.5m over Open Shrubland of Xanthorrhoea preissii to 1.8m over Low Open Shrubland of Phyllanthus calycinus, Banksia nivea and Jacksonia sericea to 0.8m over Very Open Sedgeland of Lepidosperma ?pubisquameum to 0.3m over Very Open Herbland of Desmocladus flexuosus and *Urospermum picroides to 0.3m.
Reg
Regrowth/rehabilitated vegetation including Melaleuca huegelii, Olearia axillaris and Acacia rostellifera.
TOSXp
Tall Open Scrub of Xanthorrhoea preissii, Acacia rostellifera and Banksia sessilis to 3.5m over Open Shrubland of Dodonaea aptera to 1.6m over Low Open Shrubland of Jacksonia sericea to 0.7m over Herbland of Desmocladus flexuosus, *Urospermum picroides and *Anagallis arvensis to 0.35m.
TSMs
Tall Shrubland of Melaleuca systena to 2.5m over Open Shrubland of Acacia lasiocarpa and Melaleuca huegelii to 1.5m over Very Open Herbland of Desmocladus flexuosa to 0.3m with scattered Grevillea preissii.
WEg
Woodland of Eucalyptus gomphocephala to 20m over Open Shrubland of Xanthorrhoea preissii to 2m over with scattered Banksia grandis.
Vegetation Condition
P - Pristine
Pristine or nearly so, no obvious signs of disturbance
E - Excellent
Vegetation structure intact, disturbance affecting individual species and weeds are non aggressive
VG - 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.
G - Good
Vegetation structure significantly altered by very obvious signs of multiple disturbance. Retains basic vegetation structure or ability to regenerate. 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.
Deg - Degraded
Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
CD - Completely Degraded
The structure of the vegetation is no longer intact and the areas is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora composing weed or crop species with isolated native trees or shrubs.
C - Cleared
No native vegetation remaining.
N
0 20 40 60 80 100m
SCALE 1 : 3 000
LEGEND
Site Boundary
Cadastral Boundary
Mining Tenement Boundary
Vegetation Type Boundary
OWEg Vegetation Type
Vegetation Condition Boundary
VG-G Vegetation Condition
Quadrat Location
LWEm VG-G
Q6
TOSXp VG-G
Reg Deg
CD
LWEm G-Deg
OWEg Deg-CD
WEm G
OWEg G-Deg
Q1
OHMs G-Deg
TSMs Ex-VG
Q2
OWEg Ex-VG
Q5
M70/339
CD
WEg Ex-VG
Q3
M70/346
LWEm Ex
Q4
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6 502 000mN
6 501 800mN
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382 600mE
382 800mE
382 000mE
382 200mE
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coffey environments
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FLORA AND VEGETATION ASSESSMENT - LIMESTONE BUILDING BLOCK COMPANY M70/339 HOPKINS ROAD, CARABOODA
VEGETATION TYPES AND CONDITION
Figure 2
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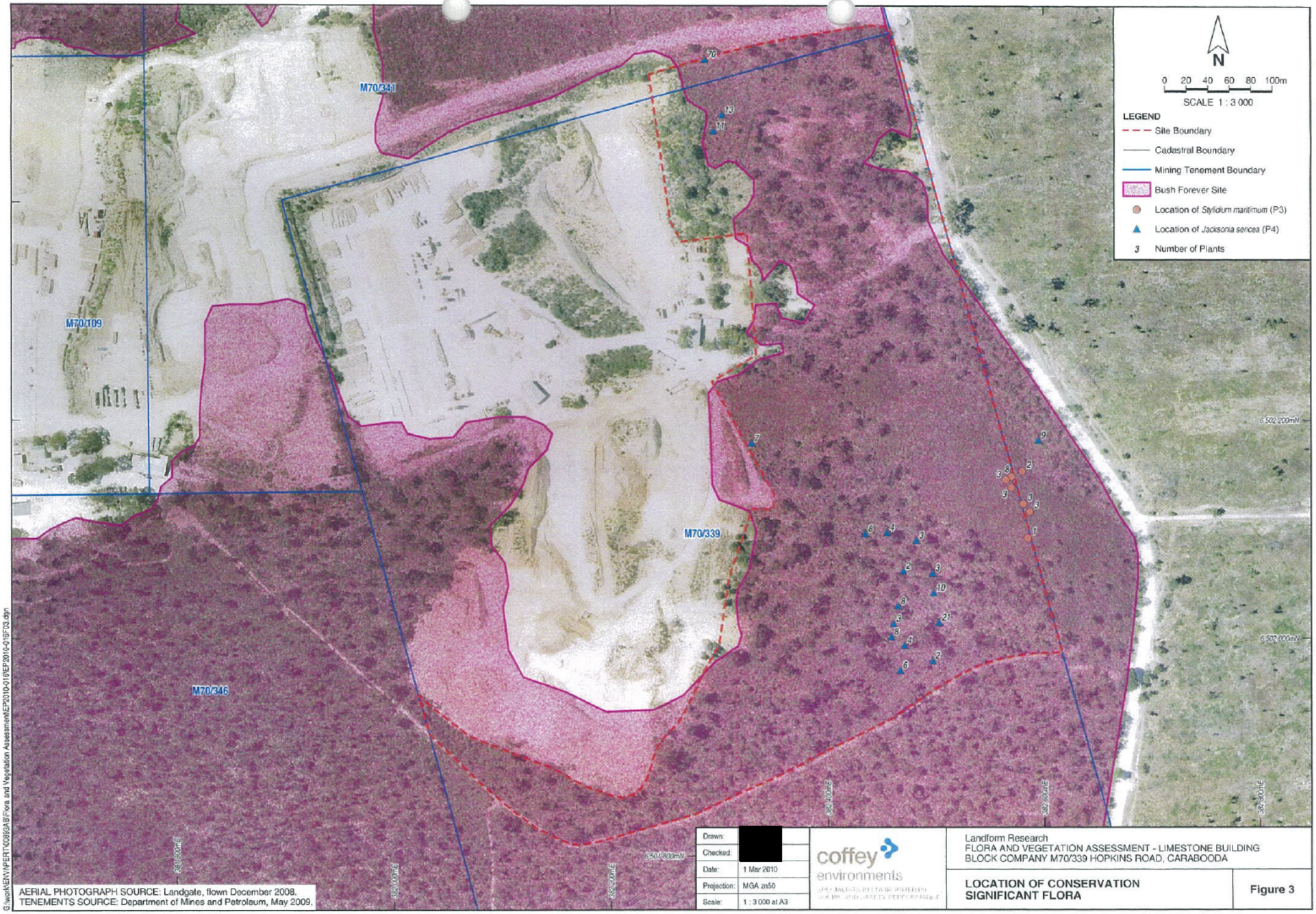

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FLORA AND VEGETATION ASSESSMENT - LIMESTONE BUILDING BLOCK COMPANY M70/339 HOPKINS ROAD, CARABOODA

LOCATION OF CONSERVATION SIGNIFICANT FLORA

Figure 3

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Appendix C
Quadrat Data

Flora and Vegetation Assessment
M70/339 Hopkins Road, Nowergup

Quadrat Data

Flora and Vegetation Survey
Limestone Building Block Co. Pty Ltd, Hopkins Road Nowergup

Quadrat 1

Described: [redacted] **Date:** 2/10/2009 **Type:** Quadrat (10m x10m) **Season:** Excellent

Location: SE of site office

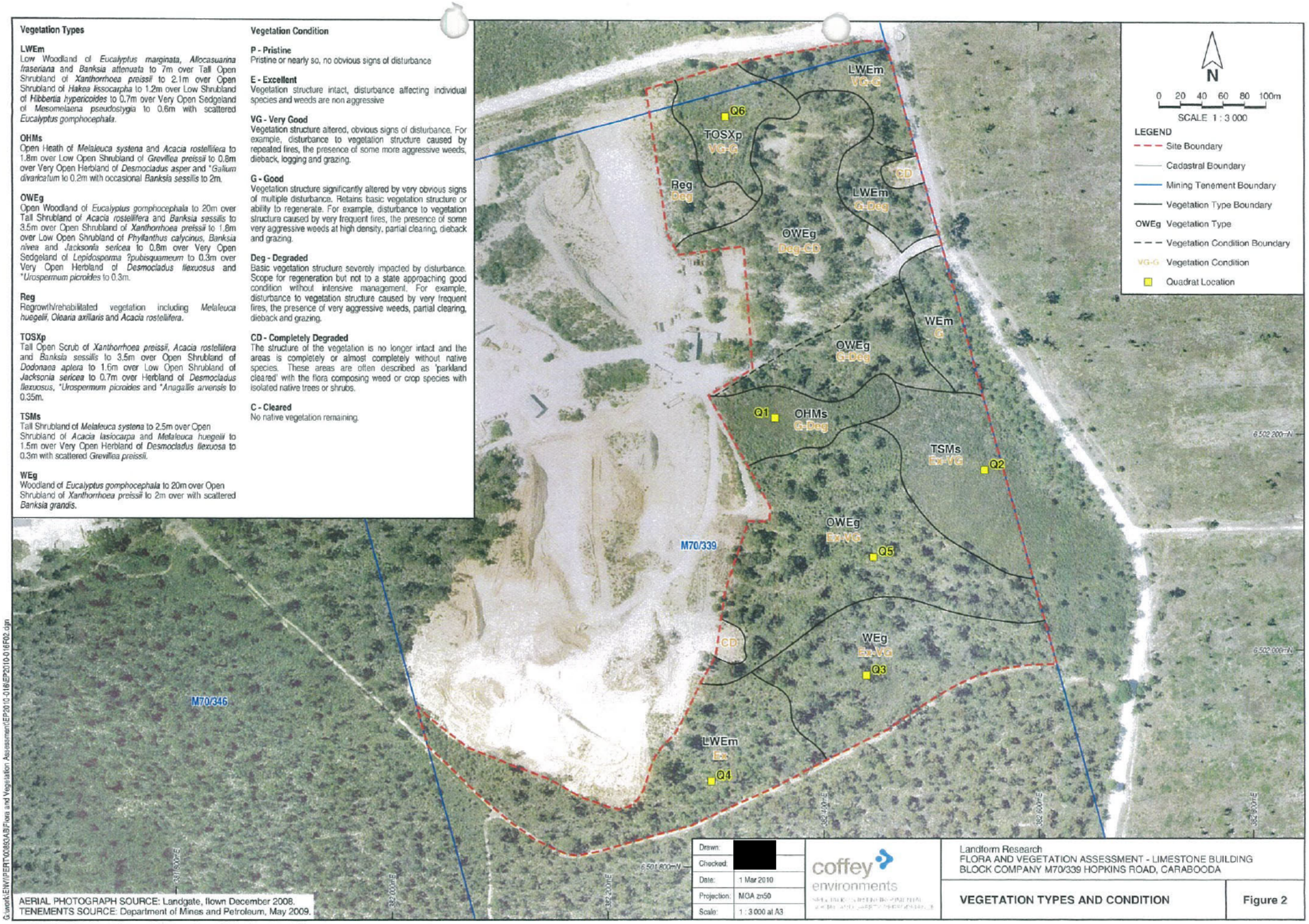
MGA Zone: 50 382348mE, 6502226mN
Habitat: Low flat ridge
Soil: Brown loamy sand
Rock Type: Limestone
Vegetation: Open Heath of *Melaleuca systena* and *Acacia rostellifera* to 1.8m over Low Open Shrubland of *Grevillea preissii* to 0.8m over Very Open Herbland of *Desmocladus asper* and **Galium divaricatum* to 0.2m with occasional *Banksia sessilis* to 2m

Condition: Good – Degraded

Species List:

Name	Cover (%)	Height (m)	
Acacia lasiocarpa	<1	0.6	
Acacia rostellifera	15	1.8	
**Aira cupaniana*	<1	0.12	
**Anagallis arvensis* var. *caerulea*	<1	0.15	
**Asparagus asparagoides*	<1	Climber	***Declared Weed***
Austrostipa flavescens	<1	0.4	
**Avena barbata*	<1	0.4	
Banksia nivea subsp. *nivea*	<1	0.2	
Banksia sessilis	1	2	
**Briza maxima*	1	0.3	
**Bromus diandrus*	<1	0.7	
Caladenia sp.	<1	0.1	
Cassytha ?racemosa forma *pilosa*	2	Climber	
**Cerastium glomeratum*	<1	0.1	

Comesperma integerrimum	1	Climber
Crassula colorata	<1	0.03
**Crassula? glomerata*	<1	0.03
Daucus glochidiatus	<1	0.05
Desmocladus asper	3	0.2
Dianella revoluta	<1	0.5
**Ehrharta longiflora*	<1	0.4
**Euphorbia peplus*	1	0.2
**Galium divaricatum*	2	0.05
**Geranium molle*	<1	0.05
Grevillea preissii	2	0.8
Hardenbergia comptoniana	<1	Climber
**Hypochaeris glabra*	<1	0.2
Leucopogon parviflorus	<1	1
Melaleuca systena	20	1.8
Millotia myosotidifolia	1	0.05
**Minuartia mediterranea*	<1	0.05
**Petrorhagia dubia*	<1	0.15
Phyllanthus calycinus	<1	0.6
**Silene nocturna*	<1	0.15
**Sonchus asper*	<1	0.3
**Sonchus oleraceus*	<1	0.1
Thysanotus manglesianus	<1	Climber
**Trifolium arvense*	<1	0.05
**Trifolium dubium*	<1	0.1
**Urospermum picroides*	<1	0.35
**Vulpia bromoides*	<1	0.1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Q2
OWEg Ex-VG
Q5
M70/339
CD
WEg Ex-VG
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BLOCK COMPANY M70/339 HOPKINS ROAD, CARABOODA
VEGETATION TYPES AND CONDITION
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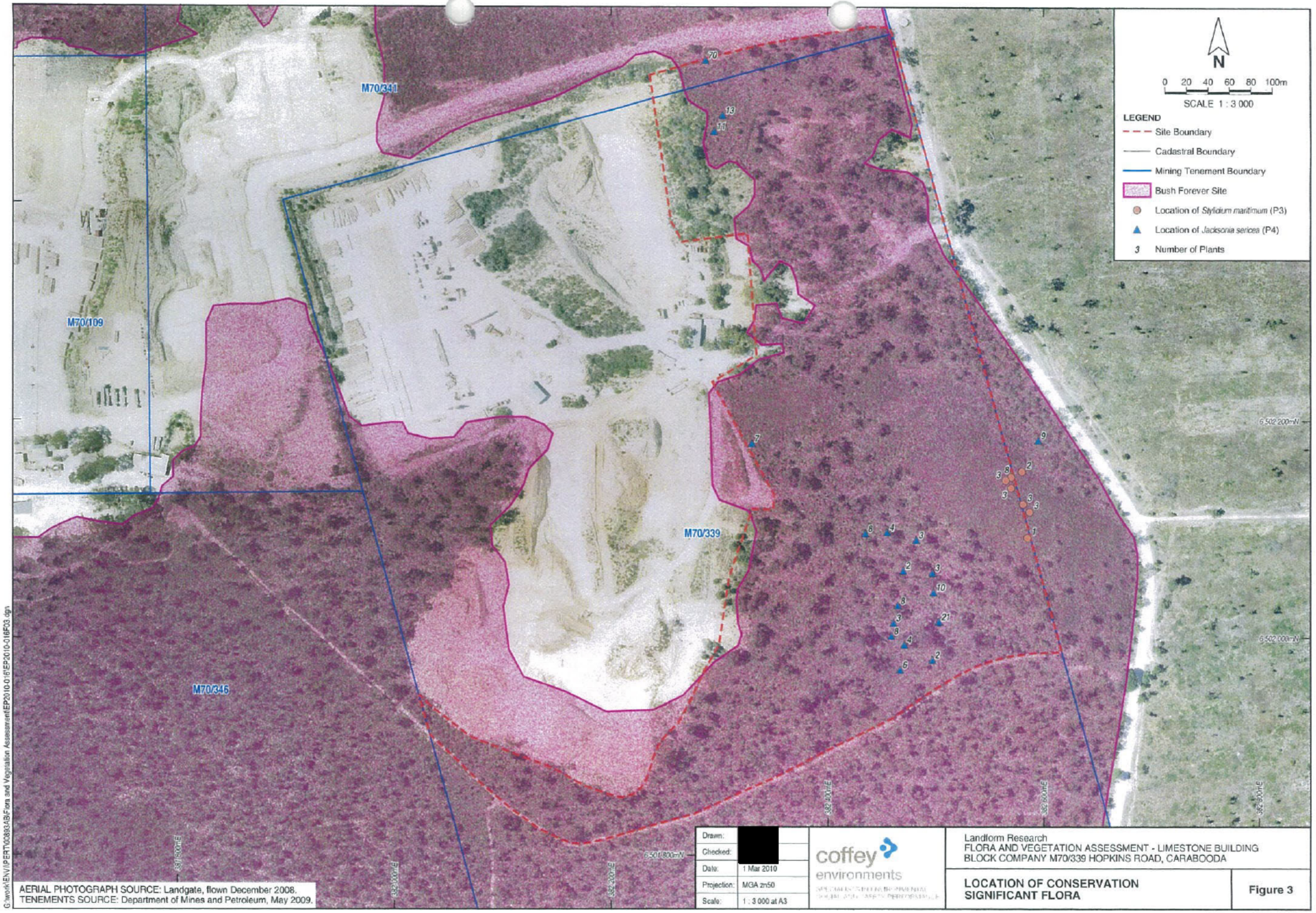

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BLOCK COMPANY M70/339 HOPKINS ROAD, CARABOODA

LOCATION OF CONSERVATION SIGNIFICANT FLORA

Figure 3

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Appendix B
Detailed Flora and Vegetation Survey (PGV Environmental, 2021)

M70/341, M70/345, M70/346 AND M70/339, HOPKINS ROAD CARABOODA

FLORA AND VEGETATION SURVEY

Prepared for: WA Limestone

Report Date: 28 January 2021

Version: 1

Report No. 2020-551

pgv ENVIRONMENTAL

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Plate 4: *Acacia benthamii* on M70/345

Plate 5: *Jacksonia sericea* on M70/345

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Appendix 3: Protected Matters Search Tool Report

Appendix 4: Conservation Codes

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Appendix 7: Quadrat Data

Appendix 8: Coffey Environments (2010) Flora and Vegetation survey tenements M70/341 and M70/345

1 INTRODUCTION

1.1 Background

Mining Tenements M70/341, M70/345, M70/346 and M70/339, Hopkins Road, Carabooda are located approximately 39km north of the Perth Central Business District (Figure 1) in the City of Wanneroo. The owners of the tenements, WA Limestone, plan to expand the existing Hopkins Road quarry into parts of each tenement (Figure 2) (the site).

The site is bounded by Cutler Road and partially cleared rural land to the west, Hopkins Road and native vegetation to the east, a harvested pine plantation to the north and native vegetation to the south (Figure 2). The proposed clearing in tenements M70/341 and M70/345 is separated from the proposed clearing in tenements M70/346 and M70/339 by the existing Hopkins Road quarry.

The total area of the proposed disturbance footprint is approximately 27.5ha of which approximately 24.5ha is previously uncleared native vegetation.

The site is located within a part of Bush Forever site 290 'Hopkins Road Bushland, Nowergup'.

PGV Environmental was commissioned by WA Limestone to undertake a flora and vegetation survey of the portions of tenements M70/346 and M70/339 proposed to be quarried and to update a previous flora and vegetation survey of tenements M70/341 and M70/345 undertaken by Coffey Environments in 2010.

1.2 Scope of Works

A Detailed Flora and Vegetation Survey of the proposed clearing in portions of tenements M70/346 and M70/339 was undertaken in accordance with EPA Technical Guidance *Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA, 2016). The survey included the following:

- Desktop search and review of the Department of Biodiversity, Conservation and Attractions (DBCA) Threatened and Priority flora and ecological community Databases;
- A search of the Naturemap website (DBCA, 2020);
- A search of the Commonwealth Government's Protected Matters Search Tool (DAWE, 2020) to identify species potentially occurring within the area that are protected under the *Environment Protection and Biodiversity Conservation* (EPBC) *Act 1999*;
- Examination of historic and recent aerial photography and contour and soil maps to provisionally identify vegetation types and condition;
- Field survey using quadrats to record native and introduced species as well as a thorough site walkover of any areas of native vegetation;
- Recording of any significant plant species using a hand-held GPS;
- Description and mapping of vegetation types and vegetation condition;
- Analysis of the vegetation to see if any areas are representative of the Banksia Woodland or Tuart Woodland Tecs as listed under the EPBC Act; and
- Compilation of a flora list.

The Coffey (2010) survey was reviewed with respect to updating any plant species nomenclature and conservation status. The conservation status of vegetation types was reviewed particularly with respect to Threatened Ecological Communities which have been listed since the 2010 report.

The results of the Coffey Environments (2010) report were compiled into this report with some changes in vegetation types made to the Coffey descriptions to make them compatible with the PGV Environmental method of describing vegetation types.

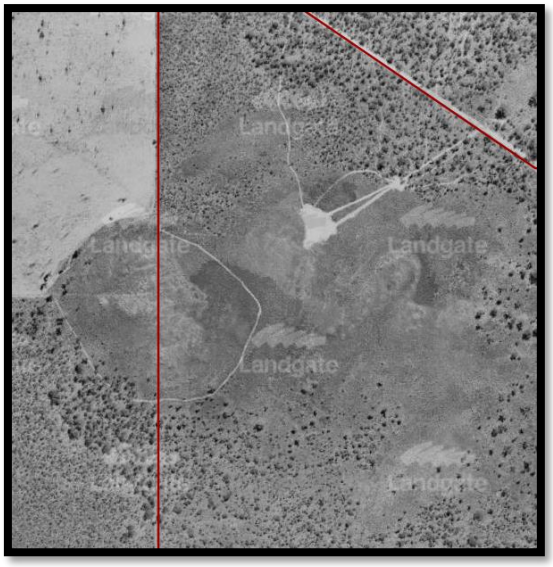
2 EXISTING ENVIRONMENT

2.1 Land Use

The site is currently zoned 'State Forest' under the Metropolitan Region Scheme (National Map, 2020) and under the City of Wanneroo Local Planning Scheme No. 2 (WAPC, 2001)

The earliest available historic aerial photograph on-line from 1965 (Landgate, 2020) shows that the site contains native vegetation (Plate 1) with limestone extraction having commenced in the current mining footprint.

Plate 1: Aerial Photograph 1953 (Landgate, 2020)



The 2000 photograph shows a large area of mining in the current quarry (Plate 2). A portion to the north of the quarry was cleared in 2000. Subsequent photos show the area cleared was not mined.

Plate 2: Aerial Photograph 2000 (Landgate, 2020)

The area surveyed for this report mostly contains native vegetation. The area cleared in 2000 regenerated to native bushland (Figure 2).

2.2 Topography

The northern part of the site slopes gently down from the west, at a high of around 70m Australian Height Datum (AHD) down to the east at around 55m AHD. The southern part of the site is very gently undulating with an elevation between 57 and 62m AHD (Figure 2).

2.3 Geology and Soils

2.3.1 Geology

The site is mapped as part of the Spearwood System which has the highest relief of the dune systems on the Swan Coastal Plain (Bolland, 1998). The Spearwood system consists of slightly calcareous Aeolian sand remnant from leaching of the underlying Pleistocene Tamala limestone (Davidson, 1995).

2.3.2 Soils

Two Spearwood soil units are mapped on the site and are described as follows:

- Karrakatta Shallow Soils Phase (211Sp_Kls) which are low hills and ridges with bare limestone or shallow siliceous or calcareous sand over limestone and are mapped over the majority of the site; and
- Karrakatta Sand Yellow Phase (211Sp_Ky) which are on low hilly to gently undulating terrain and are yellow sand over limestone at 1-2 m (DPIRD, 2020). This soil phase is located in a very small area on the western boundary.

2.4 Hydrology

Groundwater is at approximately 23 to 25m AHD, which is 32m to 47m below the surface level, and generally flows to the west (DWER, 2020). There are no wetlands mapped on the site (National Map, 2020).

3 METHODOLOGY

3.1 Database Searches

Searches of the following databases were undertaken for a 10km radius around the central point of the site prior to the site survey:

- Department of Biodiversity, Conservation and Attractions (DBCA) Declared Rare and Priority Flora database and Threatened Ecological Communities databases (Appendix 1);
- DBCA Naturemap Database (DBCA, 2020) (Appendix 2); and
- The Commonwealth Government's Protected Matters Search Tool to identify species potentially occurring within the area that are protected under the *Environment Protection and Biodiversity Conservation* (EPBC) *Act 1999* (DAWE, 2020). A radius of 5km was used for this database (Appendix 3).

3.2 Site Survey

A flora and vegetation survey of the site was conducted by Dr Paul van der Moezel of PGV Environmental on 8 October 2020.

The northern part of the site surveyed by Coffey Environments (2010) was walked to confirm the vegetation types and condition recorded in the 2010 survey and to record any additional plant species. Two 10m x 10m non-permanent quadrats were recorded in woodland vegetation in the northern part of the site to assist in the assessment of the Tuart Woodlands and Forests of the Swan Coastal Plain Threatened Ecological Community.

The southern part of the site which had not been surveyed previously was thoroughly walked to record all species in the survey area. Information on flora composition and vegetation structure was recorded in five 10m x 10m non-permanent quadrats located in representative vegetation types.

Most plant species were identified in the field. Some specimens were photographed or taken for identification at the Perth Reference Herbarium or office using standard reference guides.

3.3 Survey Conditions

The conditions that the survey was undertaken in are presented in Table 1 in order to assess the adequacy of the survey. In summary, there were no constraints to the survey.

Table 1: Statement of Botanical Survey Conditions

Issue	Constraints (Y/N)*	Comment
Competency/experience of the consultant conducting the survey	No	Dr Paul van der Moezel has extensive botanical survey experience in the Perth Metropolitan Region.
Proportion of the flora identified^	No	The timing of the survey in early October was optimal to identify most flora species on the site including all potential Threatened and Priority Flora. No follow-up survey required.
Sources of information (historic/recent or new data)	No	The flora in the Perth Metropolitan Region is well documented.
Proportion of the task achieved and further work that may need to be undertaken	No	No follow-up survey required as no Threatened Flora expected to occur in other seasons.
Timing/weather/season/cycle	No	The spring survey was optimal for most flora species. 2020 was a good year for ephemeral species, including orchids.
Disturbances (Fire)	No	The fire age of the vegetation was greater than 5 years.
Intensity of survey (e.g. In retrospect was the intensity adequate)	No	The time spent on the small site and ease of access made for a full coverage.
Completeness (e.g. was relevant area fully surveyed)	No	
Resources (e.g. degree of expertise available for plant identification)	No	Experienced botanist undertook most plant identifications on site.
Remoteness and/or access problems	No	Easily accessible site in the Perth Metropolitan Region.
Availability of contextual (e.g. bioregional) information for the study area.	No	Bush Forever

*Constraints have been rated as Significant, Moderate or No constraints

^Fungi and nonvascular flora (e.g. algae, mosses and liverworts) were not specifically surveyed for during the survey.

4 RESULTS

4.1 Flora Database Searches

A search of the DBCA Threatened Flora Databases: the WA Herbarium database (WAHerb), the Threatened (Declared Rare) and Priority Flora Species List (TFPL) (Appendix 1) and Naturemap Database (Appendix 2) indicates that a number of species that are listed as Endangered, Threatened or Priority have been located within a 10km radius of the site. The and the EPBC Act Protected Matters Search Tool (Appendix 3) indicates species that may have habitat within 5km radius of the site. The results from these database searches are shown in Table 2.

Table 3 lists the likelihood that any of these species could occur on the site based on the soil types and vegetation condition.

Table 2: Conservation Significant Flora Identified in Database Searches

Scientific Name	Common Name	Conservation Status (WA)	Status under EPBC Act
Caladenia huegelii	King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid	Schedule 1	Endangered
Calectasia cyanea	Blue Tinsel Lily	Schedule 1	Critically Endangered
Drakaea elastica	Glossy-leafed Hammer Orchid	Schedule 1	Endangered
Diuris purdiei	Purdie's Donkey-orchid	Schedule 2	Endangered
Drakaea micrantha	Dwarf Hammer-orchid	Schedule 2	Vulnerable
Marianthus paralius		Schedule 2	Endangered
Melaleuca sp. Wanneroo (G.J. Keighery 16705)		Schedule 2	Endangered
Andersonia gracilis	Slender Andersonia	Schedule 3	Endangered
Anigozanthos viridis subsp. *terraspectans*	Dwarf Green Kangaroo Paw	Schedule 3	Vulnerable
Diuris micrantha	Dwarf Bee-orchid	Schedule 3	Vulnerable
Eleocharis keigheryi	Keighery's Eleocharis	Schedule 3	Vulnerable
Eucalyptus argutifolia	Yanchep Mallee, Wabling Hill Mallee	Schedule 3	Vulnerable
Baeckea sp. Limestone (N. Gibson & M.N. Lyons 1425)		Priority 1	
Drosera patens		Priority 1	
Drosera x sidjamesii		Priority 1	
Grevillea sp. Ocean Reef (D. Pike Joon 4)		Priority 1	
Haloragis sp. Parrot Ridge (G.J. Keighery 11563)		Priority 1	
Hydrocotyle striata		Priority 1	
Leucopogon maritimus		Priority 1	
Acacia benthamii		Priority 2	

Scientific Name	Common Name	Conservation Status (WA)	Status under EPBC Act
Amanita wadulawitu	Long-spored Lepidella	Priority 2	
Calectasia elegans	Elegant Tinsel Lily	Priority 2	
Fabronia hampeana		Priority 2	
Lecania sylvestris		Priority 2	
Lecania turicensis var. turicensis		Priority 2	
Poranthera moorokatta		Priority 2	
Rinodina bischoffii		Priority 2	
Stenanthemum sublineare		Priority 2	
Tetraria sp. Chandala (G.J. Keighery 17055)		Priority 2	
Thelymitra variegata	Queen of Sheba	Priority 2	
Adenanthos cygnorum subsp. chamaephyton		Priority 3	
Amanita carneiphylla	Miller's Pink-Gilled Lepidella	Priority 3	
Austrostipa mundula		Priority 3	
Beyeria cinerea subsp. *cinerea*		Priority 3	
Conostylis bracteata		Priority 3	
Cyathochaeta teretifolia		Priority 3	
Hibbertia leptotheca		Priority 3	
Jacksonia gracillima		Priority 3	
Lasiopetalum membranaceum		Priority 3	
Leucopogon sp. Yanchep (M. Hislop 1986)		Priority 3	
Pimelea calcicola		Priority 3	
Pithocarpa corymbulosa		Priority 3	
Placynthium nigrum	Blackthread Lichen	Priority 3	
Sarcozona bicarinata	Ridged Noon-flower	Priority 3	
Sphaerolobium calcicola		Priority 3	
Stylidium maritimum		Priority 3	
Stylidium paludicola		Priority 3	
Styphelia filifolia		Priority 3	
Conostylis pauciflora subsp. euryrhipis		Priority 4	
Conostylis pauciflora subsp. pauciflora		Priority 4	
Hibbertia helianthemoides		Priority 4	
Jacksonia sericea	Waldjumi	Priority 4	
Lepidium pseudotasmanicum		Priority 4	
Schoenus griffinianus		Priority 4	

Scientific Name	Common Name	Conservation Status (WA)	Status under EPBC Act
Stylidium longitubum	Jumping Jacks	Priority 4	
Tripterococcus sp. Brachylobus (A.S. George 14234)		Priority 4	

Conservation Codes are shown in Appendix 4

Table 3: Likelihood of Identified Significant Flora Species Occurring on the Site

Scientific Name	Common Name	Habitat*	Likelihood to occur on the site
Caladenia huegelii	King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid	The Grand Spider-orchid prefers sand or clay loam. This species generally does not survive in disturbed areas.	Unlikely – Shallow sand over limestone not typical habitat for the species
Calectasia cyanea	Blue Tinsel Lily	The Blue Tinsel Lily prefers white, grey or yellow sand or gravel.	No – this species occurs in the south west near Albany
Drakaea elastica	Glossy-leafed Hammer Orchid	The Glossy-leafed Hammer Orchid prefers low-lying situations adjoining winter-wet swamps. This species does not survive in disturbed areas.	Highly Unlikely – not wetland habitat
Diuris purdiei	Purdie's Donkey-orchid	Purdie's Donkey Orchid occurs in grey-black sand in moist winter-wet swamps.	Highly Unlikely – not wetland habitat
Drakaea micrantha	Dwarf Hammer-orchid	Dwarf Hammer-orchid occurs in grey sands over dark, grey to blackish, sandy clay-loam substrates in winter wet depressions or swamps.	Highly Unlikely – not wetland habitat
Marianthus paralius		*Marianthus paralius* occurs in white sand and brown loam amongst heath on coastal limestone cliffs (DEC, 2009).	Highly Unlikely – not coastal limestone cliff
Melaleuca sp. Wanneroo (G.J. Keighery 16705)		*Melaleuca* sp. Wanneroo occurs in very shallow soils over limestone 'caprock' on ridges.	Possible
Andersonia gracilis	Slender Andersonia	Slender Andersonia occurs in white/grey sand, sandy clay, gravelly loam in winter-wet areas, near swamps.	Highly Unlikely – not wetland habitat
Anigozanthos viridis subsp. *terraspectans*	Dwarf Green Kangaroo Paw	The Dwarf Green Kangaroo Paw occurs on grey sand, clay loam in winter-wet depressions.	Highly Unlikely – not wetland habitat

Scientific Name	Common Name	Habitat*	Likelihood to occur on the site
Diuris micrantha	Dwarf Bee-orchid	The Dwarf Bee-orchid is usually found on cleared firebreaks or open sandy patches that have been disturbed with in Jarrah Banksia woodland or thickets of Spearwood (*Kunzea ericifolia/ glabrescens*) (Williams *et al*., 2001).	Unlikely – not typical habitat and has not previously been recorded in the area
Eleocharis keigheryi	Keighery's Eleocharis	Keighery's Eleocharis occurs in clay, sandy loam and is emergent in freshwater: creeks, claypans.	Highly Unlikely – not wetland habitat
Eucalyptus argutifolia	Yanchep Mallee, Wabling Hill Mallee	The Yanchep Mallee occurs in shallow soils over limestone on slopes or gullies of limestone ridges, outcrops.	Possible
Baeckea sp. Limestone (N. Gibson & M.N. Lyons 1425)		*Baeckea* sp. Limestone is recorded from limestone outcrop/ridge in yellow sand derived from Tamala Limestone - Spearwood Dune System in bushland burnt 5+ years (Western Australian Herbarium, 2012).	Possible
Drosera patens		*Drosera patens* occurs in sandy soils on the margins of winter-wet depressions, swamps and lakes.	Highly Unlikely – not wetland habitat
Drosera x sidjamesii		*Drosera x sidjamesii* grows in peaty sand along lake margins, close to winter high-water line.	Highly Unlikely – not wetland habitat
Grevillea sp. Ocean Reef (D. Pike Joon 4)		*Grevillea* sp. Ocean Reef (D. Pike Joon 4) occurs in dry brown/grey sand, yellow brown sand on sandy dune, gully in coastal scrub.	Unlikely – is recorded from more coastal areas
Haloragis sp. Parrot Ridge (G.J. Keighery 11563)		*Haloragis* sp. Parrot Ridge (G.J. Keighery 11563) is recorded from a hill on margin of ridge in black sand over limestone (Western Australian Herbarium, 1989).	Possible but would be an extension of the range of this species
Hydrocotyle striata		*Hydrocotyle striata* occurs in clay near springs.	No – no suitable habitat
Leucopogon maritimus		*Leucopogon maritimus* occurs in Quindalup deep, calcareous sands, on the mid to upper slopes of dunes or in shallow sand over limestone, but avoiding the thicker vegetation of the swale (Hislop, 2011)	Possible
Acacia benthamii		*Acacia benthamii* grows on sand, typically on limestone breakaways	Known to occur on site (Coffey 2010)

Scientific Name	Common Name	Habitat*	Likelihood to occur on the site
Amanita wadulawitu	Long-spored Lepidella	Long-spored Lepidella occurs in sandy soil with *Corymbia calophylla, Eucalyptus marginata, E. todtiana, E. camaldulensis, Jacksonia furcellata, Banksia attenuata and B. menziesii.* (McGurk et al., 2016).	Unlikely – not habitat typical to the species
Calectasia elegans	Elegant Tinsel Lily	Elegant Tinsel Lily occurs in deep grey quartz soils on gentle slopes, above damplands.	Highly Unlikely – not suitable habitat
Fabronia hampeana		*Fabronia hampeana* occurs on sheltered wet trunk of *Macrozamia dyeri* in shrub layer (Western Australian Herbarium, 2005a).	No – the host plant for this species occurs in Esperance
Lecania sylvestris		*Lecania sylvestris* typically occurs on limestone (Cranfield *et al*., 2020).	Possible
Lecania turicensis var. turicensis		*Lecania turicens*is var. *turicensis* occurs on coastal rocks, limestone (Western Australian Herbarium, 1988).	Possible
Poranthera moorokatta		*Poranthera moorokatta* grows in white silica sand and has been recorded in Banksia woodland and in a shallow dampland (Barrett, 2012).	Highly Unlikely – not wetland habitat
Rinodina bischoffii		*Rinodina bischoffii* (lichen) occurs on limestone (Cranfield et al., 2020).	Possible
Stenanthemum sublineare		*Stenanthemum sublineare* grows in littered white sand on coastal plain (Rye, 2001).	Highly Unlikely – not suitable habitat
Tetraria sp. Chandala (G.J. Keighery 17055)		*Tetraria* sp. Chandala is recorded from a mound spring in peaty sand (Western Australian Herbarium, 2005b).	Highly Unlikely – not peaty habitat
Thelymitra variegata	Queen of Sheba	The Queen of Sheba orchid grows on sandy clay, sand and laterite.	Highly Unlikely – not suitable habitat
Adenanthos cygnorum subsp. chamaephyton		*Adenanthos cygnorum* subsp. *chamaephyton* occurs in grey sand, lateritic gravel.	Highly Unlikely – not lateritic habitat
Amanita carneiphylla	Miller's Pink-Gilled Lepidella	Miller's Pink-Gilled Lepidella is a deeply rooting species and grows in sandy soil.	Highly Unlikely – not typical to limestone habitat
Austrostipa mundula		*Austrostipa mundula* occurs on plains in grey sand (Western Australian Herbarium, 2001).	Highly Unlikely – not typical habitat
Beyeria cinerea subsp. *cinerea*		*Beyeria cinerea* subsp. *cinerea* grows in sand over limestone on road verges, gullies	Possible

Scientific Name	Common Name	Habitat*	Likelihood to occur on the site
Conostylis bracteata		*Conostylis bracteata* occurs in sand, limestone on consolidated sand dunes.	Unlikely, not consolidated sand dune landform
Cyathochaeta teretifolia		*Cyathochaeta teretifolia* occurs in grey sand, sandy clay on swamps, creek edges.	Highly Unlikely – not wetland habitat
Hibbertia leptotheca		*Hibbertia leptotheca* grows near-coastal limestone ridges, outcrops and cliffs in coastal heaths and thickets usually dominated by species of *Melaleuca* and *Acacia* (Thiele, 2019).	Possible
Jacksonia gracillima		*Jacksonia gracillima* occurs in grey and brown well-drained sand.	Highly Unlikely – not typical habitat
Lasiopetalum membranaceum		*Lasiopetalum membranaceum* grows in sand over limestone.	Possible
Leucopogon sp. Yanchep (M. Hislop 1986)		*Leucopogon* sp. Yanchep occurs in light grey-yellow sand, brown loam, limestone, laterite, granite on coastal plain, breakaways, valley slopes, low hills.	Possible
Pimelea calcicola		*Pimelea calcicola* occurs in sand on coastal limestone ridges.	Possible
Pithocarpa corymbulosa		*Pithocarpa corymbulosa* occurs in gravelly or sandy loam amongst granite outcrops.	Highly Unlikely – not granite habitat
Placynthium nigrum	Blackthread Lichen	Blackthread Lichen is recorded from karst limestone on lagoon shore among salt marsh (Allan Herbarium, 1997).	Highly Unlikely – not saltmarsh habitat
Sarcozona bicarinata	Ridged Noon-flower	Ridged Noon-flower is found in white sand.	Possible
Sphaerolobium calcicola		*Sphaerolobium calcicola* grows in white-grey-brown sand, sandy clay over limestone, black peaty sandy clay on tall dunes, winter-wet flats, interdunal swamps, low-lying areas.	Highly Unlikely – not wetland habitat
Stylidium maritimum		*Stylidium maritimum* occurs in sand over limestone on dune slopes and flats in coastal heath and shrubland, open Banksia woodland.	Possible
Stylidium paludicola		*Stylidium paludicola* prefers peaty sand over clay in winter wet habitats in Marri and Melaleuca woodland, Melaleuca shrubland.	Highly Unlikely – not wetland habitat

Scientific Name	Common Name	Habitat*	Likelihood to occur on the site
Styphelia filifolia		*Styphelia filifolia* occurs in sandy soils of the coastal plain (with one known occurrence from the northern Darling Scarp), usually in Banksia or Jarrah woodland and in low-lying situations (Hislop and Lelièvre, 2017).	Highly Unlikely – not low-lying habitat
Conostylis pauciflora subsp. euryrhipis		*Conostylis pauciflora* subsp. *euryrhipis* occurs in white, grey or yellow sand on consolidated dunes in coastal areas.	Highly Unlikely – not dune habitat
Conostylis pauciflora subsp. pauciflora		*Conostylis pauciflora* subsp. *pauciflora* occurs in grey sand, limestone on hillslopes, consolidated dunes in coastal areas.	Unlikely, not coastal consolidated dune landform
Hibbertia helianthemoides		*Hibbertia helianthemoides* grows in clayey sand over sandstone or loam over quartzite on hills and scree slopes.	Highly Unlikely – not suitable habitat
Jacksonia sericea	Waldjumi	Waldjumi grows in calcareous and sandy soils.	Known to occur on site (Coffey 2010)
Lepidium pseudotasmanicum		*Lepidium pseudotasmanicum* occurs in loam, sand associated with granite.	Highly Unlikely – not granite habitat
Schoenus griffinianus		*Schoenus griffinianus* grows in white sand in low heath (Wilson, 1997).	Highly Unlikely – not typical habitat
Stylidium longitubum	Jumping Jacks	Jumping Jacks prefer sandy clay, clay in seasonal wetlands.	Highly Unlikely – not wetland habitat
Tripterococcus sp. Brachylobus (A.S. George 14234)		*Tripterococcus* sp. Brachylobus occurs in grey, black or peaty sand winter-wet flats	Highly Unlikely – not wetland habitat

* sourced from Florabase (DBCA, 2017) and SPRAT Database (DoEE, 2016) as well as the DBCA database searches unless otherwise denoted

4.2 TEC and PEC Desktop Search

A search of DBCA's Threatened (TEC) and Priority Ecological Communities (PEC) database was conducted within a radius of 5km around the site (47-0820EC) (Appendix 5). Three TECs and four Priority 3 PECs at State level were identified in the database search. Two of these are also listed as a TEC under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Three of the State listed PECs are listed under the EPBC Act as TECs. The communities identified in the database searches are outlined in Table 4.

Table 4: Threatened and Priority Ecological Communities likely to occur within 5km of the Site

Ecological Community	Description	Conservation Status WA	Status under the EPBC Act
CAVES SCP01	Aquatic Root Mat Community Number 1 of Caves of the Swan Coastal Plain	Critically Endangered	Endangered
SCP10a	Shrublands on dry clay flats (floristic community type 10a as originally described in Gibson *et al.* (1994))	Endangered	Critically Endangered
SCP26a	*Melaleuca huegelii - Melaleuca systena* shrublands on limestone ridges (floristic community type 26a as originally described in Gibson *et al.* (1994))	Endangered	
SCP23b	Swan Coastal *Plain Banksia attenuata - Banksia menziesii* woodlands	Priority 3	Endangered as part of the Banksia WL SCP
SCP24	Northern Spearwood shrublands and woodlands	Priority 3	
Banksia WL SCP	Banksia Dominated Woodlands of the Swan Coastal Plain IBRA Region	Priority 3	Endangered
Tuart woodlands	Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain	Priority 3	Critically Endangered

4.3 Flora

A total of 188 plant species were recorded in the Coffey Environments (2010) and PGV Environmental surveys (Appendix 6). The total consisted of 140 native and 48 introduced species. The percentage of introduced species (26%) is considered moderate. The number of native species is moderate to high relative to the area of native vegetation (24.5ha) and the diversity of vegetation types on sand over limestone soils.

The number of species recorded in the northern and southern parts of the survey area were very similar with 135 in the northern area and 131 in the southern area.

The plant Families with the highest representation of species were the Fabaceae (Pea and Wattle family – 23 species, including 19 native and 4 introduced), Proteaceae (Banksia family - 17 species, all native), Poaceae (Grass family – 18 species including 4 native and 14 introduced), Asteraceae (Daisy family – 14 species, including 8 native and 6 introduced), Myrtaceae (Eucalyptus, Melaleuca and others – 9 species, including 7 native and 2 introduced) and Asparagaceae (Lily family – 9 species, 8 native and one introduced.

There were no Threatened (Declared Rare) species recorded on the site.

Three Priority species were recorded on the site as follows:

- *Baeckea* sp Limestone P1 – 4 plants in the southern part of the site
- *Acacia benthamii* P2 – Occurs abundantly in the northern part of the site
- *Jacksonia sericea* P4 – Occurs commonly in the northern part and southern parts of the site.

Locations of the Priority species are provided in Figure 3 of this report and Figure 3 of Appendix 8.

Quadrat Data for the southern part of the site are provided in Appendix 7. Quadrat data for the northern part of the site are contained in the Coffey Environments (2010) report in Appendix 8.

Species richness in the five quadrats from the southern part of the site ranged from 30-49 species. There were between 13 and 17 introduced species in the quadrats representing 31 to 49% of the total number of species recorded in the quadrats.

Coffey Environments (2010) recorded 47-60 species in their five quadrats in the northern part of the site with 15-22 introduced species (32-45%).

The number of species in quadrats is moderate to high for the types of vegetation surveyed.

4.4 Vegetation

4.4.1 Vegetation Complex

Vegetation Complexes are a broad level of vegetation description which is based on the underlying geomorphology and rainfall (Heddle *et al*., 1980). The areas of remnant native vegetation on the site is part of the Cottesloe Complex– Central and South vegetation complex which is described as:

> Mosaic of woodland of *Eucalyptus gomphocephala* (Tuart) and open forest of *E. gomphocephala* – *E. marginata* (Jarrah) – *Corymbia calophylla* (Marri), closed heath on the limestone outcrops' (Heddle *et al.,* 1980).

The general description of the vegetation complex matches the vegetation types recorded on the site.

4.4.2 Vegetation Type

For small scale sites, such as the survey area, vegetation mapping can be further refined by using vegetation types which are described by the composition and structure of the dominant species rather than based on geomorphology.

Seven different native vegetation types were described and mapped on the site. The vegetation types on the northern part of the site were different to those present on the southern part. This is considered a result of the slightly different soil types in each area rather than a result of the different surveys.

The vegetation types are described in Table 5 and mapped on Figure 3.

Table 5: Vegetation Types on the Site

Vegetation Type	Description	Photograph
M70/341, M70/345		
BaAfBm *Banksia attenuata/ Allocasuarina fraseriana/B. menziesii* Low Open Forest over *Xanthorrhoea preissii* Tall Open Shrubland over *Hibbertia hypericoides/ Allocasuarina humilis* Open Low Heath	Occurs at the western end of the survey area. The Banksia and *Allocasuarina fraseriana* trees are 3-8m high and a density of around 40%. Common understorey species include *Xanthorrhoea preissii, Hibbertia hypericoides, Allocasuarina humilis, Mesomelaena pseudostygia, Desmocladus flexuosus* and *Acacia benthamii*. Soil type is yellow-brown sand. Coffey Environments (2010) quadrat Q1 representative of this vegetation type	
BaAf *Banksia attenuata/ Allocasuarina fraseriana* Low Woodland over *Xanthorrhoea preissii/ Hakea prostrata* Tall Shrubland over *Hibbertia hypericoides* Low Open Shrubland over *Tetraria octandra/Mesomelaena pseudostygia* Very Open Sedgeland	Occurs towards the western end of the survey area. Similar to the BaAfBm vegetation type but without *B. menziesii* in the tree canopy and with a slightly different understorey composition. Common species include *Xanthorrhoea preissii, Hakea prostrata, Hibbertia hypericoides, Tetraria octandra, Mesomelaena pseudostygia, Desmocladus flexuosus,* Soil type is yellow-brown sand. Coffey Environments (2010) quadrat Q3 representative of this vegetation type	

Vegetation Type	Description	Photograph
BsXp *Banksia sessilis/ Xanthorrhoea preissii* Tall Open Scrub over *Melaleuca systena/Hakea lissocarpha* Open Shrubland over *Jacksonia sericea/ Hibbertia hypericoides* Low Open Shrubland	Occurs towards the western end of the survey area and along the southern boundary in the area previously cleared but not mined. *Banksia sessilis and Xanthorrhoea preissii* are 3-3.5m high and around 30-40% cover. Typical understorey species include *Melaleuca systena, Hakea lissocarpha, Jacksonia sericea, Hibbertia hypericoides, Acanthocarpus preissii* and *Desmocladus flexuosus.* Soil type is yellow-brown sand with some surface limestone. Coffey Environments (2010) quadrats Q2 and Q6 are representative of this vegetation type	
EmBa *Eucalyptus marginata* Woodland over *Banksia attenuata* Open to Low Woodland over *Xanthorrhoea preissii* Open Shrubland over *Hibbertia hypericoides* Low Shrubland to Closed Low Heath over *Mesomelaena pseudostygia* Very Open Sedgeland	Occurs in the eastern half of the survey area. Jarrah (*Eucalyptus marginata*) is the main tree species up to 10m high with occasional Tuart (*E. gomphocephala*) over a sparse canopy of *Banksia attenuata* to 7m and generally less than 10% cover. Common understorey species include *Xanthorrhoea preissii, Hibbertia hypericoides, Mesomelaena pseudostygia, Desmocladus flexuosus* and *Hakea lissocarpha.* Soil type is yellow-brown sand. Coffey Environments (2010) quadrats Q4 and Q5 representative of this vegetation type.	

Vegetation Type	Description	Photograph
M70/346 and M70/339		
Em *Eucalyptus marginata* Low Open Woodland over *Xanthorrhoea preissii/ Macrozamia riedlei/ Hibbertia hypericoides* Open Heath over *Mesomelaena pseudostygia* Very Open Sedgeland	Occurs in the western half of the survey area. Jarrah is the only tall tree species present, with Tuart absent. *Banksia attenuata* and *B. menziesii* trees are very scattered at less than 1% cover. Common understorey species include *Xanthorrhoea preissii, Macrozamia riedlei, Hibbertia hypericoides, Mesomelaena pseudostygia, Acacia pulchella, Gompholobium tomentosum* and *Petrophile macrostachya.* The soil type is orange-brown sand. Quadrats CLS1 and CLS2 are representative of this vegetation type	
Eg *Eucalyptus gomphocephala* Low Open Woodland over *Banksia sessilis* Open Shrubland over *Xanthorrhoea preissii/ Hibbertia hypericoides/ Jacksonia sericea/* Closed Low Heath over *Mesomelaena pseudostygia* Very Open Sedgeland	Occurs in the northern half of the survey area. Tuart is the only tree species present, up to 8m high and 5-10% cover. Jarrah and Banksia trees are absent. The understorey contains a mid-stratum of sparse *Banksia sessilis* to 2m with *Acacia xanthina* common in some areas. Typical understorey species include *Xanthorrhoea preissii, Hibbertia hypericoides, Jacksonia sericea, Mesomelaena pseudostygia, Phyllanthus calycinus* and *Conostylis candicans.* The soil type is orange-brown sand with minimal surface limestone. Quadrats CLS4 and 5 are representative of this vegetation type	

Vegetation Type	Description	Photograph
EgEm *Eucalyptus gomphocephala/ E. marginata* Low Woodland over *Jacksonia sternbergiana/ Macrozamia riedlei* Shrubland over *Hibbertia hypericoides* Open Low Heath over *Mesomelaena pseudostygia* Very Open Sedgeland	Occurs in the southern central part of the survey area and is transitional between the Em and Eg vegetation types. Jarrah and Tuart are in equal proportion at around 10% cover each. Banksia trees are absent. Common understorey species include *Xanthorrhoea preissii, Macrozamia riedlei, Hibbertia hypericoides, Mesomelaena pseudostygia, Jacksonia sericea* and *Cassytha racemosa.* The soil type is orange-brown sand. Quadrat CLS3 is representative of this vegetation type	

4.4.3 Floristic Community Types

Floristic Community Types (FCT) are based on the whole floristic composition of the vegetation rather than being determined by soil type and geomorphology (Vegetation Complex) or the nature of the dominant species (Vegetation Types).

Coffey Environments (2010) determined the FCT in the northern survey area by analysing the quadrat data using computer PATN analysis. PGV Environmental determined the FCT of the southern survey area using the spreadsheet method which compares the species in the quadrats to the species found in each FCT (Table 12 in Gibson *et al.* 1994). Computer analysis of the southern quadrats was not a requirement of the scope of works.

Coffey Environments (2010) determined that the vegetation in the northern survey area represented two FCTs as follows:

- FCT 24 'Northern Spearwood shrubland and woodlands'
- FCT 28 'Spearwood *Banksia attenuata* or *Banksia attenuata-Eucalyptus* woodlands'

FCT24 included the BsXp vegetation type while FCT28 included the BaAfBm, BaAf and EmBa vegetation types.

PGV Environmental determined that all three vegetation types in the southern survey area (Em, Eg and EgEm) most similar to FCT28 'Spearwood *Banksia attenuata* or *B. attenuata – Eucalyptus* woodland'. The result is consistent with the findings of Coffey Environments (2010) who found that the woodlands in the northern survey area were also FCT28.

4.4.4 Vegetation Condition

The condition of the vegetation was assessed according to the system of Keighery as described in Bush Forever (Government of Western Australia, 2000) (Table 6).

Table 6: Vegetation Condition Rating Scale

Condition	Description
Pristine	Pristine or nearly so, no obvious signs of disturbance.
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
Very Good	Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbance. Retains basic vegetation structure or ability to regenerate to 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.
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.

Condition	Description
Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.

The condition of the vegetation is shown in Figure 4. Most of the native vegetation was assessed as being in Very Good condition with variations of Very Good-Excellent and Very Good-Good in some areas. The vegetation was not rated higher, as Excellent, due to the high percentage of introduced species in all quadrats and over the site in general.

The northern area previously cleared but not mined is rated as Good to Degraded with a higher percentage of weed cover in that area.

4.5 Conservation Significance of Flora and Vegetation

4.5.1 Flora

No Threatened flora species were recorded on the site. The two Threatened species that were identified as possibly being present on the site during the database search, *Eucalyptus argutifolia* and *Melaleuca* sp. Limestone are found on areas with more outcropping limestone than occurs on the site. Therefore, these two species are not considered likely to occur in the survey areas.

Three Priority species were recorded on the site as follows:

- *Baeckea* sp Limestone P1 – 4 plants in the southern part of the site
- *Acacia benthamii* P2 – Occurs abundantly in the northern part of the site
- *Jacksonia sericea* P4 – Occurs commonly in the northern part and southern parts of the site.

Four plants of the Priority 1 species *Baeckea* sp. Limestone were recorded in the southern survey area (Figure 6). *Baeckea* sp. Limestone is a medium sized shrub and was readily identifiable during the survey as it was in full flower (Plate 3). It is unlikely that additional plants occur in the survey area. *Baeckea* sp. Limestone is known to occur in the Cities of Wanneroo, Joondalup, Stirling and the Shire of Gingin.

Acacia benthamii was recorded as occurring abundantly in the northern survey area by Coffey Environments (2010). Over 200 plants were observed mostly in the *Banksia sessilis/Xanthorrhoea preissii* vegetation type and the western Banksia/Sheoak woodland (Figure 6). The presence of *Acacia benthamii* was confirmed in the PGV Environmental survey (Plate 4). No *A. benthamii* plants were recorded in the southern area due to the absence of the BsXp vegetation type and Banksia/Sheoak woodland. *Acacia benthamii* is known to occur from Gosnells to Dandaragan, typically on limestone breakaways.

Coffey Environments (2010) recorded over 700 *Jacksonia sericea* plants occurring in all vegetation types in the northern survey area. PGV Environmental also recorded *J. sericea* as common in the Tuart woodland vegetation in the southern survey area (Figure 6). Previous advice from the Department of Biodiversity, Conservation and Attractions on a nearby clearing permit application has indicated that the form of *J. sericea* in Carabooda is an intergrade between the more typical form of *Jacksonia sericea*

(P4) and *Jacksonia calcicola,* a commonly occurring species on limestone soil. The Carabooda form of *J. sericea* also occurs abundantly in the portion of Bush Forever Site 290 to the north of Old Yanchep Road (PGV Environmental, 2019).

Plate 3: *Baeckea* sp. Limestone on M70/346

Plate 4: *Acacia benthamii* on M70/345

Plate 5: *Jacksonia sericea* on M70/345

4.5.2 Vegetation

4.5.2.1 Vegetation Complex

The vegetation on the site is part of the Cottesloe Complex - Central and South (Heddle *et al.*, 1980). Approximately 32% of the pre-European vegetation extent of this complex remains, of which 14% is currently managed by DBCA (DBCA, 2018).

The percentage retention is above EPA's target for minimum 30% retention of vegetation complexes State-wide in the Perth and Peel Region Constrained Areas and the area in protection is above the 10% minimum criteria for vegetation complexes.

4.5.2.2 Threatened and Priority Ecological Communities

The FCT on the site was determined to be most similar to FCT 24 'Northern Spearwood shrubland and woodlands' and FCT28 'Spearwood *Banksia attenuata* or *B. attenuata – Eucalyptus* woodland'. FCT 28 is not a TEC or PEC at State level.

FCT24 is a Priority 3 Ecological Community at State level. The FCT24 PEC has previously been deemed of 'low to moderate conservation significance' through an appeal on a previous clearing permit application (CPS 2858/1) in 2011.

FCT28 is not listed as a Priority Ecological Community, however may be part of the broader ecological community 'Banksia Woodlands of the Swan Coastal Plain' which is listed as a PEC at State level and a TEC at Commonwealth level under the EPBC Act. Further analysis of the Banksia Woodland TEC is provided below.

The vegetation types containing Tuart trees have has potential to be part of the Tuart Woodlands and Forests of the Swan Coastal Plain TEC. An assessment of the TEC is provided below.

The vegetation types containing *Banksia attenuata* trees have has potential to be part of the Banksia Woodlands of the Swan Coastal Plain TEC. An assessment of the TEC is provided below.

4.5.2.3 Tuart Woodlands and Forests of the Swan Coastal Plain

Description

The Tuart Woodlands and Forests of the Swan Coastal Plain was listed as a Threatened Ecological Community (TEC) with a rating of Critically Endangered under the Commonwealth EPBC Act on 4 July 2019 (for brevity the community will be called the Tuart Woodland TEC in this report). A description of the Tuart Woodland TEC is available through the EPBC Act listing and more specifically the *Approved Conservation Advice (incorporating listing advice) for the Tuart (Eucalyptus gomphocephala) woodlands and forests of the Swan Coastal Plain ecological* released by the Commonwealth Government (Commonwealth of Australia, 2019). According to the Conservation Advice the diagnostic characteristics of the TEC are:

Key diagnosis characteristics

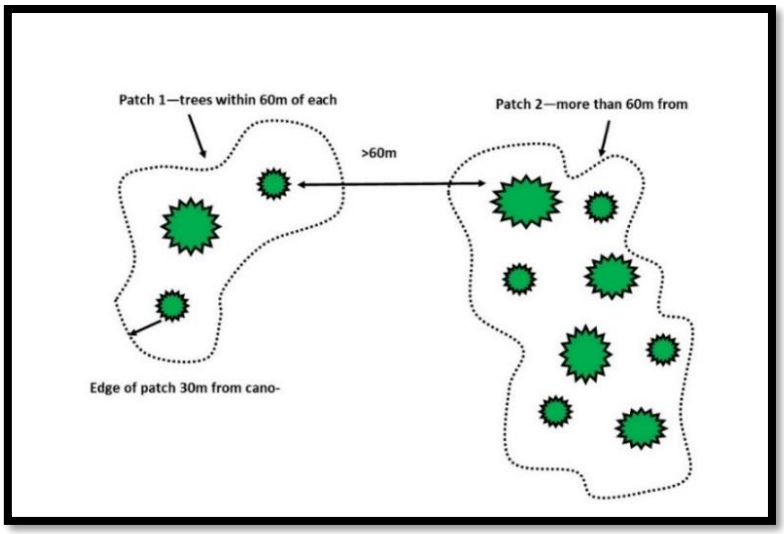
- The ecological community is limited to patches of vegetation (with their associated biota) that meet all of the following key diagnostic characteristics:
- Occurs in the Swan Coastal Plain Bioregion, Western Australia (IBRA v7. Department of the Environment 2012).
- Primarily occurs on the Spearwood and Quindalup dune systems but can also occur on the Bassendean dunes and Pinjarra Plain. It can occur on the banks of rivers and wetlands.
- The primary defining feature is the presence of at least two living established *Eucalyptus gomphocephala* (Tuart) trees in the uppermost canopy layer, although they may co-occur with trees of other species. There is a gap of no more than 60 m between the outer edges of the canopies of adjacent Tuart trees. These trees may occur either as single stemmed trees or as a mallee growth form.
- Most often occurs as a woodland but can occur in other structural forms, For example, forest, open forest, woodland, open woodland, and various mallee forms.
- Other tree species may be present in the canopy or sub-canopy. They commonly include: *Agonis flexuosa* (Peppermint) and *Banksia grandis* (Bull Banksia) (both in the southern part of the range), *Banksia attenuata* (Candlestick Banksia), *Eucalyptus marginata* (Jarrah); and less commonly, *Corymbia calophylla* (Marri), *Banksia menziesii* (Firewood Banksia) and *Banksia prionotes* (Acorn Banksia).
- An understorey of native plants is typically present, which may include grasses, herbs and shrubs, although this is often modified by disturbance. Some understorey plant species that are most commonly present are listed in Section 2.3.3 of the Conservation Advice.
- Native fauna species that are most commonly present are noted in Section 2.4 of the Conservation Advice (Commonwealth of Australia, 2019).

Defining a patch of the ecological community

- A patch of the ecological community is a discrete and mostly continuous area of vegetation that meets the key diagnostic characteristics.
- Boundaries for a patch can extend beyond a site or property boundary, or potential area of impact for a proposed action.
- The patch boundary is 30 m beyond the outer canopy of the established Tuart trees (≥15 cm diameter at breast height (DBH)), including dead Tuart trees (stags). See Plate 6

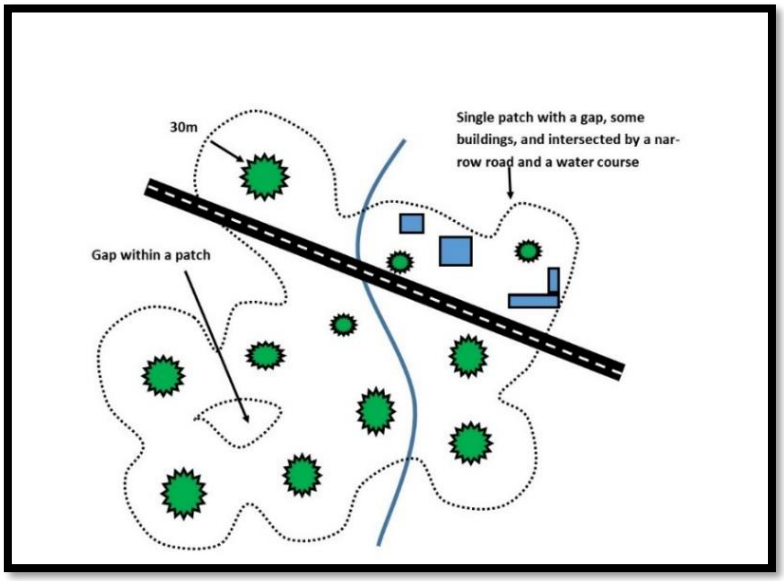
- Where a dead Tuart tree (stag) is being considered for inclusion in a patch of the ecological community, the vertical projection of its outermost remaining branches is used to define the edge of its canopy. If the species of a stag tree is unclear, if the edge of its canopy is within 60 m of an identified Tuart tree the stag is presumed to be a Tuart.
- Patches of Tuart woodlands and forests may contain areas that vary in structural or biological complexity. One part of a patch may have a larger number of mature trees and more ecological diversity, whereas another part of the same patch may demonstrate fewer mature trees and less groundcover. Areas with soil exposed and/or plant litter can also be expected within this ecological community.
- Variation in quality or condition of vegetation across a patch should not necessarily be considered to be evidence of multiple patches. Patches of the ecological community can be spatially variable and are often characterised by one or more areas within a patch that meet higher condition thresholds amongst areas of lower condition.
- If an area meets the key diagnostic characteristics but the average condition across that area falls below the minimum condition thresholds, the largest area or areas of at least 0.5 ha that meet minimum condition thresholds on average, should be specified as the patch or patches of the nationally listed ecological community. This may result in multiple patches of the ecological community being identified within the overall area first identified as meeting the key diagnostics.
- A patch may include small areas without understorey vegetation, such as bare ground, as well as waterbodies or hardscape (e.g. roads, paths, car parks, or buildings) that do not significantly alter the overall function of the ecological community. These small areas do not break up a patch, or divide a patch into multiple patches, as long as there are some parts of the canopy within 60 m of the outer edges of the canopies of adjacent Tuart trees (as per Plate 5). However, existing buildings and other human-made structures and gardens are not part of the nationally protected ecological community and should be excluded from the calculation of patch size and condition. See Plate 7 (Commonwealth of Australia, 2019).

Plate 6: Tuart TEC Patch boundaries



Source: Commonwealth of Australia, 2019

Plate 7: Variation within a patch, including small areas without understorey vegetation, and a small gap within a patch due to part of the Tuart canopy being >60 m apart



Source: Commonwealth of Australia, 2019

Condition thresholds and categories

For confirmed patches of the ecological community, following the key diagnostic characteristics and patch definition above (Step 1), determine the following requirements for information on condition to indicate if they are part of the nationally protected ecological community:

- If the patch is smaller than 0.5 ha it is **not** part of the nationally protected ecological community.
- If **the patch is at least 0.5 ha and up to 5 ha** in size, conduct on ground surveys. Patches in this size range are presumed to be part of the nationally protected ecological community unless surveys indicate they do not meet the minimum condition required for national protection. For patches in this size range inclusion in the nationally protected ecological community is determined by surveyed characteristics such as native plant species richness and contribution to cover, habitat values, evidence of regeneration and landscape characteristics.
- **All patches of 5 ha or greater** that meet the key diagnostic characteristics **are part of the nationally protected ecological community**. It is not necessary to conduct additional surveys to confirm that they meet biotic condition thresholds (Table 7) and that they are protected.

Table 7: Tuart TEC Condition Categories and Thresholds

All patches ≥5 ha is part of the nationally protected ecological community, regardless of their understorey condition. That is, thresholds in this table do not apply to patches ≥5 ha, but the key diagnostic characteristics and patch definition must be met.

Patch size Biotic thresholds	≥2 ha <5 ha	≥0.5 ha <2 ha
Very high condition ≥80 % of all understorey^ vegetation cover is native# Or At least 12 native understorey^ species per 0.01 ha (10 m x 10 m plot or equivalent sample unit)	Medium sized patches with very high condition understorey. PART OF THE PROTECTED ECOLOGICAL COMMUNITY	Smaller patches with very high condition understorey. PART OF THE PROTECTED ECOLOGICAL COMMUNITY
High condition ≥60 % of all understorey^ vegetation cover is native# Or At least 8 native understorey^ species per 0.01 ha (10 m x 10 m plot or equivalent sample unit)	Medium sized patches with high condition understorey. PART OF THE PROTECTED ECOLOGICAL COMMUNITY	Smaller patches with high condition understorey. **AND** That either: have an important landscape role (≤100 m to native vegetation)* OR have a habitat role (≥2 very large trees per 0.5 ha)* OR show regeneration (≥15 seedlings and/or saplings per 0.5 ha)* PART OF THE PROTECTED ECOLOGICAL COMMUNITY
Moderate condition ≥50 % of all understorey^ vegetation cover is native# Or At least 4 native understorey^ species per 0.01 ha (10 m x 10 m plot or equivalent sample unit)	Medium sized patches with moderate condition understorey. **AND** That either: have an important landscape role (≤100 m to native vegetation)* OR have a habitat role (≥2 very large trees per 0.5 ha)* OR show regeneration (≥15 seedlings and/or saplings per 0.5 ha)* PART OF THE PROTECTED ECOLOGICAL COMMUNITY	NOT PART OF THE PROTECTED ECOLOGICAL COMMUNITY (but may be a focus for local protection or restoration)

Patch size Biotic thresholds	≥2 ha <5 ha	≥0.5 ha <2 ha
Poor Has minimal or no native cover and species richness. That is: <50 % of all understorey^ vegetation cover is native# And Less than 4 native understorey^ species per 0.01 ha (10 m x 10 m plot or equivalent sample unit)	NOT PART OF THE PROTECTED ECOLOGICAL COMMUNITY (but may be a focus for local protection or restoration)	NOT PART OF THE PROTECTED ECOLOGICAL COMMUNITY (but may be a focus for local protection or restoration)

Tuart Woodland TEC Assessment

The survey area contains Tuart trees in the following vegetation types:

EmBa – occurs in the eastern part of the northern survey area. Tuarts described as 'occasional;' in the Coffey Environments (2010) survey.

Eg – A common vegetation type in the southern survey area with Tuart as the dominant tree species

EgEm – occurs in the southern survey area as a mix of Tuart and Jarrah trees.

The presence of Tuart trees does not automatically mean that the Tuart Woodland TEC occurs on site.

The Conservation Advice contains the following step-wise approach to use in determining if the TEC occurs on a site:

- Step 1: Is the Tuart Woodlands and Forests ecological community in your proposed project site? Is it in other adjacent or off-site areas that may be impacted (for example, by introducing weeds)?
- Step 2: What is the patch size and condition category of the Tuart Woodlands and Forests in the proposed project site and in the surrounding area?

A survey of the vegetation containing Tuart trees was undertaken at the same time as the flora and vegetation survey on 8 October 2010. The survey included recording the location of Tuart trees and measuring plant species in 10m x 10m quadrats in areas containing Tuarts.

The assessment of the Tuart Woodland TEC on the site is outlined in Table 8 and Table 9.

Three patches of Tuart were mapped on the site, two in the northern survey area and one in the southern area. The two northern patches were separated due to the closest Tuart canopies being more than 60m apart in the two patches.

Step 1: Is the Tuart Woodlands and Forests ecological community in your proposed project site? Is it in other adjacent or off-site areas that may be impacted (for example, by introducing weeds)?

Table 8: Tuart Woodland TEC Step 1 Diagnostics

Key diagnostic characteristics♦	**Information**	**Key diagnostic questions*** (Refer to Section 3.2 of the Approved Conservation Advice for a complete explanation of these diagnostic features – other sections of the Approved Conservation Advice are referenced where relevant)	**Response (yes/no/possibly) and detailed comments. Use as much space as you need to fully answer the question#**
Location and physical environment	Bioregion	Is the proposal site within the Swan Coastal Plain IBRA bioregion?	Yes
Soils and Landform	Soil type	Is the soil type consistent with where the Tuart Woodlands and Forests may occur? (see Section 2.2.1♦)	Yes, Spearwood Dune soil type
	Location in the landscape, topography	Is the topography/physical environment consistent with where the Tuart Woodlands and Forests may occur? Is the site associated with any hydrology (groundwater/surface water)?	Yes, Tuarts commonly found in the Carabooda area. Not associated with any hydrology
Structure	Presence of Tuart trees	How many Tuart trees are present and are they consistent with the characteristics set out in the Approved Conservation Advice? **Note:** Please present this information in terms of total number of trees (dead, established, seedlings etc.) and trees per hectare of the footprint. Diagrams/maps should also be provided.	Sixteen Tuart trees in the northern survey area (plus additional trees outside adjoining the northern area. At least 50 established Tuarts in the southern survey area
	Structural form	What structural form is the vegetation?	Low Open Woodland
Composition	Dominant tree species, emergent tree layer, understory	Is the composition of the community consistent with the characteristics set out in the Approved Conservation Advice? What other tree species are present? How many native understorey species are present and what is the number of weedy species/proportion of weeds?	Tuarts occur in pure stands as well as with Jarrah. Native understorey species range from 16-29 in quadrats. Refer to quadrat data.

Key diagnostic characteristics♦	Information	Key diagnostic questions* (Refer to Section 3.2 of the Approved Conservation Advice for a complete explanation of these diagnostic features – other sections of the Approved Conservation Advice are referenced where relevant)	Response (yes/no/possibly) and detailed comments. Use as much space as you need to fully answer the question#
Defining a patch of Tuart Woodlands and Forests	Patch definition	What is the extent of the patch? **Note:** Descriptions of patch extent must include analysis of canopy extent and associated understorey vegetation (see Section 3.2.2♦). Patches may extend beyond the project area or include areas of infrastructure (i.e. road, powerline). The referral should make clear how, and how much of the patch will be directly or indirectly impacted.	Two patches recorded within the boundary of the site in the northern survey area and one in the southern survey area as follows: Patch 1 – 0.583ha Patch 2 – 1.215ha – extends off site, likely to be >5ha. Patch 3 – 8.305ha
Relationship with other ecological communities	Other vegetation communities	Are other vegetation communities present? What are they and how do they intergrade and/or interact with the Tuart Woodlands and Forests TEC? (see Section 3.2.3♦)	Other vegetation types without Tuart occur next to vegetation types containing Tuart trees.

The complete key diagnostic characteristics are provided in the Approved Conservation Advice.

* The Tuart Woodlands and Forests may include restored, planted or revegetated flora. Do not exclude vegetation from being classed as the Tuart Woodlands and Forests because it is a planted, restoration or revegetation site (unless it is a garden).

Comments should include references to appropriate supporting information and data.

Step 2: What is the patch size and condition category of the Tuart Woodlands and Forests in the proposed project site and in the surrounding area?

Table 9: Tuart Woodland TEC Step 2 Diagnostics

Size and condition♦	Information	Relevant content to be discussed in the referral (Refer to Section 3.3 of the Approved Conservation Advice for a complete explanation of these diagnostic features)	Detailed comments. Use as much space as you need to fully answer the question#
Patch Size	Patch size in hectares	Is the patch size large enough to meet the minimum patch size in this section? (Section 3.3♦) **Note:** Patch boundaries are not limited to the proposal site. You must make clear that the patch boundary is consistent with Section 3.2.2♦.	All three patches are larger than the 0.5ha minimum

Size and condition♦	**Information**	**Relevant content to be discussed in the referral** (Refer to Section 3.3 of the Approved Conservation Advice for a complete explanation of these diagnostic features)	**Detailed comments. Use as much space as you need to fully answer the question#**
Patch condition	Condition thresholds	Using the condition categories in this section, what is the patch condition? (Section 3.3.1♦) What is the quality and size (hectares) of the vegetation community in and around the site where the proposed action will occur? Is the patch expected to improve in condition (e.g. after appropriate fire management) or is there a threatening process underway that will reduce the current size and/or condition? **Note:** Refer to Section 3.4 – Step 3 – Further information to assist in identifying patches of the protected ecological community and avoiding significant adverse impacts If patch quality varies over the site; characterisation of the variation should be provided. Patch condition includes consideration of thresholds for characteristics such as plant species richness, landscape features, Tuart tree age and size and other habitat roles of the vegetation. Other vegetation condition measures (e.g. Keighery scale) do not necessary reflect the condition thresholds and both should be provided, where relevant. Where threats are identified (i.e. those listed in Appendix C of the Approved Conservation Advice) please provide further information on what these are and how they have impacted the condition.	All three patches have at least 12 native understorey species per 0.1ha. Therefore, the condition category of all patches is rated as Very High. A patch in Very High condition requires a minimum 0.5ha size to be the TEC. Therefore, all three patches meet the minimum condition threshold for the TEC.

♦ Further information on the key diagnostic characteristics is provided in the Approved Conservation Advice.

Comments should include references to appropriate supporting information and data. The response which includes the information does not need to be presented in table form.

(Commonwealth of Australia, 2019)

Conclusion

The conclusion of the assessment is that all three patches containing Tuart trees are part of the Tuart Woodlands and Forests TEC, as they meet the minimum size criteria for vegetation in Very High condition as rated by the Tuart Woodland TEC methodology. The total area of Tuart Woodland TEC on the site is estimated to be around 9ha (Figure 5). The patch of Tuart Woodland TEC extends out of the northern survey area to the east, north-east and south-east.

4.5.2.4 Banksia Woodland TEC Assessment

The Banksia Woodlands of the Swan Coastal Plain Threatened Ecological Community (Banksia Woodland TEC) is listed as an Endangered TEC under the Commonwealth EPBC Act. The Banksia Woodland community is a conglomerate of a number of Banksia-dominated FCTs recognised at State level. FCTs 24 and 28, which occur on the site, are two of the FCTs that form part of the Banksia Woodland TEC. However, the identification of one of the relevant FCTs on a site is not of itself sufficient to assign the vegetation to the Banksia Woodland TEC. The vegetation needs to meet specific criteria to be considered the TEC.

The *Approved Conservation Advice (incorporating listing advice) for the Banksia Woodlands of the Swan Coastal Plain ecological community* (Commonwealth of Australia, 2016) (Conservation Advice) describes the Banksia Woodland TEC as:

> *The ecological community is a woodland associated with the Swan Coastal Plain of southwest Western Australia. A key diagnostic feature is a prominent tree layer of Banksia, with scattered eucalypts and other tree species often present among or emerging above the Banksia canopy. The understorey is a species rich mix of sclerophyllous shrubs, graminoids and forbs. The ecological community is characterised by a high endemism and considerable localised variation in species composition across its range* (Commonwealth of Australia, 2016).

Table 10 assesses the vegetation type on the site against the Banksia Woodland TEC criteria contained in the Conservation Advice.

Table 10: Assessment of the Banksia Woodland of the Swan Coastal Plain TEC.

Feature	Characteristic	Vegetation Type		
		BaAfBm	**BaAf**	**EmBa**
		Banksia attenuata/Allocasuarina fraseriana/B. menziesii Low Open Forest over *Xanthorrhoea preissii* Tall Open Shrubland over *Hibbertia hypericoides/Allocasuarina humilis* Open Low Heath	*Banksia attenuata/Allocasuarina fraseriana* Low Woodland over *Xanthorrhoea preissii/Hakea prostrata* Tall Shrubland over *Hibbertia hypericoides* Low Open Shrubland over *Tetraria octandra/Mesomelaena pseudostygia* Very Open Sedgeland	*Eucalyptus marginata* Woodland over *Banksia attenuata* Open to Low Woodland over *Xanthorrhoea preissii* Open Shrubland over *Hibbertia hypericoides* Low Shrubland to Closed Low Heath over *Mesomelaena pseudostygia* Very Open Sedgeland
Banksia Species	The patch must include at least one of the following diagnostic species: • *Banksia attenuata* (Candlestick Banksia) • *Banksia menziesii* (Firewood Banksia) • *Banksia prionotes* (Acorn Banksia) • *Banksia ilicifolia* (Holly-Leaved Banksia).	*Banksia attenuata* and *B. menziesii* present	*Banksia attenuata* present	*Banksia attenuata* present.
Vegetation Structure	• A distinctive upper sclerophyllous layer of low trees (occasionally large shrubs more than 2 m tall), typically dominated or codominated[3] by one or more of the *Banksia* species (*B. attenuata, B. menziesii, B. ilicifolia, B. prionotes*); • An emergent tree layer of medium or tall (>10 m) height *Eucalyptus* or *Allocasuarina* (Sheoak) species may sometimes be present above the *Banksia* canopy. • An understory that is often highly species-rich consists of: – A layer of sclerophyllous shrubs of various heights; and, – A herbaceous ground layer of cord rushes, sedges and perennial and ephemeral forbs, that sometimes includes grasses. The development of a ground layer may vary depending on the density of the shrub layer and disturbance history.	• Banksia trees form a distinctive upper layer of low trees, representing about 2-25% canopy cover mixed with Sheoak (*Allocasuarina fraseriana*) trees • Sheoak (*Allocasuarina fraseriana*) trees co-occurring in this vegetation type. • Understorey of shrubs, sedges, herbs in Good to Very Good condition with a high diversity of native species including shrubs, sedges, climbing plants and ephemerals.	• Banksia trees form a distinctive upper layer of low trees with a canopy cover around 20% mixed with Sheoak (*Allocasuarina fraseriana*) trees • Sheoak (*Allocasuarina fraseriana*) trees co-occurring in this vegetation type. • Understorey of shrubs, sedges, herbs in Good to Very Good condition with a high diversity of native species including shrubs, sedges, climbing plants and ephemerals.	• Banksia trees form a sparse canopy cover less than 10% forming a reasonably distinctive upper layer of trees. • Jarrah (*Eucalyptus marginata*) is the main tree species with Tuart (*E. gomphocephala*) also present. • Understorey of shrubs, sedges, herbs, in Very Good to Excellent condition have a moderate diversity of native species including shrubs, sedges, climbing plants and ephemerals
Vegetation Condition	An area of Banksia woodland needs to be at least in Good condition to be considered the TEC.	Vegetation type is all in Very Good condition	Vegetation type is all Good to Very Good	Vegetation type is all Very Good to Excellent
Patch Size	The Banksia woodland TEC needs to meet a minimum 'patch' size depending on its condition to qualify as the TEC, as follows: • 'Pristine' – no minimum patch size • 'Excellent' – 0.5ha • 'Very Good' – 1ha • 'Good' – 2ha	BaAfBm vegetation type approximately 2.5ha in size which is above the minimum criterion of 1ha for vegetation in Very Good condition	BaAf vegetation type approximately 3.1ha in size which is above the minimum criterion of 1ha for vegetation in Very Good condition and 2ha for vegetation in Good condition	EmBa vegetation type on site approximately 4.0ha in size, extending to the north and east. Above the minimum criteria for vegetation in Very Good and Excellent condition
Conclusion		Meets the definition of the Banksia Woodland TEC in all features	Meets the definition of the Banksia Woodland TEC in all features	Does not meet the definition of the Banksia Woodland TEC as the Banksia trees do not form a distinctive upper layer of trees. Jarrah and Tuart trees are more common than being 'emergent' above the sparse Banksia.

(Commonwealth of Australia, 2016)

The relevant species of Banksia trees were only found to be present in three vegetation types in the northern survey area. The woodland vegetation in the southern survey area contained very few to no Banksia trees. In addition, the southern area did not have any dead trees or any seedlings/saplings of the relevant Banksia tree species suggestive of a disturbed or regenerating Banksia canopy. Therefore, the assessment in Table 10 has only been undertaken for the three vegetation types shown in Figure 3 that contain the relevant Banksia tree species. The vegetation types are:

- **BaAfBm** *Banksia attenuata/Allocasuarina fraseriana/B. menziesii* Low Open Forest over *Xanthorrhoea preissii* Tall Open Shrubland over *Hibbertia hypericoides/Allocasuarina humilis* Open Low Heath
- **BaAf** *Banksia attenuata/Allocasuarina fraseriana* Low Woodland over *Xanthorrhoea preissii/Hakea prostrata* Tall Shrubland over *Hibbertia hypericoides* Low Open Shrubland over *Tetraria octandra/Mesomelaena pseudostygia* Very Open Sedgeland
- **EmBa** *Eucalyptus marginata* Woodland over *Banksia attenuata* Open to Low Woodland over *Xanthorrhoea preissii* Open Shrubland over *Hibbertia hypericoides* Low Shrubland to Closed Low Heath over *Mesomelaena pseudostygia* Very Open Sedgeland

Conclusion

The conclusion of the assessment is the vegetation types BaAfBm and BaAf meet all the requirements of the Banksia Woodland TEC. The total area of Banksia Woodland TEC on the site is calculated to be 5.658ha (Figure 5).

The EmBa vegetation type was considered to not meet the definition of the Banksia Woodland TEC as the Banksia trees do not form a distinctive upper layer of trees. The Banksia trees are sparse and the Jarrah and Tuart trees present are more common than being just ‘emergent’.

5 SUMMARY AND CONCLUSIONS

The Flora and Vegetation survey of the survey area by PGV Environmental (this report) and Coffey Environments (2010) resulted in the following findings:

- A total of 188 plant species were recorded during the two flora surveys. This total consisted of 140 native species and 48 (25%) introduced species;
- No Threatened (Declared Rare) flora species were recorded on the site;
- Three Priority flora species were recorded on the site as follow:
  - *Baeckea* sp Limestone P1 – 4 plants in the southern part of the site
  - *Acacia benthamii* P2 – Occurs abundantly in the northern part of the site
  - *Jacksonia sericea* P4 – Occurs commonly in the northern part and southern parts of the site.
- Seven different native vegetation types were described on the site, with four in the northern part and three in the southern area. Six of the vegetation types were woodlands of Jarrah, Tuart and/or Banksia/Sheoak on sand over limestone soils. The seventh vegetation type was a Parrot Bush (*Banksia sessilis/Xanthorrhoea preissii*) Shrubland on sand and outcropping limestone soils;
- The vegetation was rated from Good to Excellent condition with a moderate number of native species and a high proportion of weeds in the understorey, although not a high percentage weed cover;

- The egetation is part of the Cottesloe – Central and South Vegetation complex which is well retained in the Perth Metropolitan Region;
- The vegetation was assessed as being part of FCT28 'Spearwood *Banksia attenuata* or *B. attenuata* – *Eucalyptus* woodland' and FCT 24 'Northern Spearwood shrubland and woodlands'. FCT 24 is a Priority 3 ecological community at State level;
- Three patches of Tuart woodland were assessed as occurring in the northern and southern survey areas. All three patches were determined to meet the criteria for being recognised as part of the Tuart Woodlands and Forests of the Swan Coastal Plain ecological community which is listed as Critically Endangered under the Commonwealth EPBC Act and Priority 3 at State level. The total area of Tuart Woodland TEC on the site is calculated to be 10.103 ha;
- The BaAfBm and BaAf vegetation types in the northern survey area meet the criteria to be recognised as part of the Banksia Woodlands of the Swan Coastal Plain ecological community which is a Priority 3 community at State level and an Endangered TEC under the EPBC Act. The total area of Banksia Woodland TEC on the site is calculated to be 5.658 ha;
- Any proposed clearing of the Tuart Woodland TEC or Banksia Woodland TEC will require a Referral under the EPBC Act and likely Controlled Action assessment; and
- All vegetation types are foraging habitat for Carnaby's Black Cockatoo and many Tuart and some Jarrah trees would be considered potential breeding habitat. Any proposed clearing of Carnaby's Black Cockatoo habitat may need to be referred under the EPBC Act.

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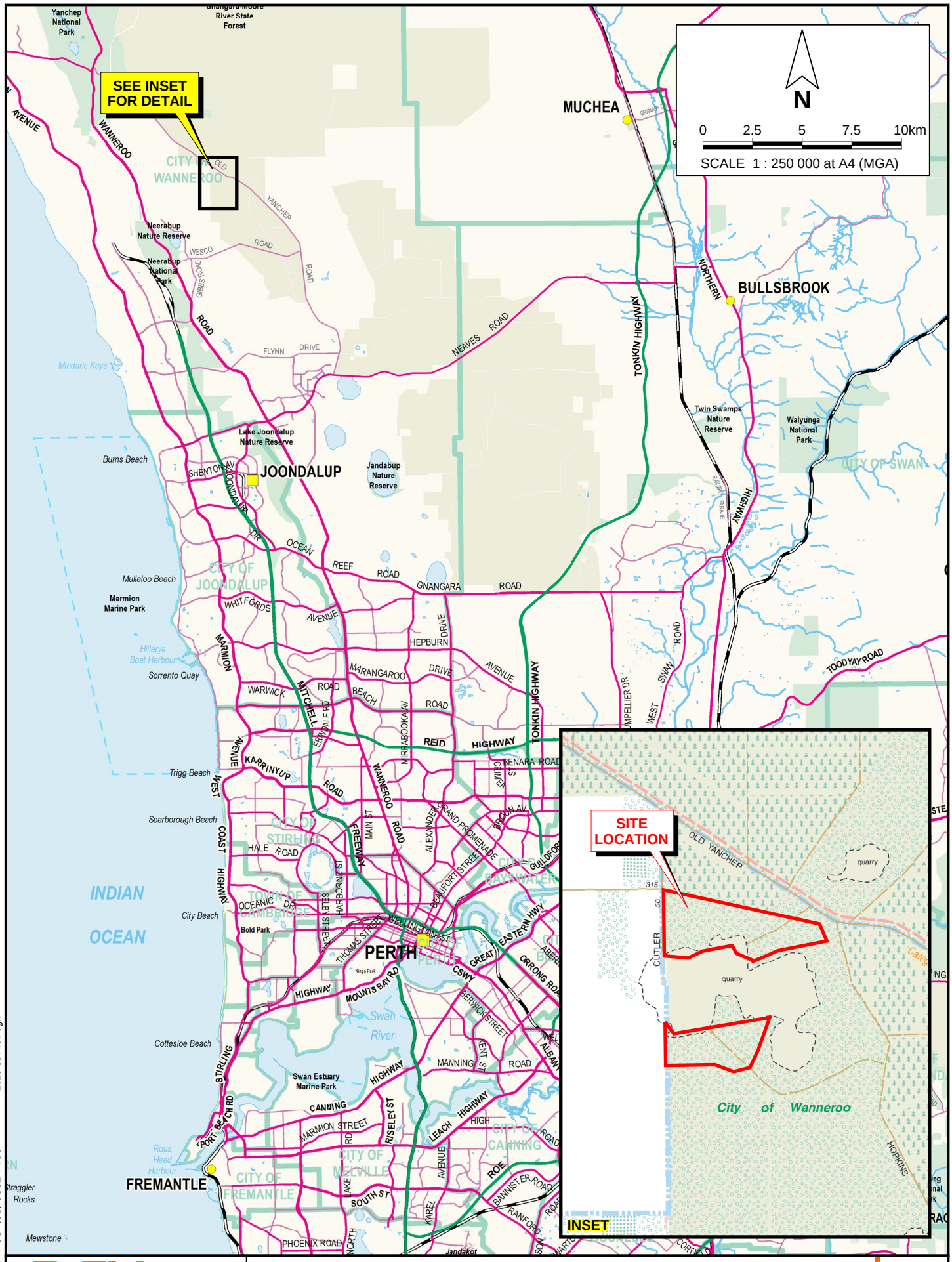
FIGURES



PINPOINT CARTOGRAPHICS (08) 9562 7136 2020-551-f01.dgn

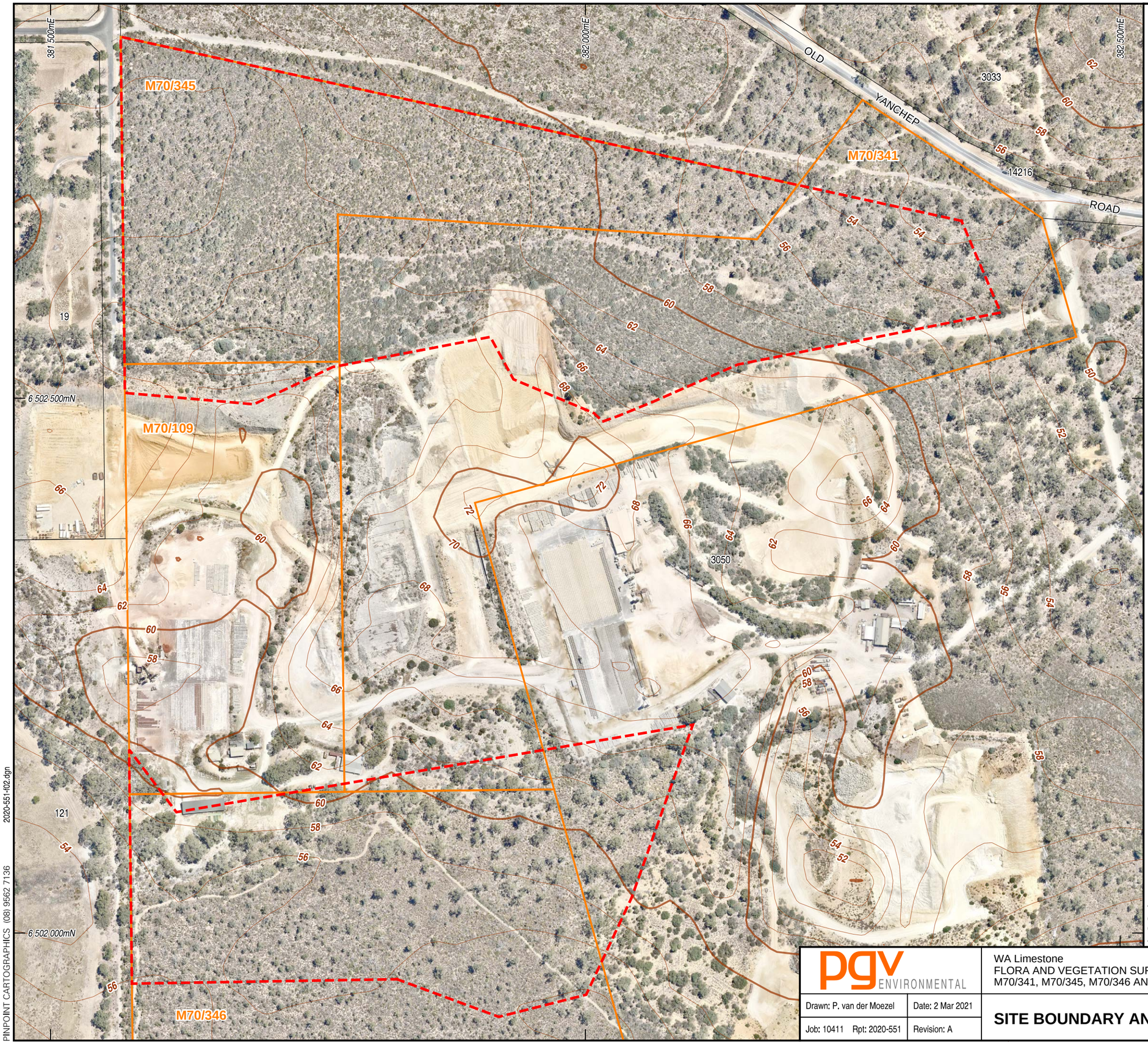
pgv ENVIRONMENTAL

Drawn: P. van der Moezel	Date: 2 Mar 2021
Job: 10411 Rpt: 2020-551	Revision: A

WA Limestone
FLORA AND VEGETATION SURVEY
M70/341, M70/345, M70/346 AND M70/339, HOPKINS ROAD CARABOODA

SITE LOCATION

Figure 1



N

0 50 100 150 200m

SCALE 1 : 3 500 at A3 (MGA)

Legend

- Site Boundary
- Cadastral Boundary
- Tenement Boundary
- Topographic Contour

TENEMENT SOURCE: DMIRS, March 2020.
CONTOUR SOURCE: Dept. of Agriculture, 2000.
CADASTRAL SOURCE: Landgate, March 2021.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown January 2021.

pgv ENVIRONMENTAL

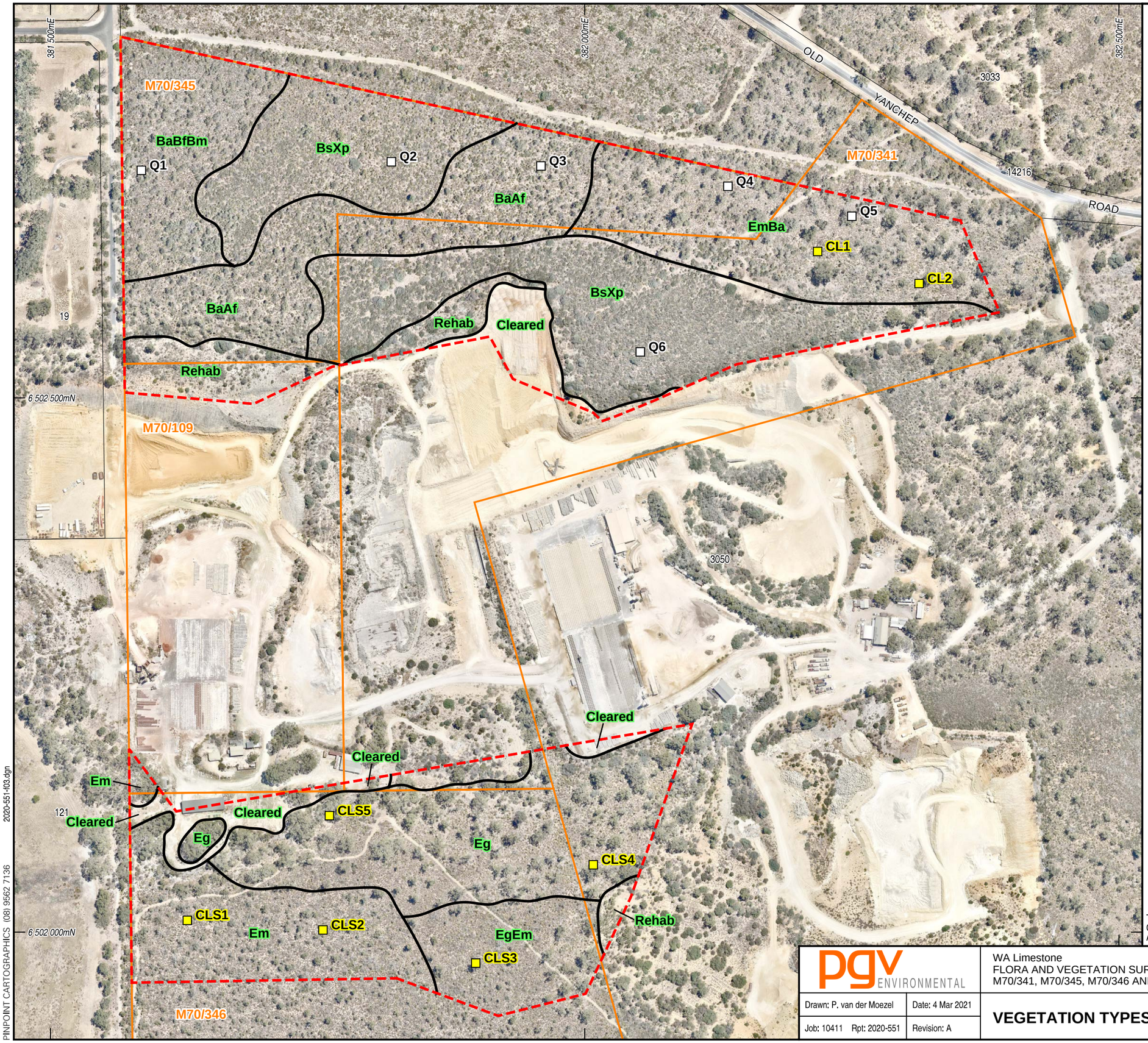
WA Limestone
FLORA AND VEGETATION SURVEY
M70/341, M70/345, M70/346 AND M70/339, HOPKINS ROAD CARABOODA

Drawn: P. van der Moezel | Date: 2 Mar 2021
Job: 10411 Rpt: 2020-551 | Revision: A

SITE BOUNDARY AND TOPOGRAPHY

Figure 2

PINPOINT CARTOGRAPHICS (08) 9562 7136 2020-551-f02.dgn



N

0 50 100 150 200m

SCALE 1 : 3 500 at A3 (MGA)

Legend

- Site Boundary
- Cadastral Boundary
- Tenement Boundary
- Quadrat Location - Coffey Environments
- Quadrat Location - PGV Environmental
- Vegetation Type Boundary
- Em Vegetation Type

M70/341, M70/345 - Vegetation Types

BaAfBm
Banksia attenuata/Allocasuarina fraseriana/B. menziesii Low Open Forest over *Xanthorrhoea preissii* Tall Open Shrubland over *Hibbertia hypericoides/Allocasuarina humilis* Open Low Heath

BaAf
Banksia attenuata/Allocasuarina fraseriana Low Woodland over *Xanthorrhoea preissii/Hakea prostrata* Tall Shrubland over *Hibbertia hypericoides* Low Open Shrubland over *Tetraria octandra/Mesomelaena pseudostygia* Very Open Sedgeland

BsXp
Banksia sessilis/Xanthorrhoea preissii Tall Open Scrub over *Melaleuca systena/Hakea lissocarpha* Open Shrubland over *Jacksonia sericea/Hibbertia hypericoides* Low Open Shrubland

EmBa
Eucalyptus marginata Woodland over *Banksia attenuata* Open to Low Woodland over *Xanthorrhoea preissii* Open Shrubland over *Hibbertia hypericoides* Low Shrubland to Closed Low Heath over *Mesomelaena pseudostygia* Very Open Sedgeland

M70/346 and M70/339 - Vegetation Types

Em
Eucalyptus marginata Low Open Woodland over *Xanthorrhoea preissii/ Macrozamia riedlei/Hibbertia hypericoides* Open Heath over *Mesomelaena pseudostygia* Very Open Sedgeland

EgEm
Eucalyptus gomphocephala/E. marginata Low Woodland over *Jacksonia sternbergiana/Macrozamia riedlei* Shrubland over *Hibbertia hypericoides* Open Low Heath over *Mesomelaena pseudostygia* Very Open Sedgeland

Eg
Eucalyptus gomphocephala Low Open Woodland over *Banksia sessilis* Open Shrubland *Xanthorrhoea preissii/Hibbertia hypericoides/Jacksonia sericea* Closed Low Heath over *Mesomelaena pseudostygia* Very Open Sedgeland

TENEMENT SOURCE: DMIRS, March 2020.
CADASTRAL SOURCE: Landgate, March 2021.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown January 2021.

PINPOINT CARTOGRAPHICS (08) 9562 7136 2020-551-f03.dgn

pgv ENVIRONMENTAL

WA Limestone
FLORA AND VEGETATION SURVEY
M70/341, M70/345, M70/346 AND M70/339, HOPKINS ROAD CARABOODA

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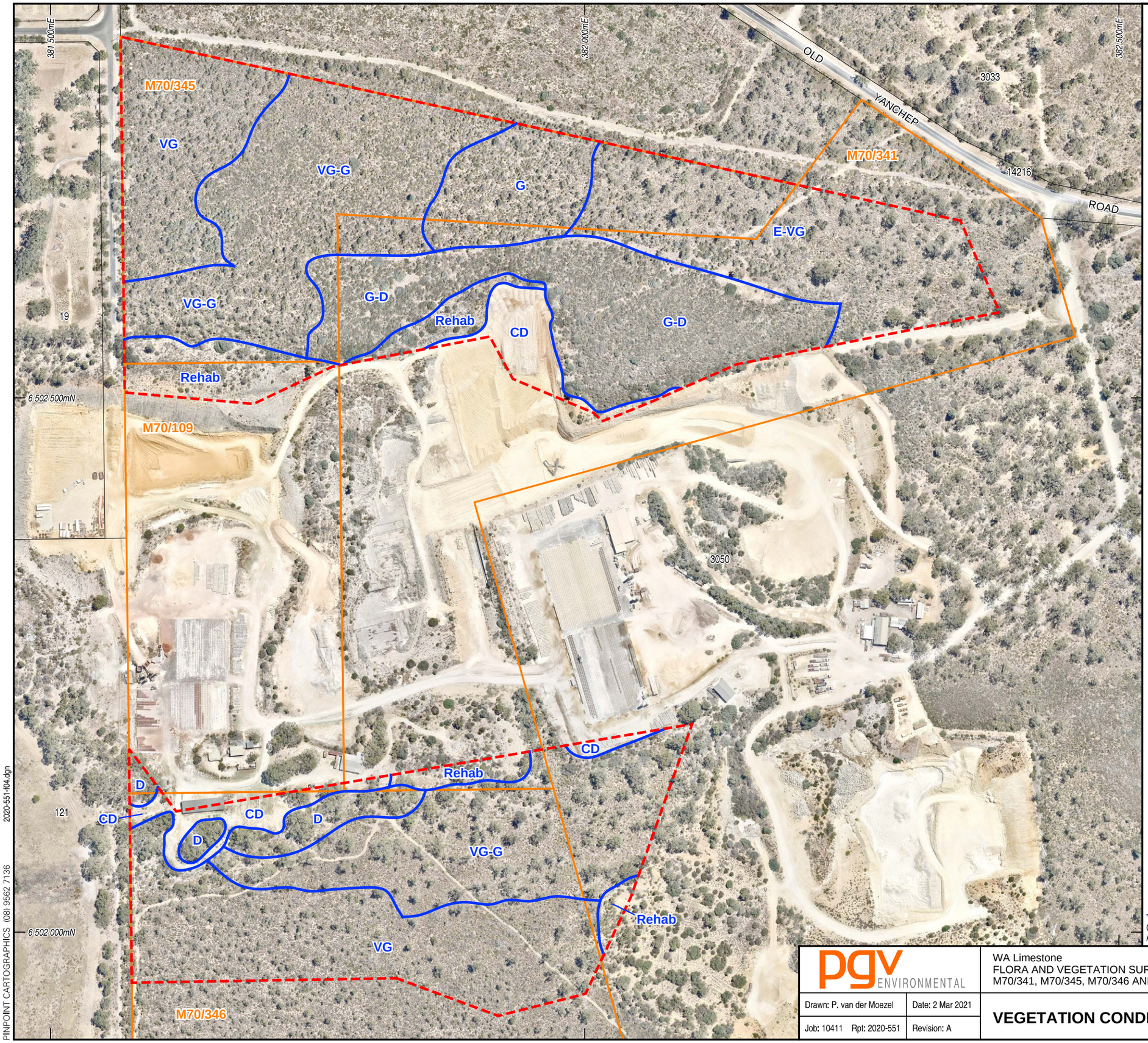
Job: 10411 Rpt: 2020-551 | Revision: A

VEGETATION TYPES

Figure 3



N

0 50 100 150 200m

SCALE 1 : 3 500 at A3 (MGA)

Legend

- Site Boundary
- Cadastral Boundary
- Tenement Boundary
- Vegetation Condition Boundary
- Em Vegetation Condition

Vegetation Condition
(SOURCE: Bush Forever, Govt. of W.A., 2000)

P - Pristine
Pristine or nearly so, no obvious signs of disturbance.

Ex - Excellent
Vegetation structure intact, disturbance affecting individual species and weeds are non aggressive species.

VG - 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.

G - Good
Vegetation structure significantly altered by very obvious signs of multiple disturbance. 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.

D - Degraded
Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.

CD - Completely Degraded
The structure of the vegetation is no longer intact and the areas is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora composing weed or crop species with isolated native trees or shrubs.

Cl - Cleared
No native vegetation remaining.

TENEMENT SOURCE: DMIRS, March 2020.
CADASTRAL SOURCE: Landgate, March 2021.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown January 2021.

PINPOINT CARTOGRAPHICS (08) 9562 7136 2020-551-604.dgn

pgv ENVIRONMENTAL

WA Limestone
FLORA AND VEGETATION SURVEY
M70/341, M70/345, M70/346 AND M70/339, HOPKINS ROAD CARABOODA

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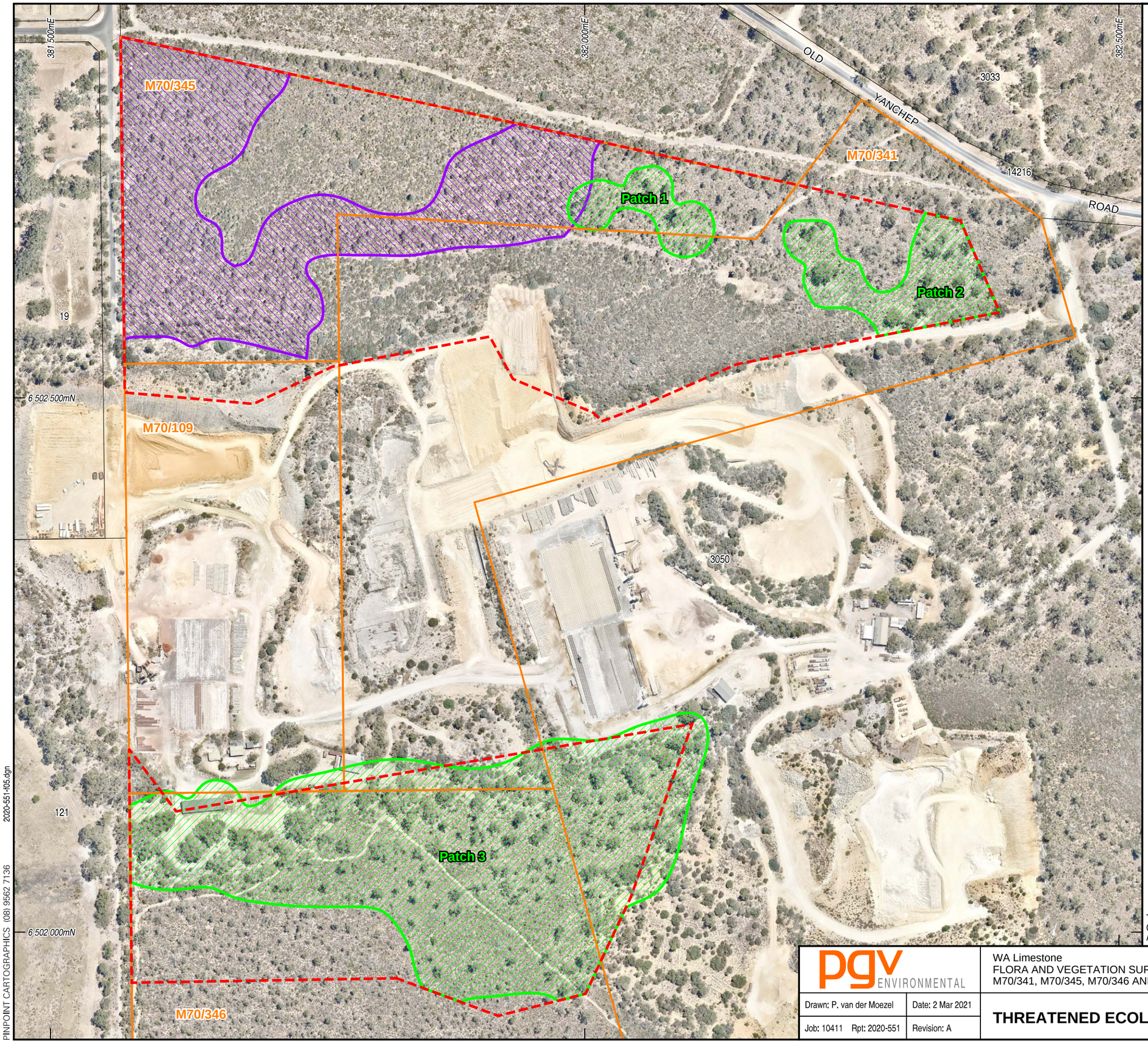
VEGETATION CONDITION

Figure 4



N

0 50 100 150 200m

SCALE 1 : 3 500 at A3 (MGA)

Legend

- Site Boundary
- Cadastral Boundary
- Tenement Boundary

Threatened Ecological Communities

- Tuart Woodland TEC
- Banksi Woodland TEC

TENEMENT SOURCE: DMIRS, March 2020.
CADASTRAL SOURCE: Landgate, March 2021.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown January 2021.

PINPOINT CARTOGRAPHICS (08) 9562 7136 2020-551-f05.dgn

pgv ENVIRONMENTAL

WA Limestone
FLORA AND VEGETATION SURVEY
M70/341, M70/345, M70/346 AND M70/339, HOPKINS ROAD CARABOODA

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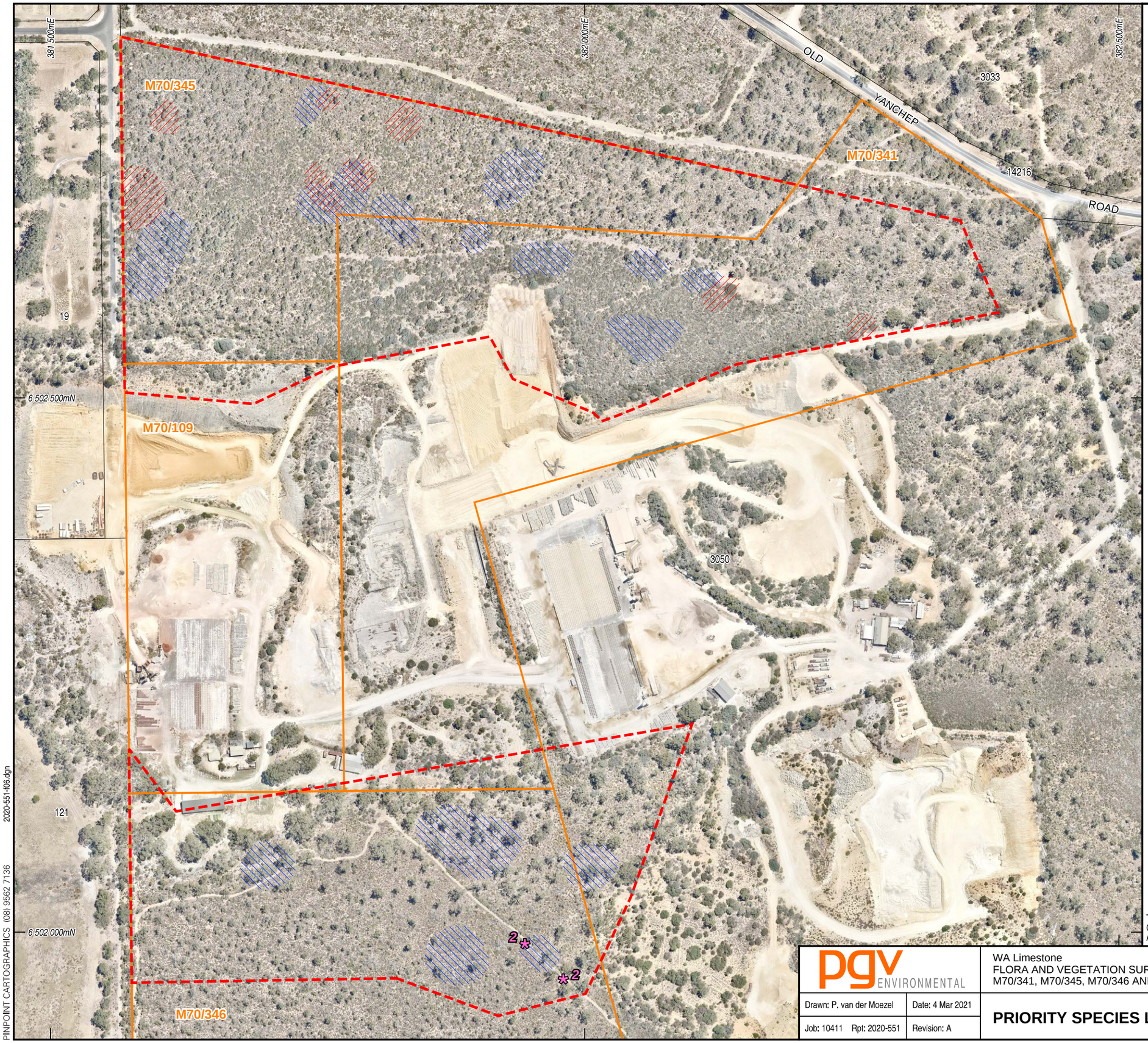
Job: 10411 Rpt: 2020-551 | Revision: A

THREATENED ECOLOGICAL COMMUNITIES

Figure 5



N

0 50 100 150 200m

SCALE 1 : 3 500 at A3 (MGA)

Legend

- Site Boundary
- Cadastral Boundary
- Tenement Boundary

Priority Species

- *Baeckea sp.* Limestone
- 2 Number of Plants
- *Jacksonia sericea*
- *Acacia benthamii*

TENEMENT SOURCE: DMIRS, March 2020.
CADASTRAL SOURCE: Landgate, March 2021.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown January 2021.

pgv ENVIRONMENTAL

WA Limestone
FLORA AND VEGETATION SURVEY
M70/341, M70/345, M70/346 AND M70/339, HOPKINS ROAD CARABOODA

Drawn: P. van der Moezel	Date: 4 Mar 2021
Job: 10411 Rpt: 2020-551	Revision: A

PRIORITY SPECIES LOCATIONS

Figure 6

PINPOINT CARTOGRAPHICS (08) 9562 7136 2020-551-f06.dgn

Appendix C
WA Limestone Carabooda Project
Fauna Assessment (Bamford, 2022)

WA Limestone
Carabooda Project
Fauna Assessment

View over the Carabooda site. Photo: Wes Bancroft.

Prepared for: WA Limestone
401 Spearwood Avenue
BIBRA LAKE WA 6163

Prepared by: Wes Bancroft and Mike Bamford
M.J. & A.R. BAMFORD CONSULTING ECOLOGISTS
23 Plover Way
KINGSLEY WA 6026

29th July 2022

Executive Summary

Bamford Consulting Ecologists (BCE) was commissioned by WA Limestone to conduct a Basic (*sensu* EPA 2020) fauna assessment (desktop review and site inspection) of their proposed Carabooda quarry expansion in Nowergup. The purposes of this report are to provide information on the fauna values of the project area, an overview of the ecological function of the site within the local and regional context, and to provide discussion on the interaction of proposed development on the site with these fauna values and functions.

BCE uses a 'values and impacts' assessment process with the following components:

- The identification of **fauna values**:
  - Assemblage characteristics: uniqueness, completeness and richness;
  - Species of conservation significance;
  - Recognition of ecotypes or vegetation/substrate associations (VSAs) that provide habitat for fauna, particularly those that are rare, unusual and/or support significant fauna;
  - Patterns of biodiversity across the landscape; and
  - Ecological processes upon which the fauna depend.
- The review of **impacting processes** such as:
  - Habitat loss leading to population decline;
  - Habitat loss leading to population fragmentation;
  - Degradation of habitat due to weed invasion leading to population decline;
  - Ongoing mortality from operations;
  - Species interactions including feral and overabundant native species;
  - Hydrological change;
  - Altered fire regimes; and
  - Disturbance (dust, light, noise).
- The **recommendation** of actions to mitigate impacts (if requested).

Description of project area

The proposed location ('project area') for the Carabooda quarry expansion is adjacent to existing quarries within Mining Tenement M70/341 both held by WA Limestone, in the suburb of Nowergup, approximately 34 km north of the Perth CBD. The project area is c. 5.7 ha, of which at c. 1.0 ha has previously been cleared (as per DPIRD 2022).

The project area is within the Swan Coastal Plain 2 (SWA02) subregion of the Swan Coastal Plain bioregion and falls within the 'Cottesloe Complex – Central and South' of Heddle *et al.* (1980) and Webb *et al.* (2016). Most of the project area sits within Bush Forever Site number 290: Hopkins Road Bushland, Nowergup (Dell and Banyard 2000). This Bush Forever listing is also captured in the database of Environmentally Sensitive Areas (DWER 2022a, b), with other sensitive areas extending over the project area. The project area also sits within the 'Northern Swan Coastal Plain' Key Biodiversity Area. There are no known Ramsar Sites or Important Wetlands within the project area.

Key fauna values

Vegetation and Substrate Associations (VSAs) that provide habitat for fauna. Five major Vegetation and Substrate Associations were identified in the project area: Jarrah-Banksia woodland (VSA 1), Banksia-Sheoak woodland (VSA 2), Mixed shrubland (VSA 3), Rehabilitation (VSA 4), and Cleared (VSA 5).

Fauna assemblage. The desktop study identified 173 vertebrate fauna species as potentially occurring in the project area: no fish, eight frogs, 46 reptiles, 100 birds and 19 mammals. The presence of at least 20 species (16 birds and four mammals) was confirmed during the 2021 site inspection. The fauna assemblage is probably typical of the near-coastal shrublands of the coastal plain north of Perth. The assemblage is likely to be substantially complete except for the mammal component, which is depauperate in both medium-sized and small species. The assemblage is likely to be only moderately rich in a regional context as the environment consists largely of shrublands and lacks wetlands, and the extensive banksia and eucalypt woodlands of the coastal plain slightly further east.

Species of conservation significance. Three broad levels of conservation significance are used in this report:

- Conservation Significance 1 (CS1) – species listed under State or Commonwealth Acts.
- Conservation Significance 2 (CS2) – species listed as Priority by DBCA but not listed under State or Commonwealth Acts.
- Conservation Significance 3 (CS3) – species not listed under Acts or in publications, but considered of at least local significance because of their pattern of distribution.

The majority of the 45 conservation significant species (including two reptiles, 35 birds, five mammals and three invertebrates) expected in the project area are likely to be residents or regular visitors/migrants visitors. Only five of the expected conservation species are listed under WA State and/or Commonwealth legislation (category CS1; four birds and one mammal), with six listed as Priority by DBCA (category CS2; one reptile, two mammals and three invertebrates) and the remaining 34 considered locally significant (category CS3; one reptile, 31 birds and two mammals). Of most concern are Carnaby's Black-Cockatoo (CS1, known to be a regular migrant to the area and to use the project area for foraging), and Quenda (CS2, known to occur within the project area and expected to be resident).

Patterns of biodiversity. The three intact native VSAs can be expected to be richer in species than the rehabilitation and cleared areas. Differences in the fauna assemblage between these three VSAs might be slight, as they contain many of the same plant species and have broadly similar substrates. VSAs 1, 2 and 3 are notable for high nectar production important for a range of nectarivores (*Banksia* species) and supply of food for Carnaby's Black-Cockatoo. VSA 1 and 2 also provide an overstorey which may influence the presence of several arboreal or canopy-foraging species (e.g. some birds, Brushtail Possum, bats). VSA 1 is notable as having the only eucalypts in the project area and thus may support some birds and invertebrates that are eucalypt specialists.

Key ecological processes. The ecological processes that currently have major effects upon the fauna assemblage include landscape permeability, hydrology, fire, and the presence of feral species.

Potential impacts upon fauna

Threatening processes reviewed in relation to the proposed development included: habitat loss, habitat fragmentation, degradation due to weed invasion, direct mortality during construction, ongoing mortality, impacts of feral and overabundant native species, hydrological change, fire and disturbance (dust, noise and light). Potential impacts are considered to be negligible to minor because of the small areas involved, the low number of conservation significant species expected to be regularly present within, and wholly reliant on, the project area (and the low likelihood of their disruption), and the general fauna assemblage being well-represented in the general region. The cumulative impact of habitat loss due to the proposed Carabooda quarry expansion project is not expected to be significant because the development area is small (clearing is expected to contribute less than a further 0.01% to the c. 47.8% of the cleared lands in the region). However, the development does contribute to potential fragmentation of remaining native vegetation in the immediate area.

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1 Introduction

WA Limestone is proposing to expand operations at its Carabooda quarry within Mining Tenement M 70/341 in the suburb of Nowergup on the outskirts of the Perth Metropolitan area (see Figure 1).

Bamford Consulting Ecologists (BCE) was commissioned by WA Limestone to conduct a Basic (*sensu* EPA 2020) fauna assessment (desktop review and site inspection) of the proposed Carabooda quarry expansion. This report presents the results of that fauna desktop review and site inspection.

1.1 General approach to fauna impact assessment

The purpose of impact assessment is to provide government agencies with the information they need to decide upon the significance of impacts of a proposed development, and to provide information to proponents to help them to develop appropriate strategies for avoiding and minimising impacts of their activities. This relies on information on the fauna assemblage and its environment, and BCE uses an approach with the following components:

- The identification of **fauna values**:
  - Assemblage characteristics: uniqueness, completeness and richness;
  - Species of conservation significance;
  - Recognition of ecotypes or vegetation/substrate associations (VSAs) that provide habitat for fauna, particularly those that are rare, unusual and/or support significant fauna;
  - Patterns of biodiversity across the landscape; and
  - Ecological processes upon which the fauna depend.
- The review of **impacting processes** such as:
  - Habitat loss leading to population decline;
  - Habitat loss leading to population fragmentation;
  - Degradation of habitat due to weed invasion leading to population decline;
  - Ongoing mortality from operations;
  - Species interactions including feral and overabundant native species;
  - Hydrological change;
  - Altered fire regimes; and
  - Disturbance (dust, light, noise).
- The **recommendation** of actions to mitigate impacts (if requested).

Based on the impact assessment process above, the objectives of the study are therefore to:

1. Conduct a literature review and searches of Commonwealth and State fauna databases;
2. Review the list of fauna expected to occur on the site in the light of fauna habitats present, with a focus on investigating the likelihood of significant species being present;
3. Identify significant or fragile fauna habitats within the project area;
4. Identify any ecological processes in the project area upon which fauna may depend;
5. Identify general patterns of biodiversity within or adjacent to the project area, and
6. Identify potential impacts upon fauna and propose recommendations to minimise impacts.

Descriptions and background information on these values and processes can be found in Appendices 1 to 4. Based on this impact assessment process, the objectives of investigations are to: identify fauna values; review impacting processes with respect to these values and the proposed development; and provide recommendations to mitigate these impacts.

1.2 Description of project area and background environmental information

1.2.1 Project area

For spatial terminology (i.e. definitions of project, survey and study areas) see Section 2.1.1 below.

The proposed location ('project area') for the Carabooda quarry expansion is adjacent to existing quarries within Mining Tenement M 70/341 held by WA Limestone, in the suburb of Nowergup, approximately 34 km north of the Perth CBD. The project area is c. 5.7 ha, of which at c. 1.0 ha has previously been cleared (as per DPIRD 2022).

The field investigations in this environmental impact assessment were conducted within the project area only and, therefore, the 'survey area' and project area are treated as synonymous from hereon.

1.2.2 Interim Biogeographic Regionalisation of Australia (IBRA) and landscape characteristics

The Interim Biogeographic Regionalisation of Australia (IBRA) has identified 26 bioregions in Western Australia which are further divided into subregions (DAWE 2022b). Bioregions are classified on the basis of climate, geology, landforms, vegetation and fauna (Thackway and Cresswell 1995). IBRA Bioregions are affected by a range of different threatening processes and have varying levels of sensitivity to impact (EPA 2016c). The project area is within the Swan Coastal Plain 2 (SWA02) subregion of the Swan Coastal Plain bioregion, as mapped in Figure 2. This bioregion falls within the Bioregion Group 1 (South-West Botanical Province) classification of EPA (2016c) where native vegetation is "extensively cleared for agriculture".

The Swan Coastal Plain 2 subregion was described by Mitchell *et al.* (2003) and a summary of their work follows here. The Swan Coastal Plain is a low lying coastal plain, mainly covered with woodlands. It is dominated by Banksia or Tuart on sandy soils, *Casuarina obesa* on outwash plains, and paperbark in swampy areas. In the east, the plain rises to duricrusted Mesozoic sediments dominated by Jarrah woodland. The climate is Warm Mediterranean. Three phases of marine sand dune development provide relief. The outwash plains, once dominated by *C. obesa*-Marri woodlands and Melaleuca shrublands, are extensive only in the south. The Perth subregion is composed of colluvial and aeolian sands, alluvial river flats, coastal limestone. Heath and/or Tuart woodlands on limestone, Banksia and Jarrah-Banksia woodlands on Quaternary marine dunes of various ages, Marri on colluvial and alluvials. Includes a complex series of seasonal wetlands and also includes Rottnest, Carnac and Garden Islands etc. Rainfall ranges between 600 and 1000 mm annually and the climate is Mediterranean.

1.2.3 Land systems and vegetation complexes

Heddle *et al.* (1980) and Webb *et al.* (2016) have defined and described broad vegetation complexes for the Swan Coastal Plain and the mapping of these is provided by DBCA (2022g). The project area is located wholly within one of these:

- Cottesloe Complex – Central and South: Mosaic of woodland of *Eucalyptus gomphocephala* (Tuart) and open forest of *Eucalyptus gomphocephala* (Tuart) - *Eucalyptus marginata* (Jarrah) - *Corymbia calophylla* (Marri); closed heath on the Limestone outcrops.

Heddle vegetation complexes in the vicinity of the project area are mapped in Figure 3 (data provided by DBCA 2022g).

1.2.4 Land use and tenure

The dominant land uses within the Swan Coastal Plain 2 (SWA02) subregion are cultivation – dry land agriculture, conservation, UCL and Crown reserves, urban, rural residential, cultivation – irrigated horticulture, agriculture and plantations, forestry-plantations, roads and other easements and infrastructure, and grazing – Improved pastures, with smaller areas of mining, and defence lands (Mitchell *et al.* 2003). The project area lies in the central sector of the subregion. At the local scale, the project area is surrounded by areas of agriculture, plantations and mining.

1.2.5 Recognised sensitive sites

Most of the project area sits within Bush Forever Site number 290: Hopkins Road Bushland, Nowergup (Dell and Banyard 2000), as shown in Figure 4 (data provided by DPLH 2022). This Bush Forever listing is also captured in the database of Environmentally Sensitive Areas (DWER 2022a, b), with other sensitive areas extending over the project area as shown in Figure 5. The project area also sits within the 'Northern Swan Coastal Plain' Key Biodiversity Area (KBA 2022), listed because "supports a considerable portion of the non-breeding population of the endangered Carnaby's Black-Cockatoo and a small number of breeding pairs" (KBAP 2020). There are no known Ramsar Sites (DBCA 2022e) or Important Wetlands (DBCA 2022b), within the project area.

1.2.6 Climate information

The project areas falls within the Köppen climate classification of 'Hot-summer Mediterranean climate (*Csa*)', which is characterised by s characterized by dry summers and mild, wet winters. They usually occur on the western sides of continents between the latitudes of 30° and 45°. Hot-summer Mediterranean climates are in the polar front region in winter, and thus have moderate temperatures and changeable, rainy weather. Summers are hot and dry, due to the domination of the subtropical high pressure systems, except in the immediate coastal areas, where summers are milder due to the nearby presence of cold ocean currents that may bring fog but prevent rain (Anon. 2022; BOM 2022a).

For the Swan Coastal Plain 2 (SWA02) subregion, climate is "Warm Mediterranean" (Mitchell *et al.* 2003).

Climate averages (temperate, rainfall, sunshine) for the project area, as provided by BOM (2022b), are presented in Table 1.

Table 1. Climate averages for the project area.

Data from BOM (2022b) for:
Site name = GINGIN AERO
Site number = 009178

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years		Plot	Map
Temperature																	
Mean maximum temperature (°C)	33.1	33.0	30.8	26.8	22.8	19.7	18.4	19.1	20.8	24.4	28.1	30.9	25.7	25	1996 2021		
Mean minimum temperature (°C)	16.4	17.0	15.4	12.0	8.9	7.2	6.4	6.6	7.4	9.3	12.0	14.4	11.1	25	1996 2021		
Rainfall																	
Mean rainfall (mm)	15.7	15.5	19.1	27.1	73.1	109.3	129.1	108.6	77.3	33.9	19.4	10.1	620.7	20	1996 2021		
Decile 5 (median) rainfall (mm)	1.6	3.0	11.4	23.6	70.0	113.0	123.2	116.8	82.4	29.6	12.2	4.2	605.5	25	1996 2021		
Mean number of days of rain ≥ 1 mm	1.2	1.4	2.5	4.2	8.6	10.3	13.9	12.1	10.1	5.4	3.3	1.9	74.9	24	1996 2021		

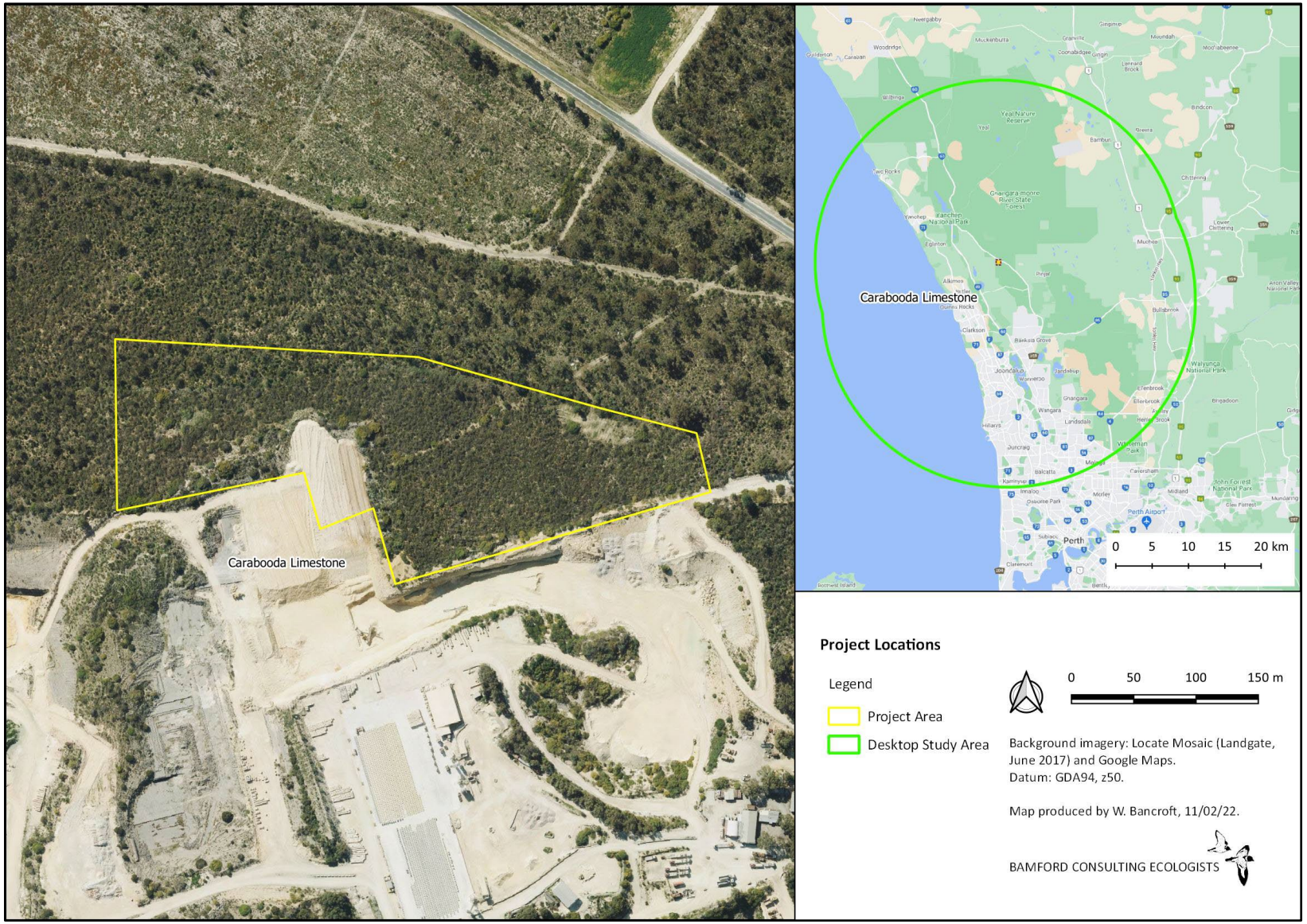

Figure 1. Location of the Carabooda Project.

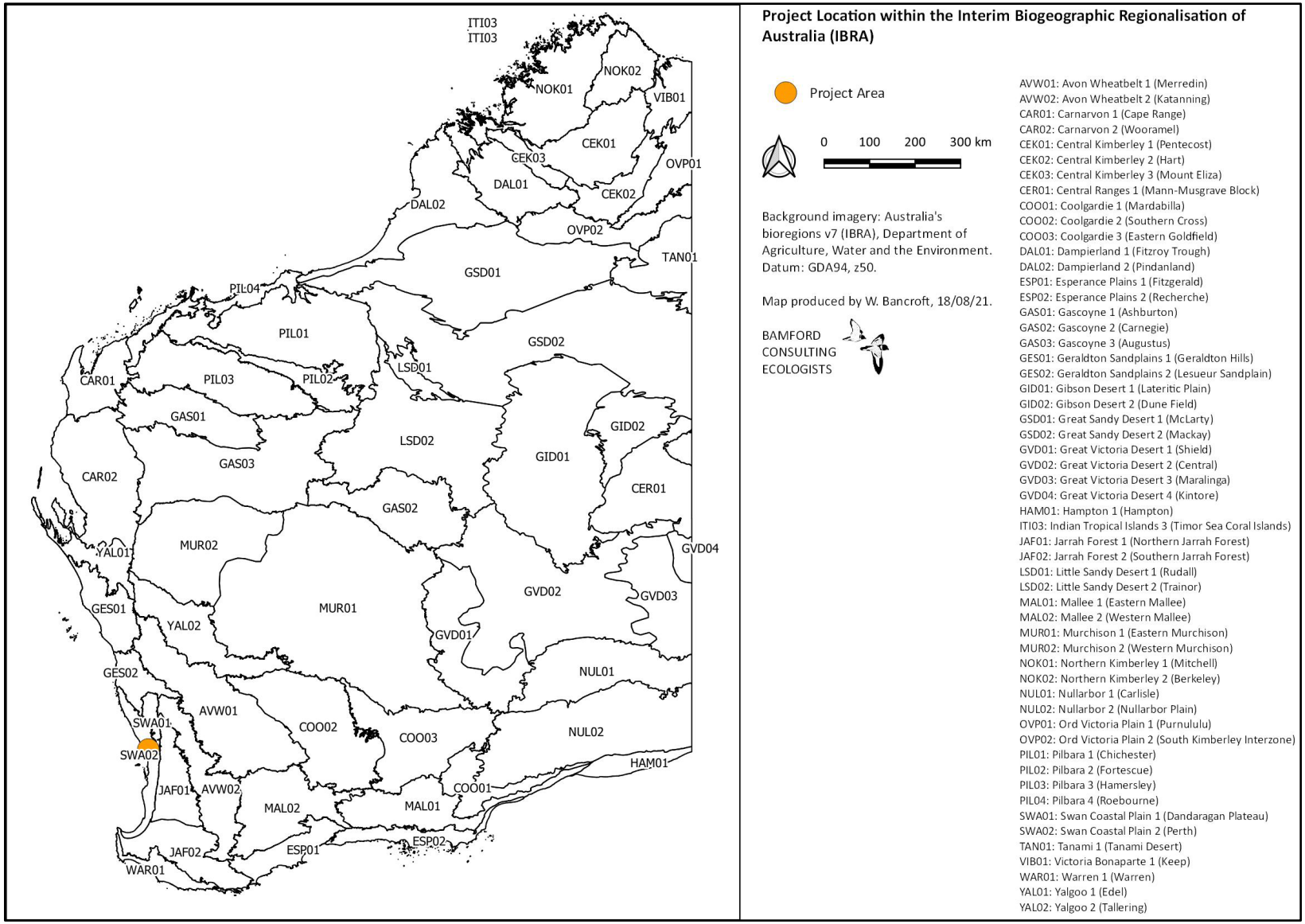

Figure 2. Project location within the Interim Biogeographic Regionalisation of Australia (IBRA).

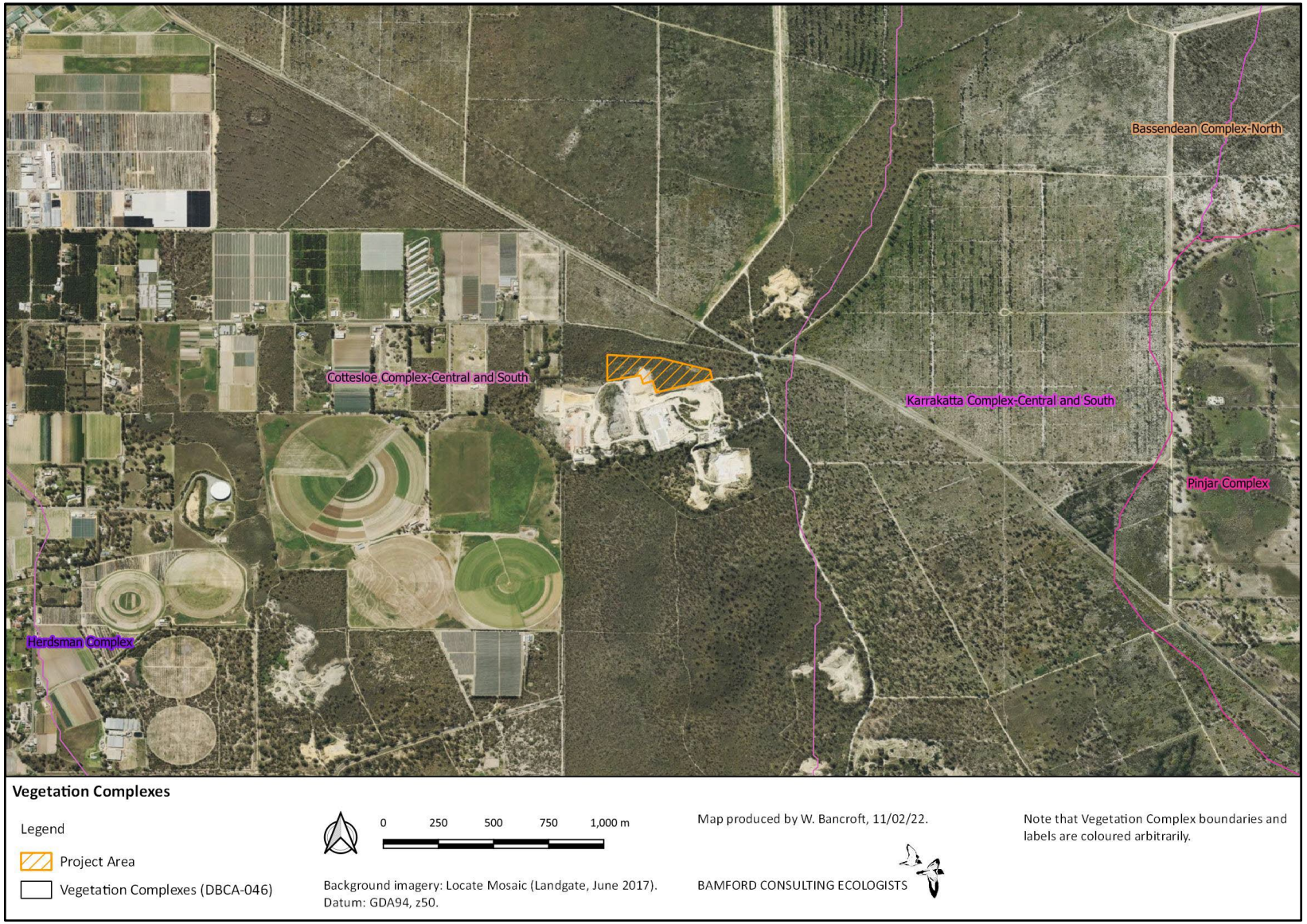

Figure 3. Vegetation Complexes (Heddle *et al*. 1980) in the vicinity of the Carabooda Project.

Figure 4. Bush Forever Sites (Dell and Banyard 2000) in the vicinity of the Carabooda Project.

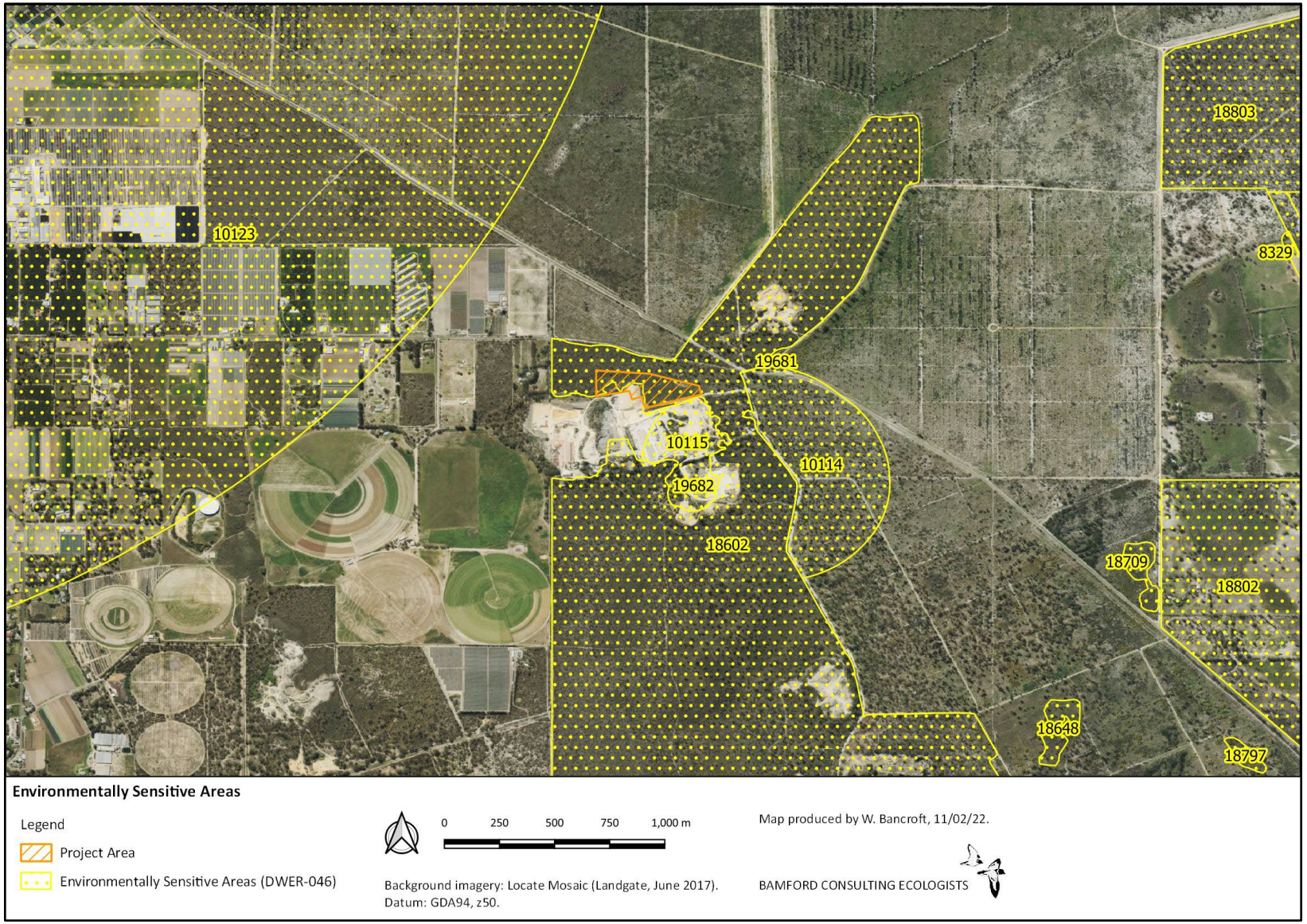

Figure 5. Environmentally Sensitive Areas (DWER 2022 a,b) in the vicinity of the Carabooda Project.

2 Methods

2.1 Overview

This approach to fauna impact assessment has been developed with reference to guidelines and recommendations set out by the Western Australian Environmental Protection Authority (EPA) on fauna surveys and environmental protection (EPA 2002, 2016c, b, 2020), and Commonwealth biodiversity legislation (DotE 2013; DSEWPaC 2013a). The EPA (2020) recommends three levels of investigation that differ in their approach for field investigations:

- Basic – a low-intensity survey, conducted at the local scale to gather broad fauna and habitat information (formerly referred to as 'Level 1'). The primary objectives are to verify the overall adequacy of the desktop study, and to map and describe habitats. A basic survey can also be used to identify future survey site locations and determine site logistics and access. The results from the basic survey are used to determine whether a detailed and/or targeted survey is required. During a basic survey, opportunistic fauna observations should be made and low-intensity sampling can be used to gather data on the general faunal assemblages present. While referred to as 'basic', this level of survey is involved and powerful, and should be considered the primary level of assessment. Other levels of assessment (where deemed necessary) add information to inform this primary level.
- Detailed – a detailed survey to gather quantitative data on species, assemblages and habitats in an area (formerly referred to as 'Level 2'). A detailed survey requires comprehensive survey design and should include at least two survey phases appropriate to the biogeographic region (bioregion). Surveys should be undertaken during the seasons of maximum activity of the relevant fauna and techniques should be selected to maximise the likelihood that the survey will detect most of the species that occur, and to provide data to enable some community analyses to be carried out.
- Targeted – to gather information on significant fauna and/or habitats, or to collect data where a desktop study or field survey has identified knowledge gaps. Because impacts must be placed into context, targeted surveys are not necessarily confined to potential impact areas. A targeted survey usually requires one or more site visits to detect and record significant fauna and habitats. For areas with multiple significant species there may not be a single time of year suitable to detect all species. In these cases, multiple visits, each targeting different species or groups, should be conducted.

The level of assessment recommended by the EPA (2020) is determined by geographic position, with a generic statement that detailed surveys are expected across all of the state except the south-west, but also recommending that site and project characteristics be considered, such as the survey objectives, existing available data, information required, the scale and nature of the potential impacts of the proposal and the sensitivity of the surrounding environment in which the disturbance is planned. These aspects should be considered in the context of the information acquired by the desktop study. When determining the type of survey required, the EPA (2020) suggested that the following be considered:

- level of existing regional knowledge
- type and comprehensiveness of recent local surveys
- degree of existing disturbance or fragmentation at the regional scale
- extent, distribution and significance of habitats

- significance of species likely to be present
- sensitivity of the environment to the proposed activities
- scale and nature of impact.

Guidance for field investigations methods is provided by the EPA (2016c, 2020) and by Bamford *et al.* (2013).

A 'basic' level survey (desktop review, fauna habitat identification and a site inspection) is considered appropriate for the current project. This is based upon the level of existing knowledge (see Section 2.3 below), the extent, distribution and significance of habitats (widespread) and the significance of species likely to be present (generally a limited assemblage of significant species).

The approach and methods utilised in this report are divided into three groupings that relate to the stages and the objectives of impact assessment:

- **Desktop assessment.** The purpose of the desktop review is to produce a species list that can be considered to represent the vertebrate fauna assemblage of the project area based on unpublished and published data using a precautionary approach.
- **Field investigations.** The purpose of the field investigations carried out for a Basic assessment is to gather information on the vegetation and soil associations ('habitats') that support the fauna assemblage and place the list generated by the desktop review into the context of the environment of the project area. The brief field investigations that form part of a Basic assessment also allow for some fauna observations to be made and assist the consultant to develop an understanding of the ecological processes that may be operating in the project area.
- **Impact assessment.** Determine how the fauna assemblage may be affected by the proposed development based on the interaction of the project with a suite of ecological and threatening processes.

2.1.1 Spatial terminology

A range of terms are used through the report to refer to the spatial environment around the proposed project, and these are defined below:

- Study area – the outermost boundary of the desktop assessment that is almost always a specified buffer distance (see Section 2.3.1 below) around the *survey area*. The study area thus encompasses the *survey area* but includes the area from which databases are sourced.
- Survey area – the *survey area* is the area to which the results of the desktop analysis are directed and/or the area within which field investigations are conducted. Note that while the term '*survey area*' is used throughout the guidance provided by EPA (2020), it does not appear to be explicitly defined and, therefore, the above definition has been developed with interpretation of both the guidance and BCE report structure.
- Project area – this may be equivalent to the *survey area* but is strictly the land over which the proponent has tenure or some control and within which on-site impacts may occur.
- Development footprint – the expected extent of land clearing and/or development.

Where available, these spatial boundaries are mapped in Figure 1.

2.2 Identification of vegetation and substrate associations (VSAs)

Vegetation and substrate associations (VSAs) combine vegetation types, the soils or other substrate with which they are associated, and the landform. In the context of fauna assessment, VSAs are the environments that provide habitats for fauna.

BCE deliberately makes the distinction between 'habitat' (a species-specific term that may encompass the whole or part of one or more VSAs and is the physical subset of an ecosystem that a given species, or species group, utilises) and 'VSA' (a general, discrete and mutually exclusive spatial division of a target area, based on soil, vegetation and topography). It is recognised, however, that, within the broader EIA literature/guidance, the former term is used more or less synonymously to indicate the latter (e.g.' habitat assessment' used by EPA 2020). Further discussion is provided in Appendix 1.

For the current assessment, VSAs were identified based on the consultant's previous experience in the area, a vegetation assessment of the site (by RPS), and on observations made during the field investigations.

2.3 Desktop assessment of expected species

2.3.1 Sources of information

As per the recommendations of EPA (2020), information on the fauna assemblage of the project area was drawn from a range of sources including databases (as listed in Table 2) and reports from other fauna surveys in the region (as listed in Table 3). Information from these sources was supplemented with species expected in the area based on general patterns of distribution. Sources of information used for these general patterns are listed in Table 4.

2.3.2 Previous fauna surveys

Bamford Consulting Ecologists has undertaken multiple previous fauna investigations in the region of the current study area (Table 3). These indicate the local experience of the Bamford Consulting team in the region. Fauna records from almost all these investigations would have been added to NatureMap, and NatureMap will also contain records from other consultants who have worked in the region.

Table 2. Databases searched for the desktop review; accessed August 2021.

Database	Type of records held in database	Area searched
BCE Database	Fauna recorded by BCE in the vicinity of the project area.	25 km buffer around the centroid of the project area (381990E, 6502585N; or 31.606° S, 115.756° E).
Atlas of Living Australia (ALA 2022)	Fauna records from Australian museums and conservation/research bodies, including records from BirdLife Australia's Atlas (Birdata) Database.	25 km buffer around the centroid of the project area (381990E, 6502585N; or 31.606° S, 115.756° E).
NatureMap (DBCA 2022d)	Records from the Western Australian Museum (WAM) and Department of Biodiversity, Conservation and Attractions (DBCA) databases, including historical data and Threatened and Priority species in WA.	25 km buffer around the centroid of the project area (381990E, 6502585N; or 31.606° S, 115.756° E).
EPBC Protected Matters Search Tool (DAWE 2022g)	Records on MNES protected under the EPBC Act.	25 km buffer around the centroid of the project area (381990E, 6502585N; or 31.606° S, 115.756° E).
Index of Biodiversity Surveys for Assessment (IBSA) (DWER 2022c)	Flora and fauna data contained in EIA biodiversity survey reports.	25 km buffer around the centroid of the project area (381990E, 6502585N; or 31.606° S, 115.756° E).

Table 3. Literature sources for the desktop review.

Author	Title
Syrinx Environmental and Bamford Consulting Ecologists (2011)	Yellagonga Regional Park Fauna Baseline Survey. Level 2 (Detailed) fauna survey. Unpubl. report to City of Joondalup.
Basnett, G. and Bamford, M. (2013).	Fauna Survey of the Hepburn Heights Conservation Area, Padbury. Unpubl. report to Syrinx Environmental and City of Joondalup. Level 2 (Detailed) fauna survey.
Bamford, M. (2006).	Jindee Fauna Assessment. Unpubl. report to RPS Bowman Bishaw Gorham. Level 2 (Detailed) fauna survey.
Bamford, M. and Everard, C. (2017)	Capricorn Coastal Reserve Fauna Assessment. Level 1 and targeted survey. Unpubl. report to strategen environmental (jbs&g).
Bamford, M (2020)	Neerabup Industrial Estate pre-clearing fauna survey and translocation. Unpubl. notes to EcoLogical Australia. Level 2 (Detailed) fauna survey.
McKenzie *et al.* (2009)	Neerabup Road Fauna Underpass Monitoring Project. Unpubl. report to Main Roads WA. Targeted survey.
Bamford, M., Gamblin, T., McCreery, A. and Huang, N. (2019).	Fauna Assessment for VRX Silica Muchea Silica Sands Project. Unpubl. report to VRX Silica. Level 2 (Detailed) fauna survey.
Valentine, L., Wilson, B., Johnson, B., Huang, N and Reaveley, A. (2008).	Gnangara Sustainability Strategy. Comprehensive survey of fauna and other environmental factors, including chapters on vertebrate fauna and black-cockatoos.
Wadey, J., Huang, N. and Bamford, M. (2022).	Fauna Assessment for Lots 5324 and 8037 Duringen Road, Cowalla. Unpubl. report to Focussed Vision Consulting Pty Ltd. Level 1 ('Basic') fauna investigation and targeted assessment for black-cockatoos.

Table 4. Sources of information used for general patterns of fauna distribution.

Taxa	Sources
Fish	Morgan *et al.* (1998), Allen *et al.* (2003), Morgan *et al.* (2014), DoF (2022).
Frogs	Tyler and Doughty (2009), Anstis (2017).
Reptiles	Storr *et al*. (1983, 1990, 1999, 2002), Bush and Maryan (2011), Wilson and Swan (2021).
Birds	Johnstone and Storr (1998, 2005), Menkhorst *et al*. (2017).
Mammals	Van Dyck and Strahan (2008), Churchill (2009), Menkhorst and Knight (2011).

2.3.3 Nomenclature and taxonomy

As per the recommendations of the EPA (2020), the nomenclature and taxonomic order presented in this report are generally based on the Western Australian Museum's (WAM) Checklist of the Fauna of Western Australia 2021. The authorities used for each vertebrate group were: fish (Morgan *et al.* 2014), frogs (Doughty 2021a), reptiles (Doughty 2021b), birds (BirdLife Australia 2019; Gill *et al.* 2022), and mammals (Travouillon 2021). In some cases, more widely-recognised names and naming conventions have been followed, particularly for birds where there are national and international naming conventions in place (e.g. the BirdLife Australia working list of names for Australian Birds, and the International Ornithological Congress' 'World Bird List'). Similarly, the group name 'black-cockatoo' is consistently used for all three taxa in the South-West. English common names of species, where available, are used throughout the text; Latin names are presented with corresponding English names in tables in the appendices. The use of subspecies is limited to situations where there is an important (and relevant) geographically distinct population, or where the taxonomic distinction has direct relevance to the conservation status or listing of a taxon.

2.3.4 Interpretation of species lists

2.3.4.1 Expected occurrence

Species lists generated from the review of sources of information are generous as they include records drawn from a large region (the study area, see Figure 1) and possibly from environments not represented in the project area. Therefore, some species that were returned by one or more of the database and literature searches have been excluded because their ecology, or the environment within the project area, determine that it is highly unlikely that these species will be present. Such species can include, for example, seabirds that might occur as extremely rare vagrants at a terrestrial, inland site, but for which the site is of no importance. Species returned from the databases and not excluded on the basis of ecology or environment are therefore considered potentially present or expected to be present in the project area at least occasionally, whether or not they were recorded during field surveys, and whether or not the project area is likely to be important for them. This list

of expected species is therefore subject to interpretation by assigning each a predicted status, the expected occurrence, in the project area. The status categories used are:

- **Resident:** species with a population permanently present in the project area;
- **Regular migrant or visitor:** species that occur within the project area regularly in at least moderate numbers, such as part of an annual cycle;
- **Irregular Visitor:** species that occur within the project area irregularly such as nomadic and irruptive species. The length of time between visitations could be decades but when the species is present, it uses the project area in at least moderate numbers and for some time;
- **Vagrant:** species that occur within the project area unpredictably, in small numbers and/or for very brief periods. Therefore, the project area is unlikely to be of importance for the species; and
- **Locally extinct:** species that would have been present but has not been recently recorded in the local area and therefore is almost certainly no longer present in the project area.

These status categories make it possible to distinguish between vagrant species, which may be recorded at any time but for which the site is not important in a conservation sense, and species which use the site in other ways but for which the site is important at least occasionally. This is particularly useful for birds that may naturally be migratory or nomadic, and for some mammals that can also be mobile or irruptive, and further recognises that even the most detailed field survey can fail to record species which will be present at times. The status categories are assigned conservatively based on the precautionary principle. For example, a lizard known from the general area is assumed to be a resident unless there is very good evidence the site will not support it, and even then it may be classed as a vagrant rather than assumed to be absent if the site might support dispersing individuals. It must be stressed that these status categories are predictions only and that often very intensive sampling would be required to confirm a species' status.

The results of the database searches were reviewed and interpreted, and obvious errors and out of date taxonomic names were deleted.

2.3.4.2 Conservation significance

All expected species were assessed for conservation significance as detailed in Appendix 1. Three broad levels of conservation significance are used in this report:

- Conservation Significance 1 (CS1) – species listed under State or Commonwealth Acts such as the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the Western Australian *Biodiversity Conservation Act 2016* (BC Act);
- Conservation Significance 2 (CS2) – species listed as Priority by DBCA but not listed under State or Commonwealth Acts; and
- Conservation Significance 3 (CS3) – species not listed under Acts or in publications, but considered of at least local significance because of their pattern of distribution.

See Appendix 1 for an expanded discussion of these categories and Appendix 2 for a description of the categories used in the legislation (EPBC and BC Acts) and by the DBCA.

2.4 Field investigations

2.4.1 Overview

A site inspection was conducted to familiarise the consultants with the project area. This involved looking around as much of the project area as possible; including walking through areas that did not have direct vehicle access. This enabled:

- identification of VSAs (that provide fauna habitats);
- targeted searches for significant fauna and an assessment of their likelihood of occurrence based on VSAs present;
- continuous recording of bird species encountered; and
- opportunistic fauna observations.

2.4.2 Dates

The project area was visited on the 15th June 2021.

2.4.3 Black-cockatoo habitat analysis

2.4.3.1 Guidelines

The Commonwealth Department of Agriculture, Water and the Environment (DAWE) provides guidelines for the referral of actions that may result in impact to black-cockatoos (for assessment under the EPBC Act). The survey and analysis reported here have been conducted with strong reference to both the existing guidelines (DSEWPaC 2012) as well as the recently revised draft guidelines (DEE 2017). This includes application of the foraging habitat scoring tool in DEE (2017). In addition, survey methodology followed the recommendations listed on the DAWE's Species Profile and Threats Database (DAWE 2022c, d, e). Ecological values for black-cockatoos within the site were based on the definitions of breeding, foraging and roosting habitat as per the EPBC Act referral guidelines for black-cockatoos (DSEWPaC 2012).

The DBCA has also indicated that the methodology developed and applied previously by BCE (e.g. Bancroft and Bamford 2021), and as described below, to score nesting value and foraging habitat is an acceptable approach.

2.4.3.2 Breeding

The aim of the breeding surveys was to record all potential hollow-bearing trees (suitable for black-cockatoo nesting) within the project area. The entire project area (see Figure 1), was examined for the presence of these trees. The following information was recorded for every suitable tree[1] with a diameter at breast height (DBH) equal to or greater than 500 mm:

- tree location;
- tree species;
- life status;
- DBH; and

[1] the draft revised EPBC Act study guidelines (DEE 2017) stress that any tree species may provide suitable hollows. Note that trees where the DBH criterion is >300mm do not occur at Lowlands.

- nest-tree rank: trees were assessed (from the ground) for the potential presence/quality of nest-hollows and allocated a nesting rank (developed by BCE) as described in Table 5.

The BirdLife Australia database of black-cockatoo breeding surveys was also searched for relevant local records (see Peck 2019).

Table 5. Ranking system for the assessment of potential nest-trees for black-cockatoos (revised 08/01/2021).

As per (DAWE 2022c, d, e) guidance, a potential nest-tree is any tree with a diameter at breast height >500 mm (or >300 mm for *Eucalyptus salmonophloia* and *E. wandoo*). Note that black-cockatoos favour vertical hollows for the nest chamber, but the hollow entrance may be vertical (a chimney hollow), have a side entrance or have a horizontal spout entrance.

Rank	Description of tree and hollows/activity
1	Activity at hollow observed; adult (or immature) bird seen entering or emerging from hollow. Can also be used for a known nest tree active in the previous 12 months (although this should be noted in the description). Note that activity at a hollow does not absolutely mean that breeding is occurring unless a young bird in hollow is observed.
2	Hollow of suitable size visible with chew marks around entrance. Record if chew-marks are recent or old.
3	Potentially suitable hollow visible but no chew marks present at entrance; or potentially suitable hollow suspected to be present - as suggested by structure of tree, such as large, vertical trunk broken off at a height of >8m; but note that hollow height is contextual. Carnaby's Black-Cockatoo will nest in hollows <5m so in a Wheatbelt breeding site a lower criterion may be more appropriate.
4	Tree with large hollows or broken branches that might contain large hollows, but hollows or potential hollows (nest chamber) are not vertical or near-vertical; thus a tree with or likely to have hollows of sufficient size but not to have hollows of the angle preferred by Black-Cockatoos. Trees with low but otherwise suitable hollows can also be assigned a rank or 4, depending on the species of black-cockatoo likely to be present.
5	Tree lacking large hollows or broken branches that might have large hollows; a tree with more or less intact branches and a spreading crown.

2.4.3.3 Foraging

The foraging value of the study area was assessed by calculating a foraging score for areas of similar vegetation type/condition (see Appendix 5). The foraging score provides a numerical value that reflects the significance of vegetation as foraging habitat for black-cockatoos, and this numerical value is designed to provide the sort of information needed by DAWE, Department of Water and Environmental Regulation (DWER) and the Environmental Protection Authority (EPA) to assess impact significance and offset requirements. The foraging value of the vegetation depends upon the type, density and condition of trees and shrubs in an area, and can be influenced by the context such as the availability of foraging habitat nearby. The BCE scoring system for value of foraging habitat has three

components as detailed in Appendix 5. These three components are drawn from the DAWE offset calculator but with the scoring approach developed by BCE:

- A score out of six for the vegetation composition, condition and structure.
- A score out of three for the context of the site.
- A score out of one for species density.

Foraging value can thus be assigned a score out of six, based upon site vegetation characteristics, or a score out of 10 if context and species density are also considered. A higher score represents better foraging value. A score out of 10 is presented for the purposes of aiding offset calculations. The approach to assigning scores for vegetation, context and species density are outlined in Appendix 5. Foraging value scores are calculated differently for the three black-cockatoo species (Appendix 5) depending upon the vegetation present; thus a separated score is given for each VSA for each species.

Black-cockatoo foraging signs were also recorded in conjunction with the breeding tree surveys (see Section 2.4.3.2) and general site inspections. When observed, the location, tree species and approximate age of the foraging evidence were recorded. Black-cockatoo foraging evidence may persist for some months or years after the foraging event. There is currently no published evidence documenting the deterioration process of forage. Factors that help to establish the time since foraging include: the colour of nuts/foliage, the degree of weathering or decay of debris, the presence of small fragments of nut debris, the position/compression of the foraging debris relative to surrounding vegetation and leaf litter, and the strength of the eucalypt smell emitted. Despite the absence of empirical data, four categories of foraging activity were recognised, based on the time since foraging:

(i) Active – where birds were observed in the act of foraging;
(ii) Recent – foraging signs (e.g. chewed nuts or vegetation) were 'fresh' (i.e. foraging was likely to have occurred within days to weeks). Recent foraging signs were typically green and/or with very little sign of weathering. Approximately less than four weeks old;
(iii) Intermediate – foraging was likely to have occurred within weeks to months previously. Approximately one to six months old; and
(iv) Old – foraging was likely to have occurred months to years previously. Approximately more than six months old.

As an indication, Appendix 6 shows examples of Forest Red-tailed Black-Cockatoo foraging signs across the range of these categories (note that it is uncertain as to the exact time frame for each stage).

2.4.3.4 Roosting

As the breeding and foraging surveys were conducted, areas likely to be used as roosting sites (e.g. sites adjacent to watercourses with large trees) or areas that had cockatoo activity in the late-afternoon were noted.

The BirdLife Australia Great Cocky Count (GCC) database of roost sites was also searched for relevant local records (see Peck *et al.* 2019).

2.5 Personnel

Personnel involved in the field investigations and report preparation (including desktop review) are listed in Table 6.

Table 6. Personnel involved in the field investigations and report preparation.

Personnel	EIA Experience	Field Investigations	Report Preparation
Dr Wes Bancroft *BSc (Zoology/Microbiology), Hons (Zoology), PhD (Zoology)*	24 years	+	+
Dr Mike Bamford *BSc (Biology), Hons (Biology), PhD (Biology)*	40 years		+

2.6 Survey limitations

The EPA Guidance Statement 56 (EPA 2004) and the EPA (2020) outline a number of limitations that may arise during field investigations for Environmental Impact Assessment. These survey limitations are discussed in the context of the BCE investigation of the project area in Table 7. No limitations were identified.

The lack of detailed survey (i.e. intensive sampling of the fauna assemblage) is not considered a limitation as this assemblage is well-understood in the area due to multiple previous field investigations. Furthermore, EPA guidance does not consider limitations related to the effectiveness of field sampling for fauna but appears to make an assumption that the purpose of such sampling is to confirm the fauna assemblage. This is implicit in the EPA (2020) technical guidance that does provide suggestions for sampling techniques, but the level of field investigations suggested cannot confirm the presence of an entire assemblage, or confirm the absence of a species. This requires far more work than is possible (or recommended) for studies contributing to the EIA process because fauna assemblages vary seasonally and annually, and often have high levels of variation even over short distances (Beta diversity). For example, in an intensive trapping study, How and Dell (1990) recorded in any one year only about 70% of the vertebrate species found over three years. In a study spanning over two decades, Bamford *et al.* (2010) found that the vertebrate assemblage varies over time and space, meaning that even complete sampling at a set of sites only defines the assemblage of those sites at the time of sampling. The limited effectiveness of short periods of fauna sampling is not a limitation for impact assessment *per se*, as long as database information is interpreted effectively and field investigations are targeted appropriately. That is the approach taken by BCE.

Table 7. Survey limitations as outlined by EPA (2020).

EPA Survey Limitations	BCE Comment
Availability of data and information	Sufficient information from databases and previous studies (see Section 2.3.1). Not a limitation.
Competency/experience of the survey team, including experience in the bioregion surveyed	The ecologists have had extensive experience in conducting desktop reviews and reconnaissance surveys for environmental impact assessment fauna studies, and have undertaken a number of studies within the region. See also Table 5 for further details. Not a limitation.
Scope of the survey (e.g. were faunal groups were excluded from the survey)	The survey focused on terrestrial vertebrate fauna and fauna values. Some information on threatened invertebrates was available from databases. Not a limitation.
Timing, weather and season	Timing is not of great importance for Basic level field investigations in this region. Not a limitation.
Disturbance that may have affected results	None. Not a limitation.
The proportion of fauna identified, recorded or collected	All fauna observed were identified. Not a limitation.
Adequacy of the survey intensity and proportion of survey achieved (e.g. the extent to which the area was surveyed)	The site was adequately surveyed to the level appropriate for a Basic level assessment. Fauna database searches covered a 25 km radius beyond the centroid of the project area. The Basic level assessment was completed. Not a limitation.
Access problems	There were no access problems encountered. Not a limitation.
Problems with data and analysis, including sampling biases	There were no data problems. Not a limitation.

2.7 Presentation of results for Impact Assessment

While some impacts are unavoidable during a development, of concern are long-term, deleterious impacts upon biodiversity. This is reflected in documents such as the Significant Impact Guidelines provided by DSEWPaC (2012), as summarised in Appendix 4. Significant impacts may occur if:

- There is direct impact upon a VSA and the VSA is rare, a large proportion of the VSA is affected and/or the VSA supports significant fauna.
- There is direct impact upon conservation significant fauna.
- Ecological processes are altered and this affects large numbers of species or large proportions of populations, including significant species.

The impact assessment process therefore involves reviewing the fauna values identified through the desktop assessment and field investigations with respect to the project and impacting processes. The severity of impacts on the fauna assemblage and conservation significant fauna can then be quantified on the basis of predicted population change.

The presentation of this assessment follows the general approach to impact assessment as given in Section 1.1, but modified to suit the characteristics of the site. Key components to the general approach to impact assessment are addressed as follows:

Fauna values

This section presents the results of the desktop and field investigations in terms of key fauna values (described in detail in Appendix 1) and includes:

- Recognition of ecotypes or vegetation/substrate associations (VSAs);
- Assemblage characteristics (uniqueness, completeness and richness);
- Species of conservation significance;
- Patterns of biodiversity across the landscape; and
- Ecological processes upon which the fauna depend.

Impact assessment

This section reviews impacting processes (as described in detail in Appendix 3) with respect to the proposed development and examines the potential effect these impacts may have on the faunal biodiversity of the project area. It thus expands upon Section 1.1 and discusses the contribution of the project to impacting processes, and the consequences of this with respect to biodiversity. A major component of impact assessment is consideration of threats to species of conservation significance as these are a major and sensitive element of biodiversity. Therefore, the impact assessment section includes the following:

- Review of impacting processes; will the proposal result in:
    - Habitat loss leading to population decline, especially for significant species;
    - Habitat loss leading to population fragmentation, especially for significant species;
    - Weed invasion that leads to habitat degradation;
    - Ongoing mortality;
    - Species interactions that adversely affect native fauna, particularly significant species;
    - Hydrological change;
    - Altered fire regimes; or
    - Disturbance (dust, light, noise)?
- Summary of impacts upon significant species, and other fauna values.

The impact assessment concludes with recommendations for impact mitigation, based upon predicted impacts. Note that the terms direct and indirect impacts are not used in this report; for further explanation see Appendix 3.

2.7.1 Criteria for impact assessment

Impact assessment criteria are based on the severity of impacts on the fauna assemblage and conservation significant fauna, and quantified on the basis of predicted population change (Table 8). Population change can be the result of direct habitat loss and/or impacts upon ecological processes.

The significance of population change is contextual. The EPA (2016c) suggested that the availability of fauna habitats within a radius of 15 km can be used as a basis to predict low, moderate or high impacts. In this case, a high impact is where the impacted environment and its component fauna are

rare (less than 5% of the landscape within a 15 km radius or within the Bioregion), whereas a low impact is where the environment is widespread (e.g. >10% of the local landscape). Under the Ramsar Convention, a wetland that regularly supports 1% of a population of a waterbird species is considered to be significant. These provide some guidance for impact assessment criteria. In the following criteria (Table 8), the significance of impacts is based upon percentage population decline within a 15 km radius (effectively local impact) and upon the effect of the decline upon the conservation status of a recognised taxon (recognisably discrete genetic population, sub-species or species). Note that percentage declines can usually only be estimated on the basis of the distribution of a species derived from the extent of available habitat while for a few species, such as the Black-Cockatoos, there is guidance for the assessment of impact significance.

The impact assessment concludes with recommendations based upon predicted impacts and designed to mitigate these.

Table 8. Assessment criteria for impacts upon fauna.

Impact Category	Observed Impact
Negligible	Effectively no population decline; at most few individuals impacted and any decline in population size within the normal range of annual variability.
Minor	Population decline temporary (recovery after end of project such as through rehabilitation) or permanent, but < 1% within 15 km radius of centre-point of impact area (or within bioregion if this is smaller). No change in viability or conservation status of taxon.
Moderate	Permanent population decline 1-10% within 15 km radius. No change in viability or conservation status of taxon.
Major	Permanent population decline 10-50% within 15 km radius. No change in viability or conservation status of taxon.
Critical	Taxon decline > 50% (including local extinction) within 15 km and/or change in viability or conservation status of taxon.

2.8 Mapping

Low resolution maps have been provided within the body this report. Higher resolution maps and GIS files can be supplied if required. As per the recommendation of EPA (2020), maps use the GDA94 datum and are projected into the appropriate Map Grid of Australia (MGA94) zone.

3 Fauna values

3.1 Vegetation and substrate associations (VSAs) ['Habitat assessment']

Vegetation and substrate associations within the project area are a complex mosaic, largely reflecting soil types. A full vegetation assessment of the site was conducted by PGV (2021). From this, and observations made during the field investigations here, five major vegetation and substrate associations (VSAs) were identified in relation to fauna in the project area:

VSA 1. Jarrah-Banksia woodland. Woodland dominated by Jarrah (*Eucalyptus marginata*) and Candlestick Banksia (*Banksia attenuata*) on pale sands. VSA 1 corresponds to the PGV (2021) vegetation category 'Emba': *Eucalyptus marginata* Woodland over *Banksia attenuata* Open to Low Woodland over *Xanthorrhoea preissii* Open Shrubland over *Hibbertia hypericoides* Low Shrubland to Closed Low Heath over *Mesomelaena pseudostygia* Very Open Sedgeland. See Plate 1.

VSA 2. Banksia-Sheoak woodland. Woodland dominated by tree banksias (particularly *Banksia attenuata*) and sheoak (*Allocasuarina fraseriana*) over shrubland on pale sands. VSA 2 corresponds to the PGV (2021) vegetation category 'BaAf': *Banksia attenuata*/*Allocasuarina fraseriana* Low Open Woodland over *Xanthorrhoea preissii/Hakea prostrata* Tall Shrubland over *Hibbertia hypericoides* Low Open Shrubland over *Tetraria octandra*/*Mesomelaena pseudostygia* Very Open Sedgeland. See Plate 2.

VSA 3. Mixed shrubland. Shrubland dominated by Parrot Bush (*Banksia sessilis*) and Grasstree (*Xanthorrhoea preissii*) with mixed other shrub species on orange-brown sands with some limestone outcropping. VSA 3 corresponds to the PGV (2021) vegetation category 'BsXp': *Banksia sessilis/ Xanthorrhoea preissii* Tall Open Scrub over *Melaleuca systena/Hakea lissocarpha* Open Shrubland over *Jacksonia sericea/Hibbertia hypericoides* Low Open Shrubland. See Plate 3.

VSA 4. Rehabilitation. Disturbed areas, with limestone substrate, that have undergone some rehabilitation of vegetation. VSA 4 corresponds to the PGV (2021) vegetation category 'Rehab': rehabilitation.

VSA 5. Cleared. Cleared or largely disturbed areas (e.g. roads, or where quarrying is being undertaken, or has taken place), or roads, tracks or drains. VSA 5 corresponds to the PGV (2021) vegetation category 'Cleared': cleared. See Plate 4.

The extent of the VSAs in the project area is mapped in Figure 6.

Plate 1. VSA 1: Jarrah-Banksia woodland.

Plate 2. VSA 2: Banksia-Sheoak woodland.

Plate 3. VSA 3: Mixed shrubland.

Plate 4. VSA 5: Cleared.

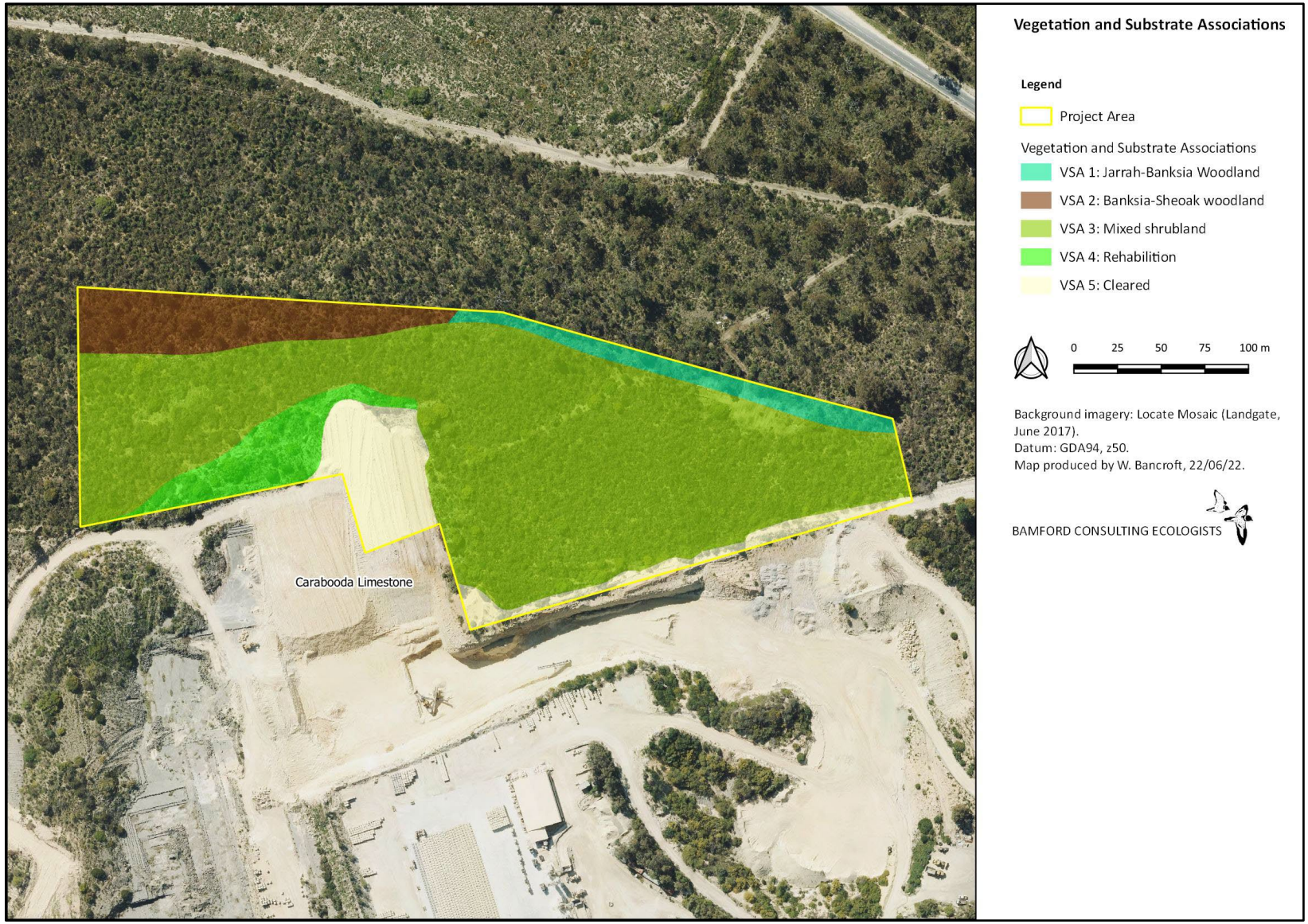

Figure 6. The distribution of VSAs in the project area.

3.1.1 Regional development

The project area is located within a highly fragmented natural landscape that has been largely cleared for housing, agriculture or plantations. Figure 7 illustrates the existing extent of development in a 15 km buffer around the project area. Existing developments (c. 28,677 ha) impact c. 47.8% of the total land area within this buffer (c. 59,957 ha). The proposed Carabooda site has a total area of c. 5.7 ha, of which at c. 1.0 ha has been cleared. Therefore, up to an additional 4.7 ha may be impacted and this would, at most, contribute 0.01% to the land clearing within the region, taking the total developments in the region to c. 47.81% of the area. It should be noted that the development footprint (see Section 2.1.1) of the Carabooda quarry within the project area may be less than this figure.

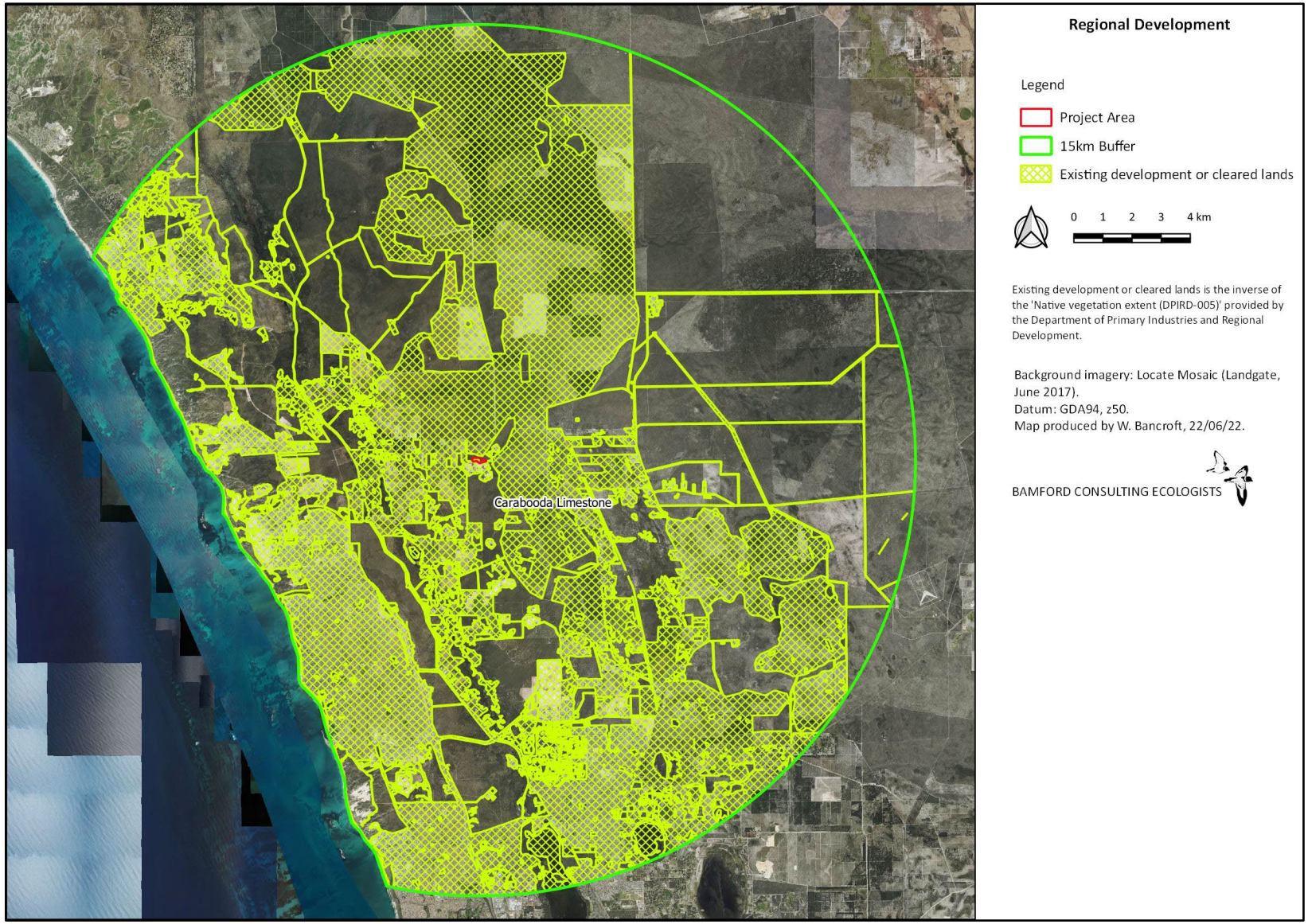

Figure 7. Estimated existing development within the region (15 km).

3.2 Fauna assemblage

3.2.1 Overview of vertebrate fauna assemblage

The desktop study identified 173 vertebrate fauna species as potentially occurring in the project area: no fish, eight frogs, 46 reptiles, 100 birds and 19 mammals. These species are listed in Appendix 7. The presence of at least 20 species (16 birds and four mammals) was confirmed during the 2021 site inspection (as presented in Appendix 8, but also indicated in Appendix 7).

Two hundred and forty-seven species (six fish, nine frogs, 30 reptiles, 174 birds and 28 mammals) that were returned by the database searches and/or literature review have been omitted from the expected species list because of habitat or range limitations, or because they are considered to be locally extinct in the project area. These species are listed in Appendix 9.

The composition of the vertebrate fauna is summarised in Table 9.

Table 9. Composition of vertebrate fauna assemblage of the project area.

The number of non-native species is shown in parentheses.

Taxon	Expected Species	Recorded Species	Number of species in each status category				
			Resident	Migrant or regular visitor	Irregular visitor	Vagrant	Locally extinct
Fish	0	0	0	0	0	0	0
Frogs	8	0	4	0	4	0	0
Reptiles	46	0	44	1	1	0	0
Birds	100 (6)	23	39	36	20	5	4
Mammals	19 (5)	3	11	7	0	1	9
Total	173 (11)	**23**	**98**	**42**	**27**	**6**	**13**

There is limited information on invertebrate fauna in the area; this fauna is discussed in Section 3.2.3.

3.2.2 Expected vertebrate fauna

While freshwater fish are known from the region, there was no suitable habitat for this group within the project area.

The eight frog species include four that are considered to be residents within the project area. These species spend much, or all, of their life cycle away from wetlands/damplands and may be wide-ranging through woodlands and heathlands. The remaining four species are more dependent on regular seasonal or permanent standing fresh water and are expected to be irregular visitors to the site; passing through when suitable conditions prevail and/or in very low numbers. There are no introduced species of frog expected.

The 46 reptile species are all considered to be residents with the exception of *Lerista lineopunctulata* and the Carpet Python which may occur as irregular or regular visitors. There are no introduced species of reptiles expected.

The bird assemblage of 100 species is much smaller than would be expected in the broader region. This is due to a limited range of VSAs present and, notably, the absence, or all-but-absence, of wetlands. Thirty-nine of the bird species are considered to be resident in the project area, with a further 36 that are regular visitors or migrants. A further 20 are expected to be irregular visitors and there are five vagrant species. There are six introduced species of birds expected to occur within the project area (three pigeons/doves, the Laughing Kookaburra, the Long-billed Corella and the Rainbow Lorikeet).

Most of the 19 mammal species are considered to be residents (11) or regular visitors (7), with the Chuditch considered to be a vagrant to the area. A large proportion of the original indigenous local mammal fauna has become extinct (9 species), as listed in Appendix 9, although several of these (e.g. dunnarts, pygmy-possum, Ash Grey Mouse) persist in less developed/impacted areas of the Swan Coastal Plain (e.g. well to the north of the project area). There are five introduced species of mammal expected to occur within the project area including two feral predators, two rodents and the Rabbit.

The key features of the fauna assemblage expected in the project area are:

- **Uniqueness:** The fauna assemblage is probably typical of the near-coastal shrublands, with some banksia and eucalypt woodlands, of the coastal plain north of Perth. This assemblage is only moderately well-represented due to extensive clearing.
- **Completeness:** The assemblage is likely to be substantially complete except for the mammal component, which is depauperate in both medium-sized and small species.
- **Richness:** The assemblage is likely to be only moderately rich in a regional context as the environment consists largely of shrublands and lacks wetlands, and the extensive banksia and eucalypt woodlands of the coastal plain slightly further east.

3.2.3 Invertebrate fauna of conservation significance

The project area sits within DBCA's Swan management region (DBCA 2022a). DBCA (2022f) listed 21 threatened or priority invertebrate fauna in this region, as outlined in Appendix 10. At least nine of these species can be immediately ruled out from occurring within the project area and the reasons for exclusion are presented in Appendix 10 (e.g. wholly or locally extinct, absence of suitable habitat in the project area, distance from known populations). To help ascertain the status of the remaining 12 species, all location records from ALA (2022) and WAM (2022) were compiled, collated and mapped in relation to the project area. A map of these DBCA-listed threatened and priority species is provided in Figure 6. Note that no records for *Australotomurus morbidus* (Cemetery Springtail) were available.

There are no records of threatened invertebrate fauna within the project area. Five species have been recorded from within the regional (15 km) buffer:

(i) *Austroconops mcmillani* (McMillan's Biting Midge - Swan Coastal Plain) – known from only a small number of very localised populations between Yanchep and Darkan where it appears to be associated with areas of damp soil or open water (Borkent and Craig 2004). While one of these records is only c. 10 km from the project area there is a low prevalence of this habitat type within the project area. Therefore, it is difficult to ascertain the likelihood of this species' occurrence. It is probably not present.

(ii) *Hesperocolletes douglasi* (Douglas's Broad-headed Bee) – known only from one or two records in the Pinjar/Muchea area (Arnold *et al.* 2019). A single female specimen was collected with a sweep net by Arnold *et al.* (2019) in a Banksia woodland remnant, c. 15km west of Muchea. While this record is only c. 4 km from the project area there is a low prevalence of this habitat type within the project area. Therefore, it is difficult to ascertain the likelihood of this species' occurrence. It is probably not present.

(iii) *Hylaeus globuliferus* (Woollybush Bee) – there have been a number of records of this species within 15 km of the project area, all of which are to the south. The Woollybush Bee occurs across a fairly broad region of south-western Australia, north to about Eneabba, east to the eastern edge of the wheatbelt and along the southern coast to Fitzgerald National Park near Hopetoun (ALA 2022). Houston (2018) notes that this species is known to forage on the flowers of Woollybush (*Adenanthos cygnorum*) and Candlestick Banksia (*Banksia attenuata*) which are very limited in occurrence within the project area. Therefore, it is unlikely that the project area would support the Woollybush Bee and that it is probably absent.

(iv) *Idiosoma sigillatum* (Swan Coastal Plain Shield-backed Trapdoor Spider) – there are several records of this species within 15 km of the project area, and tens of records to the south. Rix *et al.* (2017) noted that this species has a "relatively widespread although strictly … substrate-specific distribution along the Swan Coastal Plain of south-western Western Australia, from Dalyellup north to at least Ledge Point (including Rottnest Island and Garden Island)". While much of its previous range has been developed (as part of the greater Perth Metropolitan area) it still persists in areas of remnant bushland with "Banksia woodland and heathland on sandy soils". These habitats are present within the project area and, therefore, it is likely that Swan Coastal Plain Shield-backed Trapdoor Spider is present.

(v) *Synemon gratiosa* (Graceful Sun-Moth) – a number of records of this species are known from within 15 km of the project area, to the south. The Graceful Sun-Moth was previously listed as specially protected fauna under the WA Wildlife Conservation Act 1950 (rare or likely to

become extinct) and also as Endangered under the EPBC Act (Bishop *et al.* 2010a; Bishop *et al.* 2010b) but extensive surveys between 2009 and 2018 dramatically increased the known range of this species and it has been subsequently re-evaluated as a priority-listed species (Williams *et al.* 2021; ALA 2022). The moth is now known from a series of disjunct subpopulations between Binningup and Kalbarri, a range of 625 km, where it is mainly restricted to coastal and near-coastal sand dunes but extends into Banksia woodlands near Perth (Williams *et al.* 2021). Larvae feed on two host plants, *Lomandra maritima* (on coastal dunes) and *L. hermaphrodita* (in Banksia woodlands), the former of which is known from the project area (PGV 2021). It is therefore likely that this species is present.

Therefore, three known invertebrate species of conservation significance are most likely to occur in the vicinity of the project area:

- Swan Coastal Plain Shield-backed Trapdoor Spider – CS2 (P3)
- *Leioproctus contrarius* (a short-tongued bee) – CS2 (P3)
- Graceful Sun-Moth – CS2 (P4)

It should be noted that the ecology and distribution of short-range endemic invertebrates is often poorly understood or documented, and the project area occurs in a region that is remote and likely to be poorly-surveyed for these groups. Thus there may be undetected SRE species present.

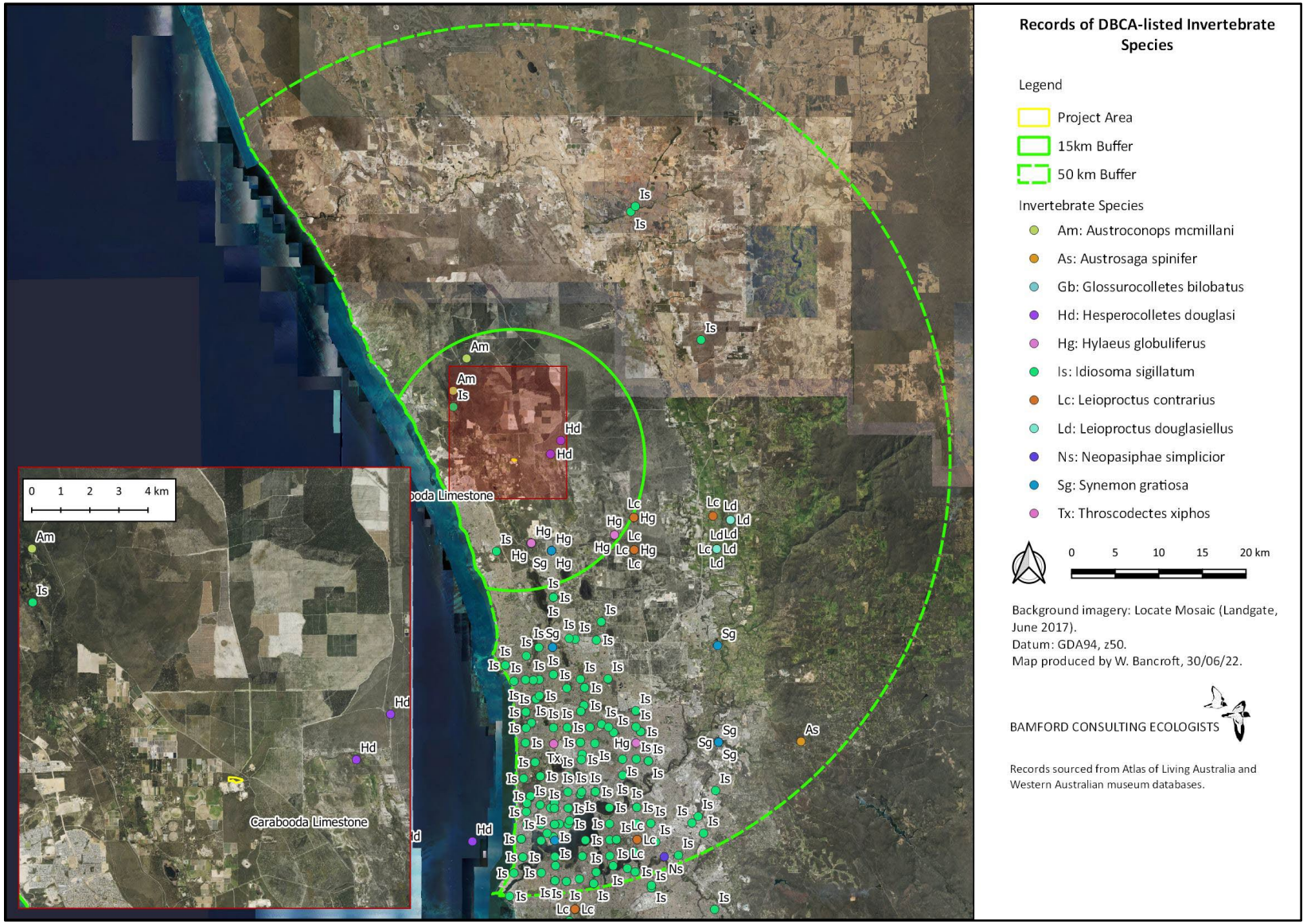

Figure 8. Records of DBCA-listed (threatened or priority) invertebrate species within 50 km of the project area.

3.2.4 Vertebrate fauna of conservation significance

Of the 173 species of vertebrate fauna that are expected to occur in the project area (Section 3.2.1 above), 42 are considered to be of conservation significance (five CS1, three CS2 and 34 CS3; see Appendix 1 for descriptions of these CS (conservation significance) levels). A summary of the numbers in each vertebrate class is presented in Table 10. These species of conservation significance are indicated in the complete species list (Appendix 7) but are also listed with details of their conservation significance in Table 11. The majority of conservation significant species are expected as residents or regular visitors/migrants visitors (30 species), with some irregular visitors (9 species) or vagrants (3 species).

Table 10. The number of conservation significant species in each vertebrate class.

See Appendix 1 for full explanation of Conservation Significance (CS) levels: CS1 = listed under WA State and/or Commonwealth legislation; CS2 = listed as Priority by DBCA; CS3 = considered locally significant.

CLASS	CONSERVATION SIGNIFICANCE			
	CS1	CS2	CS3	Total
Fish	0	0	0	**0**
Frogs	0	0	0	**0**
Reptiles	0	1	1	**2**
Birds	4	0	31	**35**
Mammals	1	2	2	**5**
Total	**5**	**3**	**34**	**42**

Table 11. Conservation significant fauna species expected to occur within the project area.

Species are listed in taxonomic order.
CS1, CS2, CS3 = (summary) levels of conservation significance. See Appendix 1 for full explanation.
EPBC Act listings: C = Critically Endangered, E = Endangered, V = Vulnerable, M = Migratory (see Appendix 2).
WA *Biodiversity Conservation Act 2016* (BC Act) listings: S1 to S7 = Schedules 1 to 7 (see Appendix 2).
DBCA Priority species: P1 to P4 = Priority 1 to 4 (see Appendix 2).
Bush Forever (Dell and Banyard 2000) status: HS = habitat specialists with a reduced distribution on the Swan Coastal Plain, WR = wide ranging species with reduced populations on the Swan Coastal Plain.
LS = considered by BCE to be of local significance (see Appendix 1).

SPECIES	COMMON NAME	STATUS	EXPECTED OCCURRENCE
Morelia spilota imbricata	Carpet Python (southwest)	CS3 (LS)	Regular visitor
Neelaps calonotos	Black-striped Snake	CS2 (P3)	Resident (if present)
Dromaius novaehollandiae	Emu	CS3 (WR)	Regular visitor
Phaps chalcoptera	Common Bronzewing	CS3 (HS)	Resident
Phaps elegans	Brush Bronzewing	CS3 (HS)	Irregular visitor
Apus pacificus	Fork-tailed Swift	CS1 (M,Mar,S5)	Vagrant
Turnix varius	Painted Button-quail	CS3 (WR)	Resident
Lophoictinia isura	Square-tailed Kite	CS3 (WR)	Regular visitor
Aquila audax	Wedge-tailed Eagle	CS3 (WR)	Regular visitor
Hieraaetus morphnoides	Little Eagle	CS3 (WR)	Regular visitor
Accipiter fasciatus	Brown Goshawk	CS3 (WR)	Regular visitor
Accipiter cirrocephalus	Collared Sparrowhawk	CS3 (WR)	Regular visitor
Haliastur sphenurus	Whistling Kite	CS3 (WR)	Regular visitor
Falco peregrinus	Peregrine Falcon	CS1 (S7)	Regular visitor
Calyptorhynchus banksii naso	Forest Red-tailed Black-Cockatoo	CS1 (V,S3)	Irregular visitor
Calyptorhynchus latirostris	Carnaby's Black-Cockatoo	CS1 (E,S2)	Regular migrant
Malurus assimilis	Purple-backed Fairy-wren	CS3 (HS)	Resident
Malurus splendens	Splendid Fairy-wren	CS3 (HS)	Resident
Malurus leucopterus	White-winged Fairy-wren	CS3 (HS)	Regular visitor
Stipiturus malachurus	Southern Emu-wren	CS3 (HS)	Regular visitor
Phylidonyris novaehollandiae	New Holland Honeyeater	CS3 (WR)	Resident
Phylidonyris niger	White-cheeked Honeyeater	CS3 (WR)	Resident
Glyciphila melanops	Tawny-crowned Honeyeater	CS3 (WR)	Regular visitor
Anthochaera lunulata	Western Wattlebird	CS3 (WR)	Regular visitor
Manorina flavigula	Yellow-throated Miner	CS3 (WR)	Irregular visitor
Smicrornis brevirostris	Weebill	CS3 (HS)	Resident
Sericornis frontalis	White-browed Scrubwren	CS3 (HS)	Resident
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	CS3 (HS)	Resident

SPECIES	COMMON NAME	STATUS	EXPECTED OCCURRENCE
Acanthiza apicalis	Inland Thornbill	CS3 (HS)	Resident
Acanthiza inornata	Western Thornbill	CS3 (HS)	Irregular visitor
Daphoenositta chrysoptera	Varied Sittella	CS3 (HS)	Irregular visitor
Colluricincla harmonica	Grey Shrike-thrush	CS3 (HS)	Resident
Strepera versicolor	Grey Currawong	CS3 (WR)	Irregular visitor
Artamus personatus	Masked Woodswallow	CS3 (WR)	Vagrant
Artamus cyanopterus	Dusky Woodswallow	CS3 (WR)	Regular visitor
Petroica boodang	Scarlet Robin	CS3 (HS)	Regular visitor
Quoyornis georgianus	White-breasted Robin	CS3 (HS)	Irregular visitor
Dasyurus geoffroii fortis	Chuditch	CS1 (V,S3)	Vagrant
Isoodon fusciventer	Quenda	CS2 (P4)	Resident
Tarsipes rostratus	Honey Possum, Noolbenger	CS3 (LS)	Resident
Notamacropus irma	Brush Wallaby	CS2 (P4)	Regular visitor
Rattus fuscipes fuscipes	Western Bush Rat, Moodit	CS3 (LS)	Resident
Idiosoma sigillatum	Swan Coastal Plain Shield-backed Trapdoor Spider	CS2 (P3)	Resident
Leioproctus contrarius	a short-tongued bee	CS2 (P3)	Resident (if present)
Synemon gratiosa	Graceful Sun-Moth	CS2 (P4)	Resident

3.2.5 Conservation significant species accounts

A list of all conservation significant species expected within the project area is provided in Table 11; these comprise three invertebrates (see also Section 3.2.3) and 42 vertebrates (see also Section 3.2.4). Information on the conservation status, distribution and habitat, salient ecology and expected occurrence within the project area if provided for each of these species is below (and, for invertebrates, in Section 3.2.3).

3.2.5.1 Conservation Significance 1

Fork-tailed Swift (*Apus pacificus*) CS1 (M,S5)

Conservation status: Migratory under the EPBC Act and Schedule 5 under the BC Act.

Distribution and habitat: The swift is a largely aerial species of unpredictable occurrence in Western Australia. There are scattered records from the south coast, widespread in coastal and subcoastal areas between Augusta and Carnarvon, scattered along the coast from south-west Pilbara to the north and east Kimberley region. Sparsely scattered inland records, especially in the Wheatbelt, but more common in the north and north-west Gascoyne Region, north through much of the Pilbara Region, and the south and east Kimberley (Higgins 1999; DAWE 2022a). Aerial, usually flying from as low as one metre to in excess of 300 m above the ground.

Ecology: A diurnal, aerial insectivore, this species often forages along the edge of low pressure systems in flocks of ten to 1000 birds (Higgins 1999; DAWE 2022a). Breeds in Siberia (April to July) and spends the non-breeding season (October to mid-April) in Australia. Being aerial, it is effectively independent of terrestrial ecosystems when in Australia.

Expected occurrence: Vagrant. Likely to be occasionally but unpredictably present within the region, and to pass over the project area on an occasional basis.

Peregrine Falcon (*Falco peregrinus*) CS1 (S7)

Conservation status: Schedule 7 under the BC Act.

Distribution and habitat: More or less cosmopolitan throughout Australia (Menkhorst *et al.* 2017). This species occurs in a variety of habitats but is usually reliant on cliff faces or tall trees for nesting (Debus 2019).

Ecology: A highly adept aerial predator that predominantly forages on birds, although will also occasionally take invertebrates, fish, reptiles and mammals (Debus 2019). Mostly diurnal or crepuscular.

Expected occurrence: Regular visitor. Wide-ranging and likely to pass over the project area on a regular basis.

Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*) CS1 (V,S3)

Conservation status: Vulnerable under the EBPC Act and Schedule 3 under the BC Act.

Distribution and habitat: Endemic to the deeper south-west of Western Australia, from around Gingin in the north, east to Mount Helena, North Bannister and Mount Saddleback, and south to around Albany (Johnstone and Storr 1998). In recent years there appears to have been a distinct expansion of the range of this species on to the Swan Coastal Plain, including many suburbs within the Perth metropolitan area. Generally restricted to areas of Jarrah-Marri forest, farmlands with remnant trees and urban landscapes. Forest Red-tailed Black-Cockatoos are currently considered not to undergo regular migration (DAWE 2022c). Two other sub-species occur in Western Australia: *C. b. escondidus* in the western mid-west and Pilbara, and *C. b. macrorhynchus* in the Kimberley (Johnstone and Storr 1998). Neither of these is a conservation significant taxon.

Ecology: Diurnal granivore, feeding predominantly on the seeds of Jarrah and Marri (Johnstone and Kirkby 1999; Johnstone *et al.* 2013b) but is also adapting to foraging on urban (introduced) plant species. Reliant on large tree-hollows in eucalypts (especially Marri) for breeding (Johnstone *et al.* 2013a; DAWE 2022c). Threatened by habitat loss, habitat degradation, nest hollow shortage, and competition for available nest hollows from other parrots and feral Honeybees (DAWE 2022c).

Expected occurrence: Irregular visitor. The project area is at the limit of this species' range and supports very little suitable foraging or breeding habitat but, given the expansion of this species' distribution on the Swan Coastal Plain, irregular occurrence cannot be ruled out.

Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*) CS1 (E,S2)

Conservation status: Endangered under the EPBC Act and Schedule 2 under the BC Act.

Distribution and habitat: Endemic to south-western Western Australia, from Kalbarri in the north, east to Merredin and Ravensthorpe, and then further east along the south coast to the Esperance area (Johnstone and Storr 1998; DAWE 2022e). Breeds (July to December) predominantly in the east of its range with a migration to coastal areas in the non-breeding period. In recent years, however, the species has expanded its breeding range westward and south into the Jarrah-Marri forests of the Darling Scarp and into the Tuart forests of the Swan Coastal Plain (DAWE 2022e). Heavily reliant on areas of Banksia woodland and proteaceous shrubland/heath for foraging (Johnstone and Storr 1998; DAWE 2022e).

Ecology: Diurnal granivore, feeding predominantly on the seeds of the Proteaceae (especially banksias) but also known to feed on a very wide variety of plants, including non-native ornamentals and plantation species such as pine (Valentine and Stock 2008; Groom 2011; DPaW 2013; Johnston *et al.* 2016; DAWE 2022e). Reliant on large tree-hollows in eucalypts (especially smooth-barked species such as Wandoo and Salmon Gum) for breeding (Saunders 1974; Johnstone and Storr 1998; Morgan *et al.* 1998; DAWE 2022e). Threatened by habitat loss, habitat degradation, nest hollow shortage, and competition for available nest hollows from other parrots and feral Honeybees, illegal shooting and illegal trade (Burbidge 2004; DAWE 2022e).

Expected occurrence: Regular migrant. Known to occur within the project area with some foraging plants available (in particular *Banksia attenuata* and *B. sessilis*). Foraging and nesting values of the project area for the species are assessed in section 3.3.

Chuditch (*Dasyurus geoffroii fortis*) CS1 (V,S3)

Conservation status: Vulnerable under the EBPC Act and Schedule 3 under the BC Act.

Distribution and habitat: The Chuditch is a wide-ranging resident in Marri-Jarrah forest of the south-west of Western Australia and also in heaths and eucalypt woodlands of the eastern wheatbelt and goldfields (Van Dyck and Strahan 2008). This species was formerly distributed throughout much of western and inland Australia but its range has contracted to the region approximately south-west of a line between Shark Bay and Esperance (Burbidge 2004; Van Dyck and Strahan 2008; DAWE 2022f).

Ecology: The Chuditch is a nocturnal, terrestrial carnivore, feeding mainly on smaller vertebrates (e.g. reptiles, birds and mammals) and large invertebrates (Burbidge 2004; Van Dyck and Strahan 2008). During the day Chuditch shelter in dens; predominantly hollow logs and earth burrows (Van Dyck and Strahan 2008). Chuditch have a large home range, with females in the deeper south-west occupying 55-120 ha and males ranging over 400 ha or more (Van Dyck and Strahan 2008). Further east, Rayner *et al.* (2012) found that Chuditch in the Forrestania area occurred at an average density of 0.039 individuals/km^2, with home ranges as small as 189 ha (a female) and as large as 2,125 ha (a male).

Expected occurrence: Vagrant. Wide-ranging and likely to be present in the project area only as a vagrant. A juvenile male was caught about 10 km to the east in 2004, in dense riparian vegetation in the Gnangara pine plantation (M. Bamford pers obs.).

3.2.5.2 Conservation Significance 2

Black-striped Snake (*Neelaps calonotos*) CS2 (P3)

Conservation status: Listed as Priority 3 by DBCA.

Distribution and habitat: Restricted to coastal sandplains from near Dongara to Mandurah (Bush *et al.* 2010). Appears to be absent from the eastern coastal plain (M. Bamford pers. obs.). Within the Perth Metropolitan area this species may be restricted to large reserves (How and Shine 1999).

Ecology: A fossorial species that preys upon small, fossorial skinks in the upper layers of loose sand (Bush *et al.* 2010).

Expected occurrence: Resident (if present). Some suitable habitat is present within the project area.

Quenda (*Isoodon fusciventer*) CS2 (P4)

Conservation status: Listed as Priority 4 by DBCA.

Distribution and habitat: The Quenda formerly occurred across the south-west of Western Australia from Geraldton to east of Esperance, including the wheatbelt, but it now has a much-reduced range, with few records north of Yanchep/Muchea on the coastal plain, and it is more or less extinct across the Wheatbelt (Van Dyck and Strahan 2008; Travouillon and Phillips 2018). It persists around Perth, particularly in areas of dense vegetation around wetlands, and it remains locally common in suitable environments (Howard *et al.* 2014).

Ecology: Omnivorous and cathemeral (active throughout the day and night) Quenda feed on invertebrates, plant material and fungi (Van Dyck and Strahan 2008). It is one of the few native, terrestrial mammals to persist in semi-urban landscapes in the south-west. Populations of this species have declined due to ongoing threats from feral predators and land-clearing (Van Dyck and Strahan 2008; Howard *et al.* 2014).

Expected occurrence: Resident. Known to occur within the project area and suitable habitat present.

3.2.5.3 Conservation Significance 3

Carpet Python (southwest) (*Morelia spilota imbricata*) CS3 (LS)

Conservation status: This subspecies was formerly listed under the Western Australian *Wildlife Conservation Act 1950* as 'other specially protected fauna' but that status has, more recently, been removed in the WA *Biodiversity Conservation Act 2016* (DBCA 2022f). It is likely to remain uncommon or at risk in the proximity of development.

Distribution and habitat: Patchily distributed through south-west Western Australia in a wide range of habitats including woodlands, heaths and rock outcrops (Bush *et al.* 2010; Wilson and Swan 2021). It is particularly common in areas of exposed limestone, including offshore islands (Bush *et al.* 2010).

Ecology: Predominantly a nocturnal carnivore, the Carpet Python preys mainly on birds and mammals, although reptiles are occasionally taken (Bush *et al.* 2010).

Expected occurrence: Regular visitor. Parts of the project area are well suited to this species and it is known to occur in nearby Neerabup National Park, so individuals can at least be expected as regular visitors.

Habitat specialist or wide-ranging bird species with reduced populations on the Swan Coastal Plain (31 species; see Table 10) CS3 (LS)

Conservation status: These species have all been noted by Dell and Banyard (2000) as either habitat specialists or wide ranging species with a reduced population on the Swan Coastal Plain and are, therefore, considered locally significant.

Distribution and habitat: Generally species that require larger areas of intact native remnants to persist.

Ecology: There is a wide range of foraging strategies in this group but the majority of the species are small insectivores or honeyeaters. Also includes ground-foraging granivores (e.g. Emu, bronzewings, button-quail) and nectarivores (honeyeaters).

Expected occurrence: Most species are expected to be residents or regular visitors, although a number are expected as irregular visitors or vagrants (see Table 10).

Honey Possum (*Tarsipes rostratus*) CS3 (LS)

Conservation status: While locally abundant in good seasons in suitable habitat, this species is struggling to persist on the Swan Coastal Plain in the vicinity of development (e.g. urban areas, agriculture, plantations etc.).

Distribution and habitat: Occurs in sandplain heaths and woodlands of south-western Australia (south-west from Kalbarri area to Esperance) and along the south-eastern coast (Van Dyck and Strahan 2008; ALA 2022).

Ecology: A nocturnal nectarivore, the Honey Possum is dependent on a high diversity of nectar-producing plants that can provide year-around food resources (Van Dyck and Strahan 2008).

Expected occurrence: Resident. Suitable habitat, with good nectar supply, exists within the project area. The Honey Possum persists in moderate numbers in suitable habitat on the northern margins of Perth, with records within a few kilometres of the Wanneroo City Centre (M. Bamford pers. obs.).

Moodit or Western Bush Rat (*Rattus fuscipes fuscipes*) CS3 (LS)

Conservation status: While locally common in suitable habitat, this species is struggling to persist on the Swan Coastal Plain in the vicinity of development (e.g. urban areas, agriculture, plantations etc.).

Distribution and habitat: The Bush Rat (*R. fuscipes*) occurs along the south-west, southern and eastern coastlines of Australia in coastal scrubs, heaths, eucalypt forests and rainforests that provide dense cover (Van Dyck and Strahan 2008). The western subspecies, the Western Bush Rat, occurs generally within 100 km of the coast between Geraldton and Israelite Bay, east of Esperance, in Western Australia (ALA 2022).

Ecology: The Western Bush Rat is nocturnal and secretive omnivore, feeding on fungi, seeds, fruits and invertebrates (Van Dyck and Strahan 2008). The availability of food through the winter appears to limit populations of this species (Van Dyck and Strahan 2008).

Expected occurrence: Resident. Suitable habitat exists within the project area. The species was recorded in Neerabup in 2020 during fauna translocation prior to clearing in the nearby Neerabup industrial area (M. Bamford pers obs).

3.3 Black-cockatoo habitat analysis

3.3.1 Black-cockatoo presence

Only one of the three species of black-cockatoo known to occur in the south-west of Western Australia was directly recorded on the site during the site inspection: Carnaby's Black-Cockatoo. This was just outside of the northern boundary of the project area; two birds, a female and young, were observed perched in a Tuart, and there were two other birds calling from nearby. There was indirect (foraging) evidence of the presence of this species within the survey area, as presented in Section 3.3.3 below.

Given these direct observations, indirect (foraging) records (see Section 3.3.3 below), roosting data (see Section 3.3.4 below) and the literature review (including current species distributions), it is considered that, currently:

- Carnaby's Black-Cockatoo is likely to be a regular non-breeding migrant to the site in moderate numbers.
- Forest Red-tailed Black-Cockatoo is likely to be an irregular visitor to the site. The project area is at the limit of this species' range and supports very little suitable foraging or breeding habitat but, given the expansion of this species' distribution on the Swan Coastal Plain, irregular occurrence cannot be ruled out.
- Baudin's Black-Cockatoo is unlikely to use the site as it is outside its normal/expected range.

3.3.2 Black-cockatoo breeding habitat

One tree that met the potential nest-tree criteria of DAWE (2022c, d, e) and DEE (2017) was recorded just outside of the project area. This was a live Tuart (*E. gomphocephala*), with a DBH of 750 mm and assessed as a rank '3' (potentially suitable hollow), located at 382087E, 6502671N. The location of this tree is mapped in Figure 10.

3.3.3 Black-cockatoo foraging habitat

3.3.3.1 Carnaby's Black-Cockatoo

Foraging habitat for the Carnaby's Black-Cockatoo was present throughout the Carabooda site. This is predominantly due to the presence of one tree species and one shrub species known to be mainstays of the Carnaby's Black-Cockatoo diet: *Banksia attenuata* and *B. sessilis* (Groom 2011). The most widespread of these was *B. sessilis* and, where it occurred, it was generally in moderate to high density. There were also some areas of low to no *B. sessilis* density. Based upon guidance on the assessment of foraging values of vegetation (Appendix 5), the areas of moderate density *B. sessilis* are assigned a vegetation score of 4 out of 6. There were also some small pockets of the tree banksias (see Figure 6) that were also scored 4 out of 6. The areas (and percentages) of each vegetation score for each VSA are shown for the Carnaby's Black-Cockatoo in Table 12. A map of vegetation scores for Carnaby's Black-Cockatoo foraging within the project area is presented in Figure 9.

There are approximately 31,280 ha of remnant native vegetation (as assessed by DPIRD 2022) within 15 km of the project area, which itself has c. 4.6 ha of native vegetation. Therefore, the site comprises c. 0.01% of the native vegetation in the 'local area' (as per the methods outlined in Appendix 5). It is likely that the Carnaby's Black-Cockatoo breeds within the local area, given the proximity to Tuart forests in the region. Thus, a 'context' score of 1 (out of 3) has been assigned to the project area for this species (see Appendix 5). This low context score is assigned because despite the moderate quality of foraging habitat and the presence of breeding nearby, the area of habitat is small and foraging habitat is widespread nearby.

There was evidence of foraging by the Carnaby's Black-Cockatoo throughout the project area. This was almost entirely foraging on *B. sessilis* (with recent and intermediate-aged signs noted); in most areas where this plant species occurred there was evidence of foraging by Carnaby's Black-Cockatoo. There were also several records of Carnaby's Black-Cockatoos having fed on *Banksia attenuata and Hakea prostrata*. The locations of these records are shown in Figure 10. It is expected that Carnaby's Black-Cockatoo will occur regularly (including foraging) within the project area. Therefore the project area was assigned a species 'density' score for Carnaby's Black-Cockatoo of 1 (out of 1; see Appendix 5).

The context and density values have been added on to the vegetation scores to yield the overall foraging value scores (with areas and percentages) that are also presented in Table 12.

The project area is, generally, of moderate value for foraging by the Carnaby's Black-Cockatoo and there was evidence to show that this species has previously used the site for feeding.

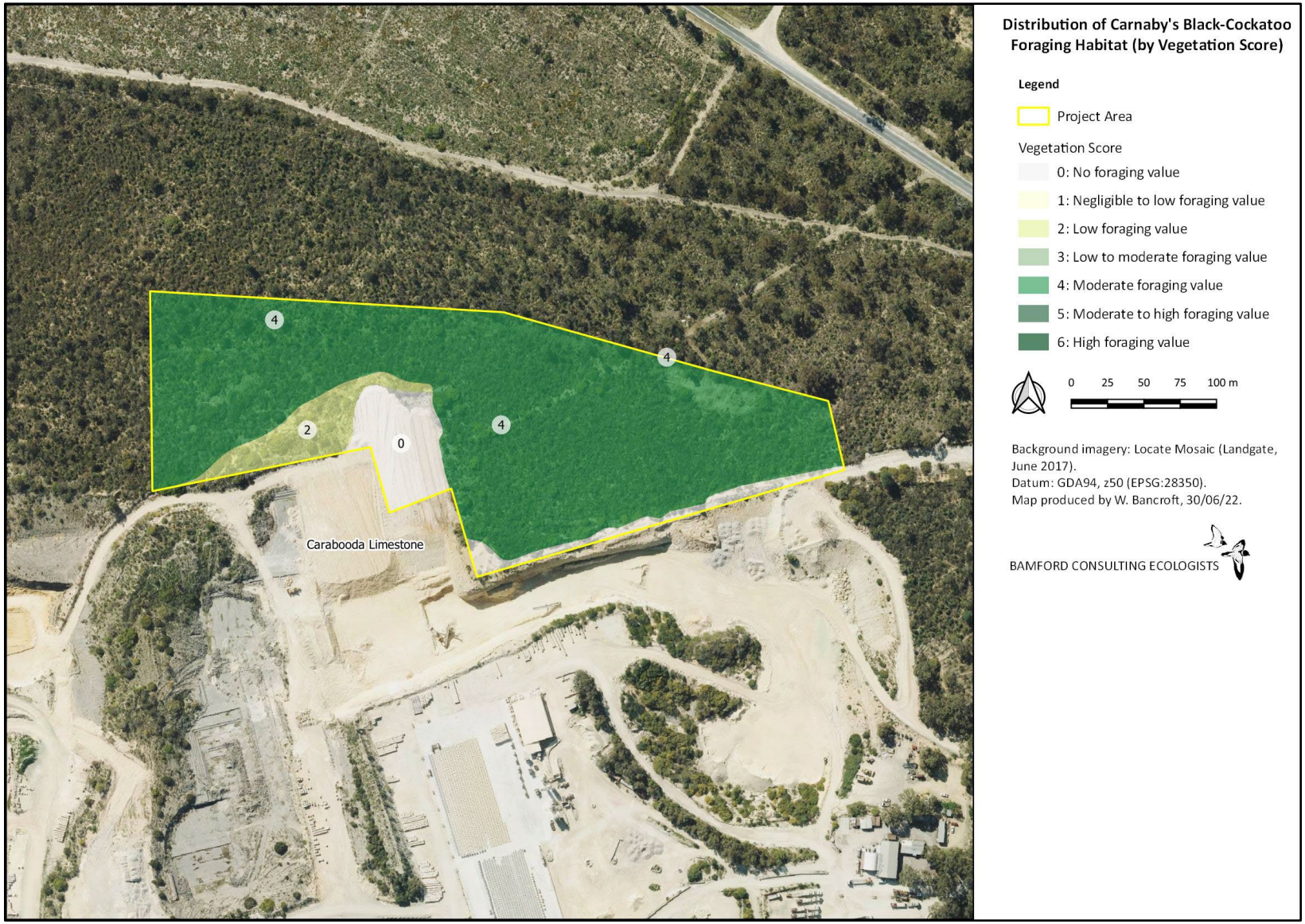

Figure 9. Distribution of Carnaby's Black-Cockatoo vegetation scores within the project area.

Table 12. Areas (ha) and proportions (%) of each category (vegetation score, combined foraging score) of foraging habitat at the survey area for Carnaby's Black-Cockatoo and Forest Red-tailed Black-Cockatoo.

See Section 2.4.3.3 and Appendix 8 for explanation of vegetation, context, species density and (combined) foraging scores.

	Carnaby's Black-Cockatoo		Forest Red-tailed Black-Cockatoo	
Vegetation Score/Value	**Area (ha)**	**%**	**Area (ha)**	**%**
6: High	0.0	0.0	0.0	0.0
5: Moderate to High	0.0	0.0	0.0	0.0
4: Moderate	4.7	83.3	0.0	0.0
3: Low to Moderate	0.0	0.0	0.3	14.3
2: Low	0.4	6.2	0.0	0.0
1: Negligible	0.0	0.0	0.0	0.0
0: Nil	0.6	10.5	4.9	85.7
TOTAL	5.7	100.0	5.7	100.0
Context Score	1		0	
Species Density Score	1		0	
Foraging Score				
10	-	-	-	-
9	-	-	-	-
8	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0
6	4.7	83.3	0.0	0.0
5	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0
3	0.0	0.0	0.3	14.3
NA (Vegetation Score < 3)	1.0	16.7	4.9	85.7
TOTAL	5.7	100.0	5.7	100.0

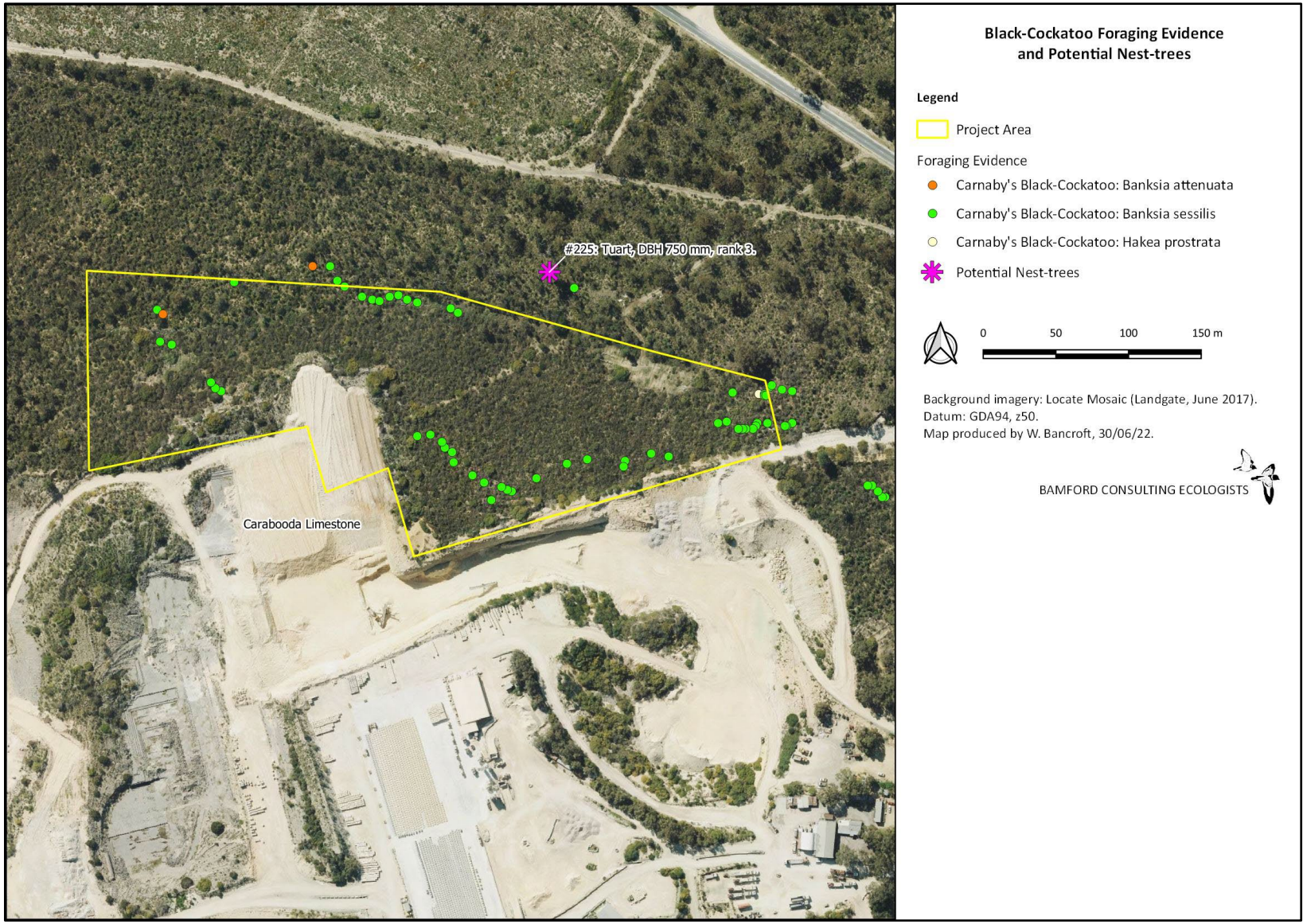

Figure 10. Location of black-cockatoo foraging records and potential nest-trees (from the June 2021 inspection) within the project area.

3.3.3.2 Forest Red-tailed Black-Cockatoo

Foraging habitat for the Forest Red-tailed Black-Cockatoo was limited within the Carabooda site. This is due to the presence of two tree species known to be a mainstays of the Forest Red-tailed Black-Cockatoo diet: *Eucalyptus marginata* and *Allocasuarina fraseriana* (Groom 2011). Where these occurred they were in moderate to low densities. The areas (and percentages) of each vegetation score for each VSA are shown for the Forest Red-tailed Black-Cockatoo in Table 12. A map of vegetation scores for Forest Red-tailed Black-Cockatoo foraging within the project area is presented in Figure 11.

There are approximately 31,280 ha of remnant native vegetation (as assessed by DPIRD 2022) within 15 km of the project area, which itself has c. 4.6 ha of native vegetation. Therefore, the site comprises c. 0.01% of the native vegetation in the 'local area' (as per the methods outlined in Appendix 5). It is unlikely that the Forest Red-tailed Black-Cockatoo breeds within the local area. Thus, a 'context' score of 0 (out of 3) has been assigned to the project area for this species (see Appendix 5).

There was no evidence of foraging by Forest Red-tailed Black-Cockatoo within the project area. Therefore, the project area was assigned a species density score for Forest Red-tailed Black-Cockatoo of 0 (out of 1; see Appendix 5).

The context and density values have been combined with the vegetation scores to yield the overall foraging value scores (with areas and percentages) that are also presented in Table 12.

The project area is, generally, of low to no value for foraging by the Forest Red-tailed Black-Cockatoo and there was no evidence to suggest that this species has previously used the site for feeding.

Figure 11. Distribution of Forest Red-tailed Black-Cockatoo vegetation scores within the project area.

3.3.4 Black-cockatoo roosting habitat

The area around the project area is known to support black-cockatoo roosting, however there are no records of roost sites within the project area itself. Previously known roost locations from BirdLife Australia's Great Cocky Count database that are within 15 km of the project area are mapped in Figure 12. The nearest of these known roosts are within c. 2 km of the project area boundary.

The absence of roosts within the project area is reasonable; there is little, if any, suitable roosting habitat. There is an almost complete absence of taller trees (e.g. eucalypts, pines) preferred by black-cockatoos as roost locations, although these occur in adjacent areas. It is highly unlikely that either of the black-cockatoo species expected in the region (Carnaby's and Forest Red-tailed Black-Cockatoos) are dependent on the project area for roosting habitat.

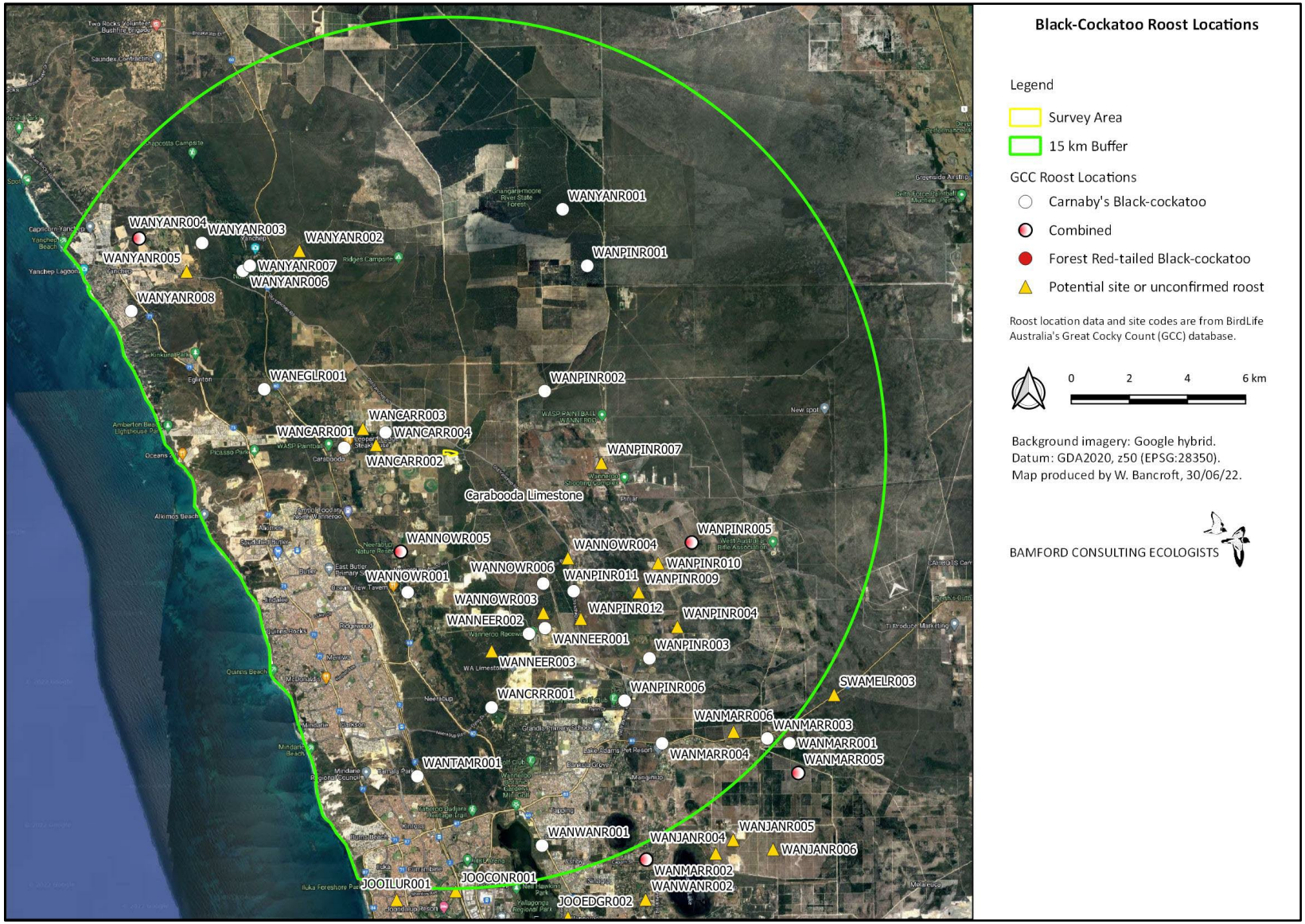

Figure 12. Known black-cockatoo roost locations within 15 km of the project area.

3.4 Patterns of biodiversity

Investigating patterns of biodiversity can be complex and are often beyond the scope even of detailed or targeted investigations (see Section 2.1 above), but it is possible to draw some general conclusions based upon the different landscapes in the project area. The three intact native VSAs (VSA 1 – Jarrah-Banksia woodland; VSA 2 – Banksia-Sheoak woodland; and VSA 3 – Mixed shrubland) can be expected to be richer in species than the rehabilitation and cleared areas. Differences in the fauna assemblage between these three VSAs might be slight, as they contain many of the same plant species and have broadly similar substrates. VSAs 1, 2 and 3 are notable for high nectar production important for a range of nectarivores (*Banksia* species) and supply of food for Carnaby's Black-Cockatoo. VSA 1 and 2 also provide an overstorey which may influence the presence of several arboreal or canopy-foraging species (e.g. some birds, Brushtail Possum, bats). VSA 1 is notable as having the only eucalypts in the project area and thus may support some birds and invertebrates that are eucalypt specialists.

3.5 Ecological processes

The nature of the landscape and the fauna assemblage indicate some of the ecological processes that may be important for ecosystem function (see Appendix 1 for descriptions and other ecological processes). These include the aspects discussed below.

Connectivity and landscape permeability. The project area is largely surrounded by development (in the immediate vicinity and at the broader scale) but connects to a corridor of remnant bushland to the south (see Figure 7). A smaller spur of remnant bushland also abuts the north of the site but this is surrounded by development and does not connect to broader areas of regional native vegetation. This makes it likely that the fauna assemblage is already affected by fragmentation and loss of connectivity. This is likely to have resulted in the loss of some mammal species. It also makes the larger area vulnerable to further fragmentation (see Section 4 below).

Local hydrology. The project area contains no wetlands, but elements of the native vegetation are likely to have some reliance on groundwater. The limestone topography suggests that a subterranean fauna assemblage is present, and this may include species that occur in the groundwater (Stygofauna).

Fire. Native vegetation throughout the project area is subject to fire and is likely to be burnt on a regular basis. While appropriate fire regimes can benefit biodiversity, inappropriate regimes can lead to a loss of biodiversity. The project area was considered not have been burnt for at least five years (PGV 2021). The project area (and surrounds) is part of a DBCA-managed fire regime, and a prescribed burn appears to be planned (SWC_081) but no timing is available (DBCA 2022c).

Feral species and interactions with over-abundant native species. Feral species occur throughout Western Australia and are a considerable component of the current mammal fauna of the project area (see Section 3.2.1). They have contributed to local extinctions (see Appendix 7) and may be affecting populations of extant species. Feral Cats, Foxes and Rabbits, and to a lesser extent the Rainbow Lorikeet, are likely to be placing considerable pressure on the native fauna in the region. Feral Bees may be competing with native nectarivores.

3.6 Summary of fauna values

The desktop study identified 173 vertebrate fauna species as potentially occurring in the project area: no fish, eight frogs, 46 reptiles, 100 birds and 19 mammals. The presence of at least 20 species (16 birds and four mammals) was confirmed during the 2021 site inspection.

Fauna assemblage. The fauna assemblage is probably typical of the near-coastal shrublands of the coastal plain north of Perth. The assemblage is likely to be substantially complete except for the mammal component, which is depauperate in both medium-sized and small species. The assemblage is likely to be only moderately rich in a regional context as the environment consists largely of shrublands and lacks wetlands, and the extensive banksia and eucalypt woodlands of the coastal plain slightly further east.

Species of conservation significance. The majority of the 45 conservation significant species (including two reptiles, 35 birds, five mammals and three invertebrates) expected in the project area are likely to be residents or regular visitors/migrants. Only five of the expected conservation species are listed under WA State and/or Commonwealth legislation (category CS1; four birds and one mammal), with six listed as Priority by DBCA (category CS2; one reptile, two mammals and three invertebrates) and the remaining 34 considered locally significant (category CS3; one reptile, 31 birds and two mammals). Of most concern are Carnaby's Black-Cockatoo (CS1, known to be a regular migrant to the area and to use the project area for foraging), and Quenda (CS2, known to occur within the project area and expected to be resident).

Vegetation and Substrate Associations (VSAs). The project area encompasses five VSAs which reflect landscape position and soil type: Jarrah-Banksia woodland (VSA 1), Banksia-Sheoak woodland (VSA 2), Mixed shrubland (VSA 3), Rehabilitation (VSA 4), and Cleared (VSA 5). The three intact (i.e. not-disturbed) native VSAs are regionally widespread.

Patterns of biodiversity. The three intact native VSAs can be expected to be richer in species than the rehabilitation and cleared areas. Differences in the fauna assemblage between these three VSAs might be slight, as they contain many of the same plant species and have broadly similar substrates. VSAs 1, 2 and 3 are notable for high nectar production important for a range of nectarivores (*Banksia* species) and supply of food for Carnaby's Black-Cockatoo. VSA 1 and 2 also provide an overstorey which may influence the presence of several arboreal or canopy-foraging species (e.g. some birds, Brushtail Possum, bats). VSA 1 is notable as having the only eucalypts in the project area and thus may support some birds and invertebrates that are eucalypt specialists.

Key ecological processes. The ecological processes that currently have major effects upon the fauna assemblage include landscape permeability, hydrology, fire, and the presence of feral species.

4 Impact assessment

Threatening processes have to be considered in the context of fauna values, the surrounding landscape and the nature of the proposed action, and are examined below. Landscape context is important, as the project area contains areas of previously cleared or disturbed lands and is in a local, and regional, landscape that is relatively continuous and intact. Impact categories are defined in Table 7.

Habitat loss leading to population decline. *Negligible to Minor*

The area to be cleared is small and is already partly disturbed. The 4.7 ha of native vegetation to be cleared represents 0.01% of native vegetation within the region (15 km radius) and would bring the total regional clearing to 47.81%. Population decline due to habitat loss is therefore very small.

Habitat loss leading to population fragmentation. *Minor*

The development footprint is expected to be compact and expands on existing developed areas, with native vegetation surrounding. However, the project area is within a region with multiple other developments (see Figure 5), so the potential exists for these multiple areas to coalesce over time with further approvals, which could result in the fragmentation of the area of native vegetation that aligns north-south, and within which the current project area and nearby developments lie.

Degradation of habitat due to weed invasion. *Minor*

The level of weed invasion is low in the native vegetation, but weeds are present in degraded areas. There is potential for development to increase the spread of weeds (particularly during clearing), but standard hygiene measures are likely to be in place to reduce this risk.

Mortality during construction. *Negligible to Minor*

This is a concern mostly on animal welfare grounds, as the development footprint is small in the context of the overall landscape. Animals will inevitably be killed during clearing but there are standard practices for reducing fauna mortality during such activities. Removal trapping and relocation of species such as Quenda and large reptiles, while avoiding clearing during spring reduces impact on breeding birds.

Ongoing mortality. *Negligible*

This results mainly from roadkill due to vehicle movements close to native vegetation, fauna striking infrastructure and effects of lighting. The numbers of animals affected are likely to be very small although the long-term impacts of lighting close to native vegetation is poorly understood.

Species interactions. *Negligible to Minor*

Feral species are already present on the site, but feral species may be attracted to work-sites and increase in abundance. Impacts to native fauna can be kept to Negligible/Minor through standard practices such as not feeding wildlife, managing waste and even implementing some feral species control.

Hydrological change. *Negligible*

There is no surface water and activities will not interact with groundwater, so hydrological change should be minimal. If drainage and runoff management of work areas is required, this should not be diverted into native vegetation but should be infiltrated into groundwater.

Altered fire regimes. *Negligible*

The vegetation of the project area is tolerant of and to some extent dependent on fire, but the fire regime is important. There have been recent fires that are likely to have affected the fauna, and any increase in fire frequency is likely to have adverse impacts. The proposed development has the potential to lead to increased fire frequency, but given the small areas involved this risk should be readily managed.

Disturbance (dust, noise, light). *Minor*

The level of dust, noise and light during development and operation has the potential to result in some impacts, but there are standard management procedures to minimise these. There is also existing activity so these forms of disturbance will not be new to the location. As noted above, impacts of additional lighting upon invertebrates is largely unknown.

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Appendix D
Targeted Survey for Threatened Flora (WEPL, 2024)

WESTERN ENVIRONMENTAL

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PO Box 437, Leederville, WA 6903
enquiries@westenv.com.au

Monday, 11 March 2024

Our Ref: P23.068-PRO-FVSR_0_FINAL

P.M.R Quarries (T/A WA Limestone)
401 Spearwood Avenue
Bibra Lake WA 6163

ATTENTION: Roger

SUBJECT: CARABOODA QUARRY TARGETED FLORA SEARCHES (EPBC 2023/09554)

Introduction

P.M.R Quarries Pty Ltd (T/A WA Limestone) proposes to expand the Carabooda Quarry to facilitate limestone extraction (the 'proposed action) within M 70/341 on Hopkins Road, Nowergup approximately 40 km north of Perth within the City of Wanneroo. The proposed action was referred under the *Environment Protection and Biodiversity Act 1999* (EPBC Act) (EPBC 2023/09554), which was validated by the Department of Climate Change, Energy, the Environment and Water (DCCEEW) on 4 September 2023 and progressed to Referral Decision stage.

The clock was stopped on the Minister's decision on 15 September 2023 when DCCEEW issued a Request for Further Information (RFI) (Appendix A).

The first item of the RFI requires the following:

- Copy of any targeted flora survey within the disturbance footprint for the following flora species:
    - *Eucalyptus argutifolia* — Yanchep Mallee, Wabling Hill Mallee (Vulnerable).
    - *Melaleuca* sp. Wanneroo (Endangered).

WEPL presents this letter report to satisfy the item by outlining the results of a targeted search for the species above within the proposed action area. This letter report should be read in conjunction with the flora and vegetation survey report prepared by PGV (2021) which is provided as Appendix B.

Scope of Work

To satisfy the first item of the RFI, WEPL completed a targeted search for threatened flora species with the potential to occur within the proposed action area. Specifically, the searches targeted:

- *Eucalyptus argutifolia* — Yanchep Mallee, Wabling Hill Mallee (Vulnerable).
- *Melaleuca* sp. Wanneroo (Endangered).

The Survey Area covered the entirety of the proposed action and is shown on Figure 1.

Methods

Desktop Review

Background information on the survey area and surrounds was provided by WA Limestone and reviewed prior to the field survey. This letter report should be read in conjunction with the flora and vegetation survey report prepared by PGV (2021) which is provided as Appendix B.

A search of the Protected Matters Search Tool (PMST) was undertaken by WEPL and PGV (2021).

A pre-survey likelihood of occurrence assessment specific to the Survey Area was undertaken by PGV (2021). Threatened and Priority Flora identified during the desktop analysis and previous surveys as known or having potential to occur were targeted (as identified in PGV (2021)), specifically:

- *Eucalyptus argutifolia* (Vulnerable).
- *Melaleuca* sp. Wanneroo (Endangered).

Field Survey

The targeted field survey was conducted on 7th December 2023 by a WEPL Senior Environmental Scientist, Andrew Fry, with over ten years of relevant experience (DBCA Licence No. FB62000002-2). The survey was conducted in accordance with the WA Environmental Protection Authority's (EPA) *Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment* (targeted survey).

A contextual targeted search was undertaken at the site of a known population of *Melaleuca* sp. Wanneroo approximately 5 km south of the survey area on the same day. *Melaleuca* sp. Wanneroo has a very strong habitat association with very shallow soils over limestone 'caprock' on ridges (TSSC, 2019). The species appears similar to the common *Melaleuca systena*, however can be differentiated in the field based on its flowering period and differences in leaf dimensions. *Melaleuca* sp. Wanneroo flowers during later November to late December, following the completion of the flowering period of *M. systena* (TSSC, 2019). The species was readily identifiable and in flower during the contextual targeted search, providing confirmation that the species could be identified within the survey area if present.

Both target species display a very strong habitat association with limestone ridges (*Melaleuca* sp. Wanneroo) (TSSC, 2019) and gullies close to the summits of limestone ridges (*Eucalyptus argutifolia*) (DEWHA, 2008). Potentially suitable habitat was identified to occur within the vegetation type MsAt mapped by PGV (2021) which was described as *Melaleuca systena / Acacia stenoptera* Closed Heath.

Searches were undertaken across the entire Survey Area in transects 10-20 m apart, narrowing in areas of more suitable/ dense habitat necessary (Figure 2). Given the majority of the Survey Area lacked suitable habitat for the target species, 20 m spacing was applied through the majority of the Survey Area.

The locations of any species of conservation significance or unknown taxa were to be recorded using a handheld GPS, together with the following data:

- Observer, date, and time.

- Local abundance/population size and/or population boundary.
- Representative photos of each species and habitat.
- Collection of representative specimens.
- Notes on habitat and vegetation type.

Limitations

An assessment against potential limitations and constraints relevant to targeted searches (as outlined in the *Flora and Vegetation Technical Guidance*) is provided in Table 1.

Table 1. Assessment Against Potential Limitations and Constraints

Possible Limitation	Degree of Limitation (Significant, Moderate or Negligible)	Potential Constraints on Survey Outcomes
Survey Level/ Scope	Not a constraint.	Targeted pre-clearance searches following a detailed flora and vegetation survey was undertaken at a sufficient level of detail and in accordance with the *EPA Flora and Vegetation Technical Guidance.*
Availability of contextual information at a regional and local scale	Not a constraint.	All data required to complete the scope of works including regional and local contextual information was available. Previous survey data was provided by WA Limestone. Available literature was reviewed, and publicly available databases were also searched. Contextual information is therefore not considered to be a limiting factor for this study.
Site Access	Not a constraint.	The Survey Area was readily accessible by foot, and the entire Survey Area was traversed.
Survey Intensity and Extent	Not a constraint.	The entire Survey Area was traversed by foot to search for conservation significant flora. Survey effort is demonstrated by the tracks shown on Figure 2. Sufficient time was allocated to survey, given the size and complexity of the Survey Area. The survey effort was considered adequate to assess values of the Survey Area and provide information required to support approvals applications.
Experience	Not a constraint.	The survey was undertaken by suitably qualified Senior Environmental Scientist Andrew Fry who has over ten years' experience in conducting flora and vegetation surveys in the southwest. All flora collections of

Possible Limitation	Degree of Limitation (Significant, Moderate or Negligible)	Potential Constraints on Survey Outcomes
		potential conservation significant species were submitted to the Western Australian Herbarium for identification.
Timing, weather, season	Not a constraint.	The recommended primary survey period for flora and vegetation surveys for the region as per the EPA Technical Guidance occurs during Spring (September through November). However, given the survey was targeting *Melaleuca* sp. Wanneroo which flowers from late November to late December, the survey was undertaken in early December to ensure the species could be identified in the field.
Mapping Reliability	Not a constraint.	The entire of the Survey Area was traversed by foot and mapping reliability is considered high.
Disturbances (fire, flood etc.)	Not a constraint.	The survey area was cleared of native vegetation in 2000 and has since regenerated naturally. As such, the survey area has been subject to disturbance over a significant period of time. This did not impact the ability to meet the objectives of the targeted search. was not a limitation to the survey.

Results and Discussion

The survey covered the entirety of the survey area in 20 m transects, as shown on Figure 2.

No threatened flora species at Commonwealth level were recorded within the Survey Area, and none are expected to occur. The survey area lacks suitable habitat for *Melaleuca* sp. Wanneroo or *Eucalyptus argutifolia*. Habitat present is degraded, and lacks limestone outcrops or ridges making it unsuitable for any target species.

Impacts to listed threatened flora species will not result from the proposed action.

References

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This report should be read in conjunction with the Schedule - Statement of Limitations. Should you have any queries regarding the above, please contact the undersigned on (08) 6162 8980.

Yours sincerely,
Western Environmental Approvals Pty Ltd

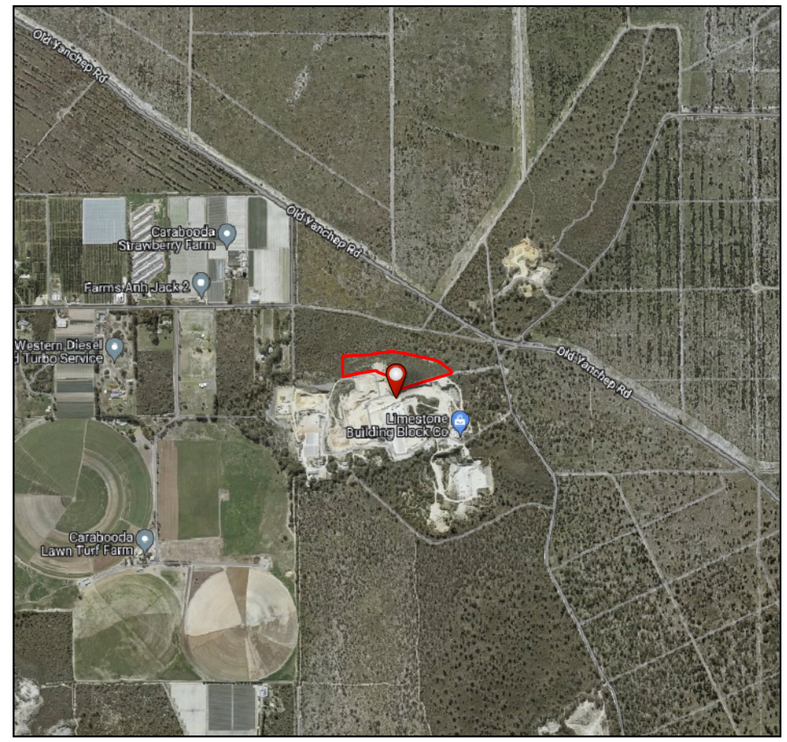
Andrew Fry
Senior Environmental Scientist

Schedule

- Statement of Limitation

Appendices

- Appendix A: Stop Clock Notice: Request for Further Information
- Appendix B: PGV (2021) M70/341, M70/345, M70/346 and M70/339 Hopkins Road Carabooda Flora and Vegetation Survey



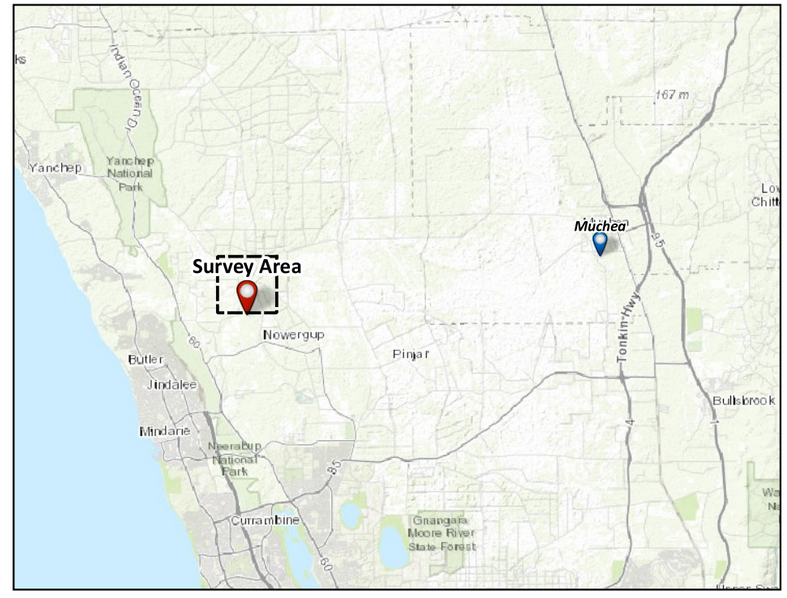


Figure 1: Survey Area

N

0 30 60 90 120 m

PROJECT/REPORT NAME	RPT- FVSR A Draft Carabooda Quarry (M70/341)
SCALE	1:2,272
SHEET SIZE	A3 COLOUR
CLIENT	WA Limestone
COORDINATE REFERENCE SYSTEM	GDA2020 / MGA zone 50
PROJECT NUMBER	A23.068
VERSION	0
DATA SOURCE	LANDGATE AERIAL IMAGERY Summer 2023
DRAWN BY / REVIEWED BY	MD/ZL
DATE	9/2/2024

Legend

Survey Area

No	Description	Drawn	Approved	Date
A	Original issue	MD	ZL	9/2/2024

NOTES:

Cadastral boundary (LGATE-002). Base map ESRI Topo. Townsites (LGATE-248).

WESTERN ENVIRONMENTAL

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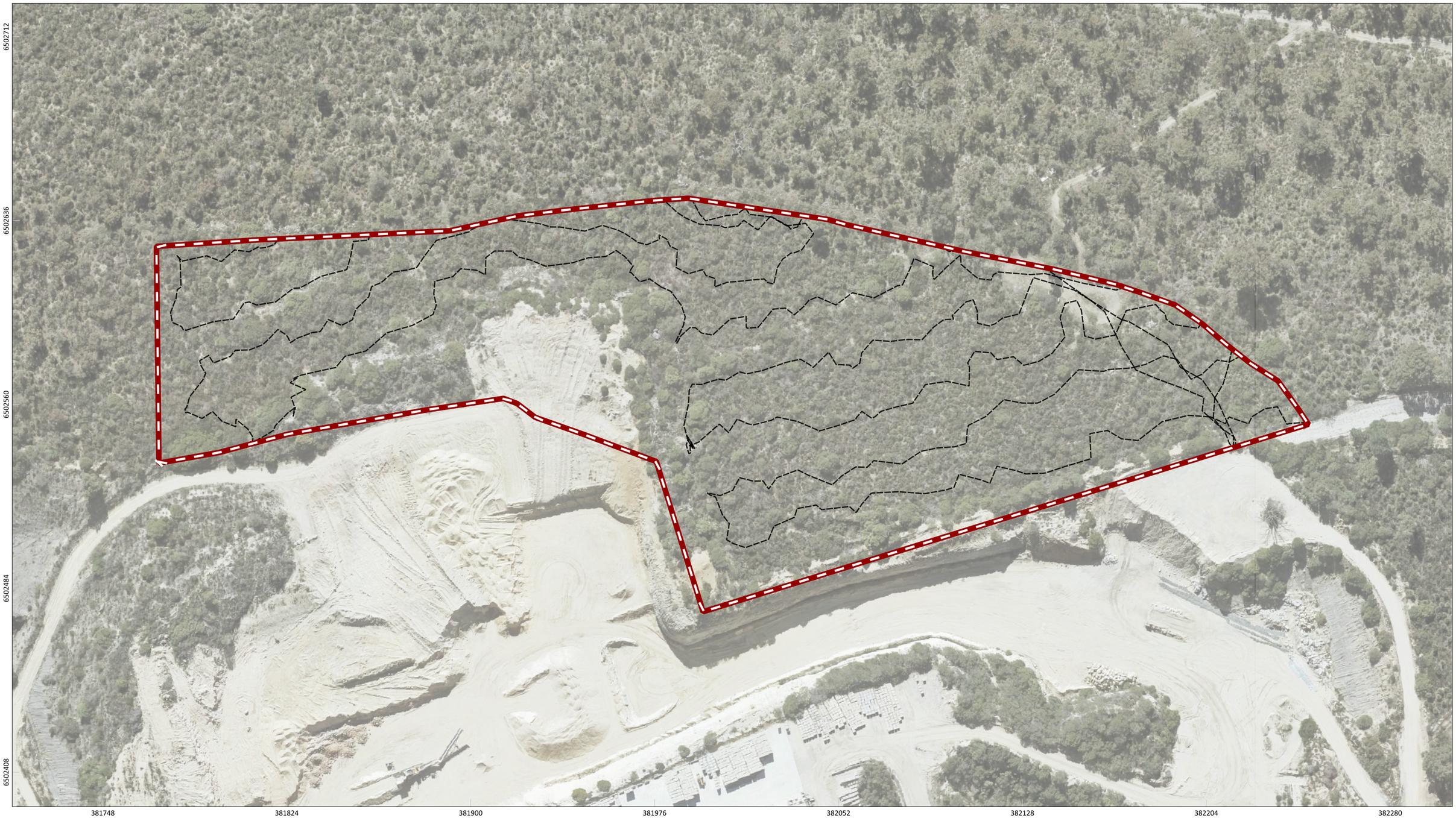

Figure 2: Survey Effort

N

0 20 40 60 80 m

SCALE: 1:1,528	SHEET SIZE: A3 COLOUR
PROJECT/REPORT NAME: RPT- FVSR A Draft Carabooda Quarry (M70/341)	
CLIENT: WA Limestone	
COORDINATE REFERENCE SYSTEM: GDA2020 / MGA zone 50	PROJECT NUMBER: A23.068 / VERSION: 0
DATA SOURCE: LANDGATE AERIAL IMAGERY Summer 2023	DRAWN BY / REVIEWED BY: MD/ZL / DATE: 28/2/2024

Legend

- SurveyArea
- Track Logs

No	Description	Drawn	Approved	Date
A	Original issue	MD	ZL	05/06/2023

NOTES:

Cadastral boundary from LANDGATE 2022. Label corresponds to the vegetation association number.

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Statement of Limitations

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Scope of Services

This environmental report ("this report") has been prepared for the sole benefit and exclusive use of the Client for the purpose for which it was prepared in accordance with the agreement between the Client and WEPL ("the Agreement"). However, in addressing the requirements of the Contaminated Sites Act 2003, an Accredited Contaminated Sites Auditor may be engaged by the Client to undertake review of this report, prior to its submission to the DWER. The report shall be made available and can be relied upon for the purposes of the Contaminated Sites Act.

WEPL disclaims any and all liability with respect to any use of or reliance upon this report for any other purpose whatsoever.

In particular, it should be noted that this report is based on a scope of services defined by the Client, and is limited by budgetary and time constraints, the information supplied by the Client (and its agents) and, in some circumstances, access and/or site disturbance constraints.

The scope of services did not include any assessment of the title to or ownership of the properties, buildings and structures referred to in this report, or the application or interpretation of laws in the jurisdiction in which those properties, buildings and structures are located.

Reliance on Data

In preparing this report, WEPL has relied on data, surveys, analyses, designs, plans and other information provided by the Client (or its agents), other individuals and organisations ("the data").

Except as otherwise stated in this report, WEPL has not verified the accuracy or completeness of the data. WEPL does not represent or warrant that the data is true or accurate, and disclaims any and all responsibility or liability with respect to the use of the data.

To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in this report ("conclusions") are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data.

WEPL does not accept any responsibility or liability for any incorrect or inaccurate conclusions should any data be incorrect, inaccurate or incomplete or have been concealed, withheld, misrepresented or otherwise not fully disclosed to WEPL.

The conclusions must also be considered in light of the agreed scope of services (including any constraints or limitation therein) and the methods used to carry out those services, both of which are as stated or referred to in this report.

Environmental Conclusions

In accordance with the scope of services, WEPL has conducted environmental field monitoring and/or testing in the preparation of this report. The nature and extent of monitoring and/or testing conducted is described in this report.

On all sites, varying degrees of non-uniformity of vertical and horizontal conditions in media (soil, water, air, waste or other media as described in the report) are encountered. Hence no monitoring, common testing or sampling technique can eliminate the possibility that monitoring or testing results/samples are not totally representative of media conditions encountered. The conclusions are based on the data and the environmental field monitoring and/or testing actually undertaken, and are therefore merely indicative of the environmental condition of the site at the time of preparing this report, including the presence or otherwise of contaminants or emissions. It should be recognised that site conditions, including the extent and concentration of contaminants, can change.

Within the limitations imposed by the scope of services, the monitoring, testing, sampling and preparation of this report have been undertaken and performed in a professional manner, in accordance with generally accepted practices and using a degree of skill and care ordinarily exercised by reputable environmental consultants under similar circumstances. To the maximum extent permitted by law, no other warranty, express or implied, is made.

Report for Benefit of Client

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Other parties should not rely on this report or the accuracy or completeness of any conclusions contained in this report, and should make their own enquiries and obtain independent advice in relation to such matters.

If an Auditor is engaged by the Client to undertake review of this report, it shall be made available subject to the terms and conditions of the agreement between the Client and WEPL and the caveats in this statement.

Other Limitations

This report is intended to be read in its entirety, and sections or parts of this report should therefore not be read and relied on out of context.

WEPL will not be liable to update or revise this report to take into account any events or circumstances or facts becoming apparent after the date of this report.

APPENDIX A Request for Further Information (EPBC 2023/09554)

Australian Government
Department of Climate Change, Energy, the Environment and Water

EPBC ref: 2023/09554

Mr David Della Bona
Managing Director
PMR Quarries Pty Ltd
401 Spearwood Avenue
Bibra Lake WA 6163

Request for further information for Carabooda Quarry, M70/341, Hopkins Road, Nowergup, WA

Dear Mr Della Bona

Thank you for submitting a referral under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) concerning the above proposed action.

Our initial examination of your referral indicates that there is insufficient information to allow us to consider all the relevant issues.

Could you please provide the following further information:

- Copy of any targeted flora survey within the disturbance footprint for the following flora species:
    - *Eucalyptus argutifolia* — Yanchep Mallee, Wabling Hill Mallee (Vulnerable).
    - *Melaleuca* sp. Wanneroo (Endangered).
- An appraisal with a short justification as to whether or not Dwarf Hammer-orchid (*Drakaea micrantha*) identified via the Department's protected matters search tool occurs within the site.
- Assessment on the impacts of the proposed action on both Banksia TEC and Tuart TEC located in the proximity of the proposed action area (>10 m) along with a copy of flora/vegetation management plan.
- A copy of management plan which will address the potential risk arising from each stage of mining activities including dust emission, erosion and sedimentation, contamination etc. This should be incorporate and linked to the flora/ vegetation and fauna Management Plan.
- A map indicating project mining layout including location of the pit, stockpiles, road transport of excavated material etc as well as clarification on mining characteristics such as pit depth, water requirement for dust suppression etc.

In any correspondence with the department please quote the title of the action and EPBC reference, as shown at the beginning of this letter. You can send information to us:

By letter:
South WA Section

Environment Assessments West (WA, SA, NT) Branch
Department of Climate Change, Energy, the Environment and Water
GPO Box 3090
CANBERRA ACT 2601

By email: EADSouthWA@dcceew.gov.au

Please note, under subsection 520(4A) of the EPBC Act and regulation 5.19 of the *Environment Protection and Biodiversity Conservation Regulations 2000* (EPBC Regulations), your project is subject to cost recovery for the request to provide specific information.

A statement of charges for $1,701.00 will be sent to the project's nominated entity responsible for payment.

You may qualify for an exemption under regulation 5.23 of the EPBC Regulations or apply under regulation 5.21A of the EPBC Regulations for a waiver of the contingency fees.

An exemption/waiver from fees form is attached.

If you qualify for an exemption or would like to apply for a waiver, please complete and return this form to me within 10 business days of the date of this letter. Further details regarding waivers and exemptions can be found on the department's website.

Please note that the timing for us to make a decision on your referral stops on the date of this letter and restarts once we have received satisfactory information. In the event that the project is determined to be a controlled action, the timing for us to make a decision on an assessment approach also stops on the date of this letter.

We will let you know whether or not approval is required under the EPBC Act as soon as a decision is taken. If you have any questions about the process, please contact the project manager, Sima Bargrizan, by email to EADSouthWA@dcceew.gov.au, or telephone (02) 5156 3402 and quote the EPBC reference number shown at the beginning of this letter.

Yours sincerely

Kylie Calhoun
Branch Head
Environment Assessments West
15 September 2023

Attach: Exemption/fee waiver form

Email: Quote request to the Referrals Gateway team at EPBC.Referrals@dcceew.gov.au

Appendix E
Mine Closure Plan

MINE CLOSURE PLAN

Extraction of Limestone

M70/013 and M70/339

ENVIRONMENTAL GROUP SITE	Hopkins Road, Carabooda
ENVIRONMENTAL GROUP SITE CODE	S0222864
PROJECT	J00947

and

M70/109, M70/341, M70/345 and M70/346

ENVIRONMENTAL GROUP SITE	Cutler Road, Carabooda
ENVIRONMENTAL GROUP SITE CODE	S0222865
PROJECT	J00891

31 July 2019

REG ID
VERSION

Address LIMESTONE BUILDING BLOCKS COMPANY PTY LTD
401 Spearwood Avenue
Bibra Lake WA 6065

PO Box 1404
Bibra Lake WA 6965

Phone 08 9434 7777

No	MINE CLOSURE PLAN CHECKLIST	Y/N NA	Page No.	Comments
1	Has the Checklist been endorsed by a senior representative within the tenement holder/operating company? (See bottom of checklist)	Y	(d)	
Public Availability				
2	Are you aware that the Mine Closure Plan will be made publically available?	Y		
3	Is there any information in the Mine Closure Plan that should not be made publically available?	N		
4	If "yes" to Q3 has confidential information been submitted separately?	NA		
Cover Page, Table of Contents				
5	Does the cover page include: • Project Title; • Company Name; • Contact Details (including telephone numbers and email addresses); • Document ID and version number; • Date of submission (needs to match the date of this checklist).	Y	Cover	
4	Has a Table of Contents been provided?	Y	(e)	
Scope and Purpose				
6	State why the MCP is submitted (as part of a Mining Proposal of a reviewed MCP or to fulfill other legal requirements)	Y	1	Update Closure Planning
Project Overview				
7	Does the project summary include: • Land ownership details; • Location of the project; • Comprehensive site plan(s); • Background information on the history and status of the project.	Y	1, 2	Section 2.0
Legal Obligations and Commitments				
8	Has a consolidated summary or register of closure obligations and commitments been included?	Y	17	Section 3.0
Stakeholder Consultation				
9	Have all stakeholders involved in closure been identified?	Y	34	Table 5
10	Does the Mine Closure Plan include a summary or register of stakeholder consultation been provided, with details as to who has been consulted and the outcomes?	Y	34	Table 5
11	Does the Mine Closure Plan include a stakeholder consultation strategy to be implemented in the future?	Y	34	

Post Mining Land use(s) and Closure Objectives				
12	Does the MCP include agreed post-mining land use(s), closure objectives and conceptual landform design diagram?	Y	37 – 38 Fig 9	Referred to DBCA for comment on State Forest 65

13	Does the MCP identify all potential (or pre-existing) environmental legacies, which may restrict the post mining land use (including contaminated sites)?	Y		Table 9 Table 10 Section 8.6
14	Has any groundwater contamination that occurred, or is suspected to have occurred, during the operation of the mine, been reported to DER as required under the Contaminated Sites Act 2003?	N		
15	Does the Mine Closure Plan include an appropriate set of specific completion criteria and performance indicators?	Y	38	Table 7
Collection and Analysis of Closure data				
16	Has materials characterisation been carried out consistent with the applicable Standards and Guidelines (eg GARD GUIDE).	Y	61	Table 10
17	Does the Mine Closure Plan identify applicable closure learnings from benchmaking against other comparable mine sites?	Y		Tables 11, 12 and 13 Section 9.1
18	Does the MCP identify all key issues impacting mine closure objectives and outcomes including potential contamination impacts?	Y		Table 9 Table 10 Section 8.6
19	Does the MCP include proposed management or mitigation options to deal with these issues?	Y	63 71 74	Tables 11, 12 and 13 Section 9.1
20	Has information relevant to mine closure been collected for each domain or feature (including pre-mining baseline studies, environmental and other data)?	Y	63	Section 8.6
21	Does the Mine Closure Plan include a gap analysis/risk assessment to determine if further information is required in relation to closure of each domain or feature?	Y	45 63	Section 7.0 Table 15 (attached) Section 8.6
22	Does the Mine Closure Plan include process, methodology, and rationale to justify identification and management of the issues?	Y	63 71 74	Table 9 Table 11, 12, 13 Table 15, 16
Closure Implementation				
23	Does the reviewed MCP include a summary of closure implementation strategies and activities for the proposed operations or for the whole site?	Y	71 74 75	Table 11, 12, 13
24	Does the MCP include a closure work program for each domain or feature?	Y	63 71 74	Section 8.6 Table 11, 12,
25	Have site layout plans been provided to clearly show each type of disturbance?	Y	Fig 11 Fig 12	Section 8.6
26	Does the MCP contain a schedule of research and trial activities?	Y	45	Section 7.1
27	Does the MCP contain a schedule of progressive rehabilitation activities?	Y	75	Section 9.4
28	Does the MCP include details of how unexpected closure and care and maintenance will be handled?	Y	71	Section 9.2 Table 11
29	Does the MCP contain a schedule of decommissioning activities?	Y	71 74	Table 12 Table 13
30	Does the MCP contain a schedule of closure performance monitoring and maintenance activities?	Y	83	Section 10 Table 16 Attached
Closure Monitoring and Maintenance				
31	Does the MCP contain a framework, including methodology, quality control and remedial strategy for closure	Y	83	Section 10 Table 16

	performance monitoring including post-closure monitoring and maintenance?			Attached
Financial Provisioning for Closure				
32	Does the MCP include costing methodology, assumptions and financial provision to resource closure implementation and monitoring?	Y	84	Section 11.0
33	Does the MCP include a process for regular review of the financial provision?	Y	84	Section 11.0
Management of Information and Data				
34	Does the mine closure plan contain a description of management strategies including systems, and processes for the retention of mine records?	Y	87	Section 12

CORPORATE ENDORSEMENT:

I hereby certify that to the best of my knowledge, the information within this Mine Closure Plan and checklist is true and correct and addresses all the requirements of the Guidelines for the Preparation of a Mine Closure Plan approved by the Director General of Mines.

Mining Tenement/s **M70/013, M70/339, M70/109, M70/341, M70/345, M70/346**

Name: David Della Bona

Position: Director

Signed:

Date: 31 July 2019

PMR Quarries who hold tenements, **M70/109, M70/341, M70/345, M70/346** is a Quality assured company with Environmental Certification under ISO 14001, Safety Certification under AS/NZ 480 and Quality Assurance Certification under ISO 9001

DOCUMENT PREPARED BY

Landform Research
Quarries, Land Systems, Environment, Geology
ABN 29 841 445 694

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Mem Aus Geomechanics Soc – MEIANZ, FIQA, MAIG Tel 08 9474 3978, landform@iinet.net.au

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ATTACHMENTS

1 Coffey environments 2010, *Flora and Vegetation Assessment M70/341 and M70/345 Cutler Road, Carabooda*

2 Western Wildlife 2008, *Fauna Study M70/341 and M70/345, CutlerRoad, Carabooda.*

3 Coffey Environments, 2010, *Flora and Vegetation Assessment, M70/339 Hopkins Road, Nowergup*

4 Western Wildlife, 2008, *Limestone Building Block Company tenements, M70/13 and M70/339, Hopkins Road Nowergup.*

1.0 SCOPE AND PURPOSE

This Mine Closure Plan is submitted to document the closure and rehabilitation of the site.

This MCP addresses the assessments and data on which closure planning has been developed. It describes the methods for planned closure and rehabilitation of the project for all disturbed areas, mining landforms, plant and other built infrastructure within the project tenements.

It provides for contingencies during temporary suspension of operations and unplanned closure.

This MCP has been prepared according to the joint DMP/EPA Guidelines for Preparing Mine Closure Plans (May 2015 revision) (DMIRS/EPA 2015). It is a dynamic document that recognises that both the project and industry closure requirements will change over time.

The MCP will be revised regularly during the life of the operations in consultation with stakeholders and as new data and policies become available.

2.0 PROJECT OVERVIEW

2.1 Land Ownership

TABLE 1A ENVIRONMENTAL GROUP SITE DETAILS		
SITE DETAILS		
EGS Name	**Hopkins Road, Nowergup**	
EGS Code *Code is derived from the EARS2 system. (Leave blank if new project)*	ENVIRONMENTAL GROUP SITE Hopkins Road, Nowergup ENVIRONMENTAL GROUP SITE CODE S0222864 PROJECT J00947	
Description of Operation	Basic Raw Material Extraction	
Mine Status	Operational – Limestone Building Blocks Company Pty Ltd.	
Commodity mined	Limestone	
Project commencement date	Active	
Estimated completion date of the project	20 years	
Tenement Details	Tenement	Tenement Holder
	M 70/013 M70/339	Limestone Building Blocks Company Pty Ltd
PROPONENT DETAILS		
Company or Individual Name	Limestone Building Block Company Pty Ltd	
ACN/ABN:	ACN 099 252 608	
Address	Limestone Building Blocks Company Pty Ltd 401 Spearwood Avenue Bibra Lake WA 6065	
Postal Address	Limestone Building Blocks Company PO Box 1404 Bibra Lake WA 6965	

Key Contact Representative	Name:	Roger Stephens
	Position	Tenement Manager
	Phone Number	08 9414 8151
	Email	admin@walimestone.com

TABLE 1B ENVIRONMENTAL GROUP SITE DETAILS		
SITE DETAILS		
EGS Name	Cutler Road Carabooda	
EGS Code *Code is derived from the EARS2 system. (Leave blank if new project)*	ENVIRONMENTAL GROUP SITE Cutler Road Carabooda ENVIRONMENTAL GROUP SITE CODE S0222865 PROJECT J00891	
Description of Operation	Basic Raw Material Extraction	
Mine Status	Operational Site is operated by Limestone Building Blocks Company Pty Ltd on behalf of PMR Quarries Pty Ltd.	
Commodity mined	Limestone	
Project commencement date	Active	
Estimated completion date of the project	20 years	
Tenement Details	Tenement	Tenement Holder
	M70/109 M70/341 M70/345 M70/346	PMR Quarries Pty Ltd
PROPONENT DETAILS		
Company or Individual Name	PMR Quarries Pty Ltd	
ACN/ABN:	ACN 008 866 448	
Address	Limestone Building Blocks Company Pty Ltd 401 Spearwood Avenue Bibra Lake WA 6065	
Postal Address	Limestone Building Blocks Company Pty Ltd PO Box 1404 Bibra Lake WA 6965	

Key Contact Representative	Name:	Roger Stephens
	Position	Tenement Manager
	Phone Number	08 9414 8151
	Email	admin@walimestone.com

2.2 Current Status - Operations

Context and history

Limestone extraction has taken place on the sites since the mid 1980's.

Limestone Building Blocks Company Pty Ltd limestone from M70/013 and M70/339, Hopkins Road, Carabooda. Limestone extraction has taken place on site since the mid 1980's on M70/013 and M70/339.

In 2018 PMR Quarries purchased Urbanstone, which included M70/109, M70/341, M70/345, M70/339, Cutler Road, Carabooda which adjoin M70/339. Limestone Building Blocks Company Pty Ltd operates the tenements on behalf of PMR Quarries Pty Ltd.

The two operations are now worked together through Limestone Building Blocks Company site facilities and entrance. Access is from Hopkins Road with lockable gates maintained at the entrance.

As the operations are worked together, using the same products and facilities, discussions were held with DMIRS to enable the Mine Closure Plan to address the closure and rehabilitation of all tenements in the one document.

Mining Activity

All commitments and environmental management contained in in the various documents remain valid and will be honoured and complied with.

Mining on both sites consists of extracting limestone with smaller amounts of sand for the manufacture of reconstituted Blocks

2.3 Approvals

- "Development Management Plan. Mining Lease 70/109 Nowergup" received 22 February 1990 and retained on Mines Department File No. 728/90.
- "Notice of Intent" to develop Mining Lease 70/341 Nowergup" dated 1993 and retained on Department of Industry and Resources File No. 728/90.
- "Letter of Intent: Proposed New Access Road - Carabooda Limestone M70/341" (NOI 4981) received 13 April 2005 and signed by Clark Scrivener and retained on Department of Industry and Resources File No. 4322/00;
- (Reg ID 56335) "Mine Closure Plan M70/109, M70/346, M70/341 and M70/345" dated 30 July 2015 signed by Michael Falconer - Registered Manager and retained on Department of Mines and Petroleum File No. EARS-MCP-56335 as Doc ID 3468558.
- "Development Management Plan ML 70/339 Nowergup" received 21 September 1989, and retained on Department of Minerals and Energy File No. 339/89.
- (Reg ID 56348) "Mine Closure Plan M70/13 and M70/339" dated 28 August 2015 signed by M.J. Barzon - Deputy Registered Manager and retained on Department of Mines and Petroleum File No. EARS-MCP-56348 as Doc ID 3494696.
- CPS 2858/1, Clearing Permit for 1.076 ha (not activated).
- CPS 5341/1, Clearing Permit for 2.797 ha, (expired)

- CPS 6203/2, Clearing Permit for 4.999 ha (current)

2.4 Location

The mining tenement is located off Wattle Avenue East, Nowergup, centred on 31 degrees 39 minutes S and 115 degrees 39 minutes E.

The site lies in part of the State Forest 65, approximately just north of Shire View Hill 11 km north from Wanneroo.

The resource lies on Geological Survey of Western Australia, Perth 1 : 250 000 geological mapsheet; SH 50 14.

The quarry location is centred on;

31 degrees 39 minutes S and 115 degrees 39 minutes E.

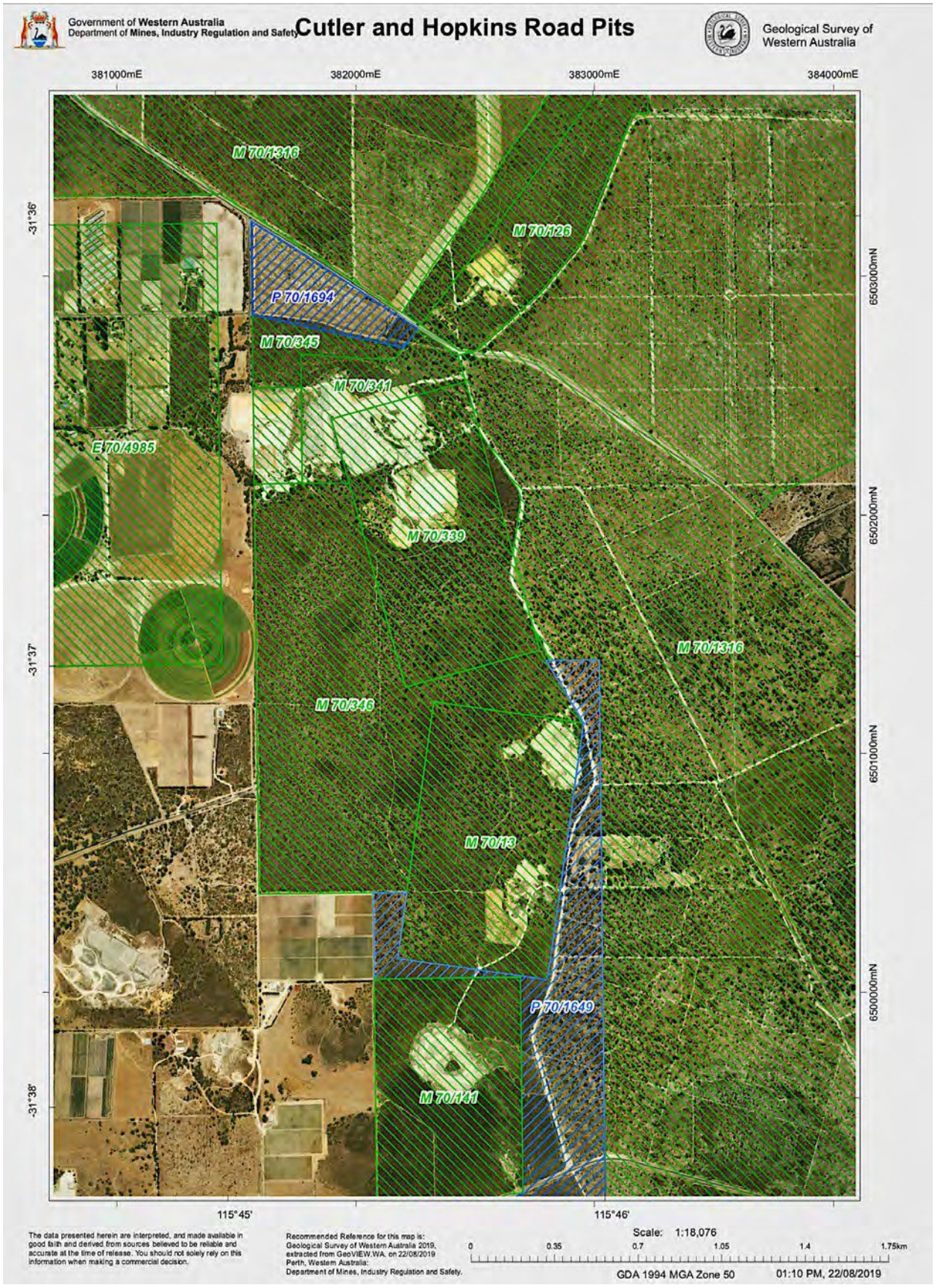


Figure 1 Location of tenements

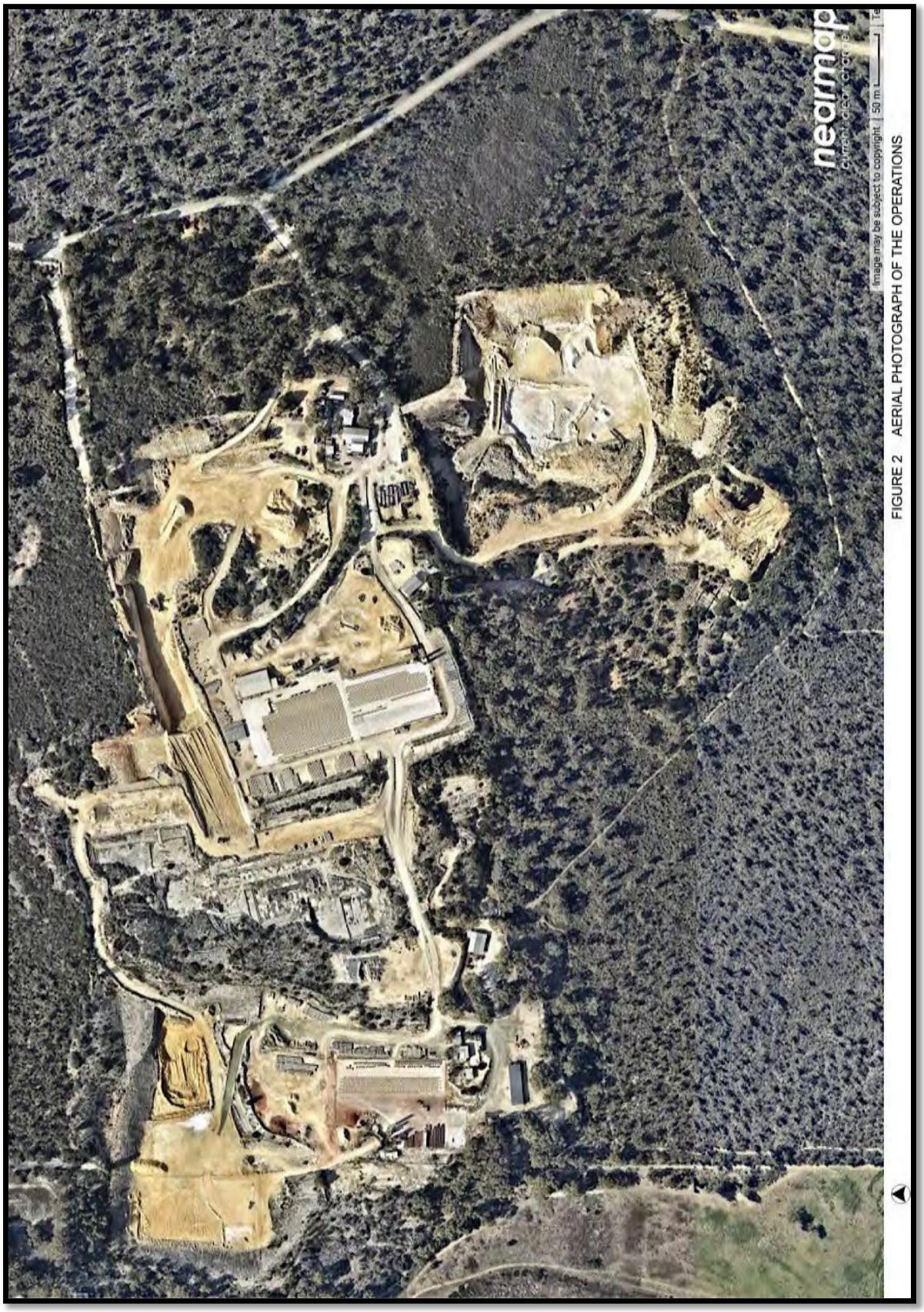


Figure 2 Aerial photograph

2.5 Overview of the Operations

The two original operations of Limestone Building Blocks Company and Urbanstone, although being operated together, are currently still producing separately from their tenements on the existing facilities.

2.6 Mining Operations

2.6.1 Site Activities

Uses of Limestone

Basic Raw Materials, including the resources on site of limestone, are of State significance.

Basic raw materials are essential for the construction and maintenance of all developments; such as roads, subdivisions, buildings, bridges, ports and rail lines.

- Almost every house on the Swan Coastal Plain is constructed using significant amounts of construction materials including sand for concrete and fill.
- Every road on the Swan Coastal Plain is constructed from limestone.
- The limestone is of high grade, and from this site is used for the sourcing of natural dimension stone blocks that are used for facings of buildings and landscaping and the manufacture of reconstituted limestone construction and landscaping blocks and features.
- The use of the limestone depends on the nature of the limestone, its colour, grade and percentage of $CaCO_3$. These characteristics vary quite quickly both laterally and vertically and as they change the limestone will be extracted for other purposes. The lowest grade materials are used for road base and, in future, as the pit is deepened and the grade drops, roadbase will be produced.
- The majority of the extraction is for reconstituted limestone blocks for the domestic construction market.

2.6.2 Mining

1. A bulldozer or loader is used to remove any vegetation by pushing it into windrows.
2. Smaller vegetation is track crushed and directly transferred to areas under rehabilitation (when available) to assist soil and habitat generation. The vegetation contains a significant seed source, because of the contained seed on many species. It is also a source of microbial material for soil formation, adds to habitat and assists in managing wind erosion.
3. The vegetation is to be used on the batters to minimise soil erosion and spreading on the final land surface as part of the final rehabilitation.
4. Topsoil is pushed to one side and formed into low storage dumps for later use for rehabilitation using either a loader or bulldozer. Topsoil that is to be stored is located in separate dumps, pushed to the outside of the disturbance area from where it can be spread during the final reconstruction of the land surface.

5. Overburden as yellow and brown sand and low grade limestone is then pushed into bunds and dumps around the perimeter of the disturbance, inside the topsoil bunds, normally by bulldozer. In some locations the dumps and bunds are pushed across low areas to provide flat and level working surfaces.

6. The bunds and dumps can be up to 5 metres high depending on the surrounding landform and security requirements to increase security and provide a barrier to define the operations.

7. This bunding is extended along the perimeters to provide screening and assist in security.

8. At the end of excavation the floor of the quarry will be deep ripped, covered by a layer of overburden and top soil and rehabilitated with indigenous tree/shrub species.

9. As noted above, subgrade material not used in reconstituted block manufacture will normally be stored in the bunds around the perimeter of the pit and then used to recontour the completed pit as the first stage of rehabilitation.

10. After mining through of the faces the final slopes are to be leveled, with some bunds and batters at 1 : 4 or between 1 : 6 vertical to horizontal in compliance with the *Mines Safety and Inspection Act (1994) and Regulations (1995).*

11. The final slopes and land surface will be reviewed in the light of any future changes to the end use and where possible will be formed to that future end use.

Rehabilitation will progressively follow mining, with completed areas of the excavation being revegetated as soon as practicable

- ***Limestone Extraction – Roadbase and limestone for reconstituted blocks***

1. Excavation is carried out as a sequence.

2. Where sand overlies the limestone, sand will be taken at this point to expose the limestone. Mostly on site the sand forms overburden and is stored with the overburden.

3. The void to be left at the end of limestone extraction will normally have a flat floor rising gently to natural land surface and bunds at the perimeter of the excavations.

4. During excavation for rubble the limestone is deep ripped with a bulldozer pushing down a sloping face below the elevation of the perimeter bunding. This track rolls and crushes the limestone.

5. Rubble is then pushed into a stockpile from which it is loaded directly into a mobile crushing plant and screening plant.

6. Water is used for dust suppression, to reduce the potential for dust generation from the movement of machinery and the effect of wind.

7. Blasting is not part of the normal operations.

8. Depending on the depth of the resources, the nature and grade of the resources and their thickness, benches may be required to differentiate product and assist safety.

- ***Limestone Extraction – Natural Dimension Stone***

1. A bull dozer is used to remove the cap rock and surface limestone, to produce a relatively flat cutting floor of soft limestone.

2. Finally a grader is used to smooth and level the floor, as flat as possible, to allow the installation of rails and cutting machines.

3. When dimension stone is cut, sections of the floor are lowered by the depth of one block until the whole floor is lowered. The next set of blocks is cut by the re-installation of the rails and cutting machines on the lowered floor and the process repeated. This method of excavation means that the cutting floor is gradually lowered below the land surface. The cutting saws are electric, using air cooling for the blades.

4. Water is used for dust suppression, to reduce the potential for dust generation from the movement of machinery and the effect of wind.

5. All static and other equipment such as cutting machines, are located on the floor of the quarry or screened by earth bunds where possible to provide visual and acoustic screening. There is currently no proposal to change the location of the existing facilities on site.

Figure 3 Crushing and screening

Processing

- ***Limestone Products***

1. A mobile plant is used to prepare limestone rubble for raw feed for use in the manufacture of reconstituted blocks.

2. The crushing plant will normally consist of a mobile crusher together with screens and stackers to sort the products into various sizes. The units fit together linked by conveyors.

3. The crusher is fed by a loader, which collects the raw materials from the face and also loads road trucks.

4. The mobile plant is located on the floor of the pit, some 5 - 10 metres below natural ground level.

5. All crushers, screens and stockpiles are to be equipped with water sprays, sprayed, enclosed or the stockpiles wetted down depending on the nature of the materials to be processed. This is the same management as for the approved extractive industry.

6. A limestone batching plant with associated hoppers is located on M70/339 to produce mix for the reconstituted limestone blocks with a second plant on M70/109.
7. At times a small amount of natural laterite gravel is introduced to the limestone blocks to change the colour of the blocks to a more brown colour to better match the soils in hills locations or for landscaping.

- ***Sand***

8. Sand is not normally screened but is when required to be of a particular grade and will be screened on the floor of the pit.

Stockpiles

- The only stockpiles are limestone and other materials waiting to be used, and the stored reconstituted blocks waiting for shipment.

- Stockpiles are located in the active working area on excavated ground and, like the excavation, will move across the site as excavation progresses.

- A rubber tyred loader or bobcat is be used to load each road truck.

Tailings Storage

- There are no tailings. All limestone is used in the reconstituted blocks. Broken and subgrade blocks are broken up and added to the manufacture of new blocks.

- Any limestone or sand that is not of suitable grade is used to restore the land surface for rehabilitation.

Workforce

The site is typically worked by up to 35 persons, depending on how busy the current situation is.

The operator has radio contact with any vehicles and can contact to check in regularly during the working day although vehicles are mostly within view of each other.

Truck drivers regularly arrive at the site throughout the working day.

Transportation

The access road runs to Hopkins Road.

Figure 4 Reconstituted block manufacture

2.7 Site Layout

Site Layout

Excavation takes limestone from the site with some raw feed brought to site to supplement the on site materials.

The eastern and western pits are used as a source of limestone as is M70/013 in the south.

Adjacent to the pits on M70/339 and M70/109 are two reconstituted block manufacturing batching operations and floors.

A service shed and facilities are located on M70/339, with several small buildings located on M70/109 which are used for storage and ancillary functions but are not normally active.

Older sections of the pits such as on M70/341 were used for cutting dimension stone but they are not now normally used.

Fenced secured areas are located near the production facilities.

Fuel is stored in a lined bunded enclosure near the maintenance shed. A cutting shed is present to produce smaller cut blocks.

The pit is internally draining.

Water is obtained from a licensed bore on site. Water is pumped to a holding tank and gravity fed to the cutting machines for dust suppression.

Dust, noise and other environmental issues are being managed by methods outlined in the Notice of Intent.

Mobile Equipment

The current equipment consists of;

- Water supply by on site licensed bore.
- Potable water is to be brought to site.
- Power is used for site activities.
- Mobile crushing plants and screens are self powered or connected to a genset.
- Two concrete batching plants and associated hoppers, mixers and ancillary plant are located in the east and west of the operations.
- Two reconstituted block production floors are constructed from level concrete.
- Reconstituted block making machines are located on the block making floors.
- Bulldozer, loaders, excavator, bob cats and other ancillary equipment
- Some fuel is stored on site as required in a fuel tank which is a small double skinned self contained tank compliant with the *Dangerous Goods Safety Act 2004* and DWER Guidelines.
- The refueling procedures have been in operation for 20 years without incident.

Fixed Structures

- The only fixed structures are the concrete reconstituted block manufacturing floors and the maintenance sheds and a workshop.
- Officers from DMIRS regularly inspect the facilities on that site.
- The workforce accesses the site daily with caretakers staying on site at times.

2.8 Disturbance Areas

The operations on site can be divided into a number of domains. The domains are provided with more information at Section 5.2 Domains to be Closed.

See the Figures at the end of this Closure Plan.

The domains identified for this site are;

- Pit - excavation areas.
- Transport Corridor
- Laydown hardstand
- Building other than workshop
- Workshop
- Other cleared land)

Table 2A – Areas of Mining Activity

KEY MINE ACTIVITIES **M70/109**	**MINE ACTIVITY REFERENCE**	**TOTAL CURRENT APPROVED AREA (ha)**	**CURRENT DISTURBANCE AREA (ha)**	**LAND UNDER REHABILITATION**	**DISTURBANCE TO BE REHABILITATED**
NIL					
KEY MINE ACTIVITY AREA TOTAL	**NIL**	**NIL**	**NIL**	**NIL**	**NIL**
MISCELLANEOUS MINE ACTIVITIES					
Transport or service infrastructure corridor	RD 1	0.5377 ha	0.5377 ha	Nil	0.5377 ha
Borrow pit or shallow surface excavation(with a depth of less than 5 metres)	Pit 1	1.7226 ha	1.7226 ha	Nil	1.7226 ha
Laydown or hardstand area	Hardstand	5.5407 ha	5.5407 ha	1.6579 ha	3.8826 ha
Building other than workshop or campsite	Site Buildings	0.0559 ha	0.0559 ha	Nil	0.0559 ha
MISCELLANEOUS MINE ACTIVITY AREA		**7.8567 ha**	**7.8567 ha**	**1.6579 ha**	**6.1988 ha**
TOTAL TENEMENT ACTIVITY AREA		**7.8567 ha**	**7.8567 ha**	**1.6579 ha**	**6.1988 ha**

Table 2B – Areas of Mining Activity					
KEY MINE ACTIVITIES **M70/341**	**MINE ACTIVITY REFERENCE**	**TOTAL CURRENT APPROVED AREA (ha)**	**CURRENT DISTURBANCE AREA (ha)**	**LAND UNDER REHABILITATION**	**DISTURBANCE TO BE REHABILITATED**
NIL					
KEY MINE ACTIVITY AREA TOTAL	**NIL**	**NIL**	**NIL**	**NIL**	**NIL**
MISCELLANEOUS MINE ACTIVITIES					
Transport or service infrastructure corridor	RD 2	0.71 ha	0.7065 ha	Nil	0.7065 ha
Borrow pit or shallow surface excavation(with a depth of less than 5 metres)	Pit 2	3.8975 ha	3.8975 ha	Nil	3.8975 ha
Laydown or hardstand area	Hardstand	8.9 ha	8.9 ha	7.2052ha	1.6948 ha
Building other than workshop or campsite	Site Buildings	0.0294 ha	0.0294 ha	Nil	0.0294 ha
MISCELLANEOUS MINE ACTIVITY AREA		**13.53344 ha**	**13.5334 ha**	**7.2052 ha**	**6.3282ha**
TOTAL TENEMENT ACTIVITY AREA		**13.53344 ha**	**13.5334 ha**	**7.2052 ha**	**6.3282ha**

Table 2C – Areas of Mining Activity					
KEY MINE ACTIVITIES **M70/345**	**MINE ACTIVITY REFERENCE**	**TOTAL CURRENT APPROVED AREA (ha)**	**CURRENT DISTURBANCE AREA (ha)**	**LAND UNDER REHABILITATION**	**DISTURBANCE TO BE REHABILITATED**
NIL					
KEY MINE ACTIVITY AREA TOTAL	**NIL**	**NIL**	**NIL**	**NIL**	**NIL**
MISCELLANEOUS MINE ACTIVITIES					
Borrow pit or shallow surface excavation(with a depth of less than 5 metres)	Pit 3	0.1 ha	0.6349 ha	0.6349 ha	Nil
MISCELLANEOUS MINE ACTIVITY AREA		**0.1 ha**	**0.6349 ha**	**1.6579 ha**	**Nil ha**
TOTAL TENEMENT ACTIVITY AREA		**0.1 ha**	**0.6349 ha**	**1.6579 ha**	**Nil ha**

Table 2D – Areas of Mining Activity					
KEY MINE ACTIVITIES **M70/346**	**MINE ACTIVITY REFERENCE**	**TOTAL CURRENT APPROVED AREA (ha)**	**CURRENT DISTURBANCE AREA (ha)**	**LAND UNDER REHABILITATION**	**DISTURBANCE TO BE REHABILITATED**
NIL					
KEY MINE ACTIVITY AREA TOTAL	**NIL**	**NIL**	**NIL**	**NIL**	**NIL**
MISCELLANEOUS MINE ACTIVITIES					
Building other than workshop or campsite	Site Buildings	0.0623 ha	0.0623 ha	Nil	0.0623 ha
Laydown or hardstand area	Hardstand	0.5261 ha	0.5261 ha	Nil	0.5261 ha
MISCELLANEOUS MINE ACTIVITY AREA		**0.5884 ha**	**0.5884 ha**	**1.6579 ha**	**0.5884 ha**
TOTAL TENEMENT ACTIVITY AREA		**0.5884 ha**	**0.5884 ha**	**1.6579 ha**	**0.5884 ha**

Table 2E – Areas of Mining Activity					
KEY MINE ACTIVITIES **M70/013**	**MINE ACTIVITY REFERENCE**	**TOTAL CURRENT APPROVED AREA (ha)**	**CURRENT DISTURBANCE AREA (ha)**	**LAND UNDER REHABILITATION**	**DISTURBANCE TO BE REHABILITATED**
NIL				Nil	
KEY MINE ACTIVITY AREA TOTAL	**NIL**	**NIL**	**NIL**	**NIL**	**NIL**
MISCELLANEOUS MINE ACTIVITIES					
Transport or service infrastructure corridor	RD 2	0.54 ha	0.54 ha	Nil	0.54 ha
Borrow pit or shallow surface excavation(with a depth of less than 5 metres)	Pit 1	0.44 ha	0.44 ha	Nil	0.44 ha
Borrow pit or shallow surface excavation(with a depth of less than 5 metres)	Pit 2	3.55 ha	3.55 ha	1.086 ha	2.464ha
Other cleared land – land that is cleared of vegetation and is not otherwise described in the table.	Other land	2.62 ha	2.62 ha	Nil	2.62 ha
MISCELLANEOUS MINE ACTIVITY AREA		**11.11 ha**	**11.11 ha**	**1.086 ha**	**10.024 ha**
TOTAL TENEMENT ACTIVITY AREA		**11.11 ha**	**11.11 ha**	**1.086 ha**	**10.024 ha**

Table 2F – Areas of Mining Activity					
KEY MINE ACTIVITIES **M70/339**	**MINE ACTIVITY REFERENCE**	**TOTAL CURRENT APPROVED AREA (ha)**	**CURRENT DISTURBANCE AREA (ha)**	**LAND UNDER REHABILITATION**	**DISTURBANCE TO BE REHABILITATED**
NIL				Nil	
KEY MINE ACTIVITY AREA TOTAL	**NIL**	**NIL**	**NIL**	**NIL**	**NIL**
MISCELLANEOUS MINE ACTIVITIES					
Workshop	WRKSHP 1	1.00 ha	0.17 ha	Nil	0.17 ha
Transport or service infrastructure corridor	RD #	1.30 ha	0.66 ha	Nil	0.66 ha
Laydown or hardstand area	HRD 1	6.79 ha	6.79 ha	0.73 ha	6.06 ha
Borrow pit or shallow surface excavation(with a depth of less than 5 metres)	Pit 3	7.69 ha	2.89 ha	0.99 ha	1.90 ha
Borrow pit or shallow surface excavation(with a depth of less than 5 metres)	Pit 4	11.27 ha	11.27 ha	5.49 ha	5.78 ha
MISCELLANEOUS MINE ACTIVITY AREA		**28.05 ha**	**21.78 ha**	**7.21 ha**	**14.57 ha**
TOTAL TENEMENT ACTIVITY AREA		**28.05 ha**	**21.78 ha**	**7.21 ha**	**14.57 ha**

3.0 IDENTIFICATION OF CLOSURE OBLIGATIONS AND COMMITMENTS

3.1 Background

The Mining Act 1978 prevails over the *Planning and Development Act 2005* and therefore approval under the planning structure is not required as part of a Mining Tenement Application.

The *Environmental Protection Act 1986* prevails over other State Legislation and sits under the *Commonwealth EPBC Act 1999*.

There are no significant closure issues that require management. There are no tailings, ponds, adverse soil or other materials or features apart from road materials from construction.

Environmental Restrictions

There are some environmental restrictions in relation to the location of the Threatened species *Eucalyptus argutifolia* located in the east of the tenement and to the east south east of the open area, and vegetation community type FCT 26a which is classified as Threatened.

There is also potential for restrictions on the excavation area from the Perth to Peel Green Growth Plan (SAPPR) when the guidelines for clearing are determined and signed off by the State and Commonwealth Governments.

3.2 Legal Obligations Register

The Legal Obligations Register, Conditions and Commitments listed below are those that relate to closure.

Table 3 - Relevant Legislation

Legislation	Environmental Factor regulated/affected	Discussion	Action
MINING			
Mining Act 1978	General environmental issues	Approved Rehabilitation Plan in Notice of Intent for each sublease operation.	The plans and commitments have been updated and incorporated into this closure plan.
Western Australian Geological Survey	Resource factors impact on the environment	Western Australian Geological Survey have assessed the site and listed it as a significant geological resource.	The site is listed in Minedex as part of a regionally significant limestone resource.
Dangerous Goods Safety Act 2004	Potential for dangerous goods to impact on the environment.	Refers to fuel, which is required.	Limestone Building Blocks and their contractors have fuel management plans in place that include closure considerations and remediation.
Mines Safety and Inspection Act 1994	Safety and management of mining operations which in turn may impact on the environment.		The site is registered under the SRS and a Project Management Plan, Risk Assessment and Emergency plans approved. The SRS System address ongoing Health and Safety for operations and closure.
Project Management Plan – SRS System	Safety and management of mining operations which in turn may impact on the environment.	Compliance with the Project Management Plan when it is submitted and approved.	The site will be registered under the SRS and a Project Management Plan, Risk Assessment and Emergency plans approved. See Above

Mining Proposal	The Mining Proposal considers environmental matters and their management during operations.	Both the old Limestone Building Blocks and Urbanstone operations operate under Notices of Intent. Mining Proposals were prepared for both sites but	This Mine Closure Plan supports the Notices of Intent (Mining Proposal) that were prepared for each sublease and incorporates the closure processes from the Notices of Intent and updates the closure methodology and commitments.
Mine Closure Plan	The Mine Closure Plan considers environmental matters ad their management during closure.	The Mine Closure Plan and the included methods and commitments are legally binding.	This Mine Closure Plan incorporates past closure processes from the Notices of Intent and updates the closure methodology and commitments.
HERITAGE			
Aboriginal Heritage Act 1972	Aboriginal heritage sites	A database search of DPLH has been conducted and no site recorded	No aboriginal heritage sites are recorded locally on or near the resource. If any heritage is found and conditions are placed on the tenement or closure obligations Limestone Building Blocks will comply with the conditions.
Native Title Act 1993	Traditional land ownership	The tenements pre date the Native Title Act.	
Heritage of Western Australia Act 1990	Heritage	No heritage matters are identified locally or on the tenements.	No matters of significance that would trigger this legislation have been identified.
ENVIRONMENTAL			
Environmental Protection Act 1986 *Part IV* - Assessment	Environmental factors that may be significantly impacted are dealt with under Part (IV).	The operations have not been assessed under Part (IV) of the Act.	Noted.
Environmental Protection Act 1986 *Part V* – DWER Licence	Environmental factors that are associated with potential screening operations, such as dust, noise and visual impacts.	If site activities require a Licence it will be applied for.	A DWER Licence will be applied for if the operations exceed the trigger threshold.
Environmental Protection (Noise) Regulations 1997	Noise impacts.	There are no changes to the operations with respect to noise buffers that will impact on closure.	No complaints relating to noise have been received during operations.
Environmental Protection (Clearing of Native Vegetation) Regulations 2004	Clearing and disturbance of native vegetation.	Clearing Permit under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* is required *under the Regulations*.	The current clearing pre-dates the Clearing Regulations. New Clearing Permits are required for any extension into vegetated areas. Clearing Permit CPS 6203/1 over 4.99 ha on M70/013 is current. Clearing Permit CPS 2858/1 over 1.076 ha on M70/341 was not activated and is now expired. Clearing Permit CPS 5341/1 over 2.797 ha on M70/339 has expired.
Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)	Matters listed on the EPBC database.	The matters listed under the *EPBC Act 1999* which might apply to this site are potentially individually listed flora and Black Cockatoo habitat. The potential cockatoo habitat was considered in the Clearing Permit applications and the provision of offsets.	Whether referral to the Commonwealth is required will be determined at the time a new Clearing Permit Application is made. The implications of the *Perth to Peel Green Growth Plan* (SAPPR) are noted and may result in the Commonwealth and State signing off on the clearing of vegetation if SAPPR

			is approved and implemented. Any conditions on clearing permits will be incorporated into the Mine Closure Planning.
Contaminated Sites Act 2003	Contaminated materials that may arise from excavation or be used in excavation and processing.	The only factor that is likely to fall under this category is the storage and use of fuel and maintenance items and on site maintenance and the use of limestone batching.	No materials are present or to be used which would trigger this legislation apart from normal fuel and maintenance. A water management plan is in place that includes commitments to remove any contaminated soils or other material regularly and at the end of excavation as part of the closure actions. The management of any potentially contaminated materials is considered in this Mine Closure Plan.
Conservation and Land Management Act 1984	Parks and Reserves and issues relating to flora and fauna.	The land is State Forest 65.	Noted. The site has been partially excavated with the excavated areas to be rehabilitated as the pit moves forward. See *Environmental Protection (Clearing of Native Vegetation) Regulations* above.
Biodiversity Conservation Act 2016	The legislation seeks to protect and manage biodiversity in all its forms through regulation, conservation and restoration.	Provides for the protection of flora and fauna.	The environmental significance of the flora and fauna was recorded in the sets of studies completed. The significant flora species listed are; The vegetation community is best ascribed as FCT 24 – Northern Spearwood Shrublands and Woodlands", a Priority 3 Community on State databases, but not listed on EPBC Database. FCT 24 is considered to be "*well reserved however it is susceptible to modification or destruction by human activities, or threatening processes"* (Gibson et al 1994). There are some environmental restrictions in relation to the location of vegetation community type FCT 26a. Possibly the most significant fauna are Black Cockatoos which have been recorded in the general area. These are listed on State (under the *Wildlife Conservation Act 1950*) and EPBC conservation databases. On the State database the taxa are listed in Schedule 1 as "Fauna that is rare or is likely to become extinct". Other significant fauna that may occur on site are Carpet Python *Morelia spilota imbricata* and Quenda *Isoodon obesulus fusciventer*. Large fauna will move away when impacted.

Bush Forever Site 290	Protection of Significant vegetation	The Strategic Assessment (SAPPR) Tengraph FNA 12231, is anticipated to lead to changes to Bush Forever Sites. Perth to Peel Green Growth Plan, shown as a Future Resource Extraction Area in the Draft Planning. Tengraph FNA 12690 Discussions have been held with the SAPRA Review Committee to update them on the industry needs for limestone. The SAPRA process has only delivered limited limestone resources for around 20 years and this resource is considered vital by the Industry for ongoing community needs of limestone which in the northern Perth area vary from around 1 million tonnes per year to 2 million tonnes per year in the last development boom.	The provision of SAPPR may lead to changes to access to resources on the tenements.
PLANNING AND PUBLIC HEALTH			
Health Act 1911	Environmental and health impacts from waste water treatment and community health.	No matters of significance that would trigger this legislation have been identified.	Waste disposal and health are noted and will be addressed during the campaign operation of the site. No waste materials will be disposed of on site with all wastes being removed at the end of each campaign. A septic toilet system is used.
Planning and Development Act 2005	Development approvals for on site constructions and any ensuing environmental impacts.	The *Mining Act 1978* prevails over Planning legislation. Planning approval is normally required for buildings and other similar structures on a mining tenement.	The Local Authority (City of Wanneroo) will provide comment and approval of any developments. No developments that would require approval from the City are proposed or in place.
State Agreement Acts	Specific acts that relate to certain large projects that may impact on some locations.	Not applicable	
WATER			
Rights in Water and Irrigation Act 1914	Water quality and management of surface water	Not really applicable to this operation. DWER has input into the approval and operational management. DWER has approved the project	Noted. This Act is not anticipated to be triggered.
Country Areas Water Supply (CAWS) Act 1947	Water supplies	The site does not lie within a surface or groundwater control area.	Noted
Waterways Conservation Act 1976	Water quality and management of surface water	There are no watercourses on site that will require referral to the DWER.	Noted

3.3 Tenement Conditions Register

TABLE 4A SUMMARY OF TENEMENT CONDITIONS RELATING TO CLOSURE		
	SUMMARY OF CONDITIONS (Check actual condition if in doubt)	**DISCUSSION**
M70/013		
3	Compliance with the provisions of the Aboriginal Heritage Act, 1972 to ensure that no action is taken which is likely to interfere with or damage any Aboriginal site.	No recorded sites
4	Compliance with Forests and Bush Fires Act and Regulations.	Noted
5	The lessee observing any lawful requirements of the Metropolitan Water Authority, Department of Conservation and Environment, Metropolitan Region Planning Authority, Scientific Research Bodies and the Local Authority.	Noted
8	All precautions being taken to minimise damage to ecological/forest values on the land and no intrusion into or damage being caused to adjoining areas of the State Forest and haul roads.	Noted
10	All such necessary precautions being taken as may be indicated by the Executive Director, Department of Conservation and Land Management or his representatives to prevent the occurrence or spread of fires within or adjacent to the lease. In particular, it will be necessary to construct a firebreak on the lease at a location(s) and to a standard considered appropriate by the Executive Director, Department of Conservation and Land Management.	Noted No fires have resulted from on site activities since operations began.
11	Approval being obtained which shall not unreasonably be withheld by the Executive Director, Department of Conservation and Land Management or his representative with respect to (a) levels of contours to remain after mining and (b) method of pit operation with particular reference to the removal and storage and topsoil, overburden and other quarry residues, and the locations of infrastructure and access roads.	The closure plan documents the concept closure landform.
12	The lessee preparing plans and rehabilitating at his own expense all areas that have been damaged, cleared or mined as a result of activities. The rehabilitation to be undertaken under the direction and to the satisfaction of the Executive Director, Department of Conservation and Land Management or his representative. The Executive Director, Department of Conservation and Land Management reserving the right to decide that the Forests Department shall undertake any revegetation work on the areas concerned at the lessee's expense.	The closure plan commits to all aspects of closure.
15	Roads used in explorations and mining being maintained in a trafficable conditions to the satisfaction of the Executive Director, Department of Conservation and Land Management or his representative.	Noted and complied with. Hopkins Road is maintained for quarry use.
17	The lessee maintaining the lease free of litter, rubbish and unused/derelict equipment arising from operations and upon the expiration of the lease the area being left in a rehabilitated, clear and tidy condition to the satisfaction	Rubbish and waste are regularly removed from site to an approved waste facility.
19	The Executive Director, Department of Conservation and Land Management or his representative giving notice, prior to entering the lease to inspect work carried out and/or to undertake any forest management operations.	Noted
21	All topsoil being removed ahead of all mining operations from sites such as pit areas, waste disposal areas, ore stockpile areas, pipeline, haul roads and new access roads and being stockpiled for later respreading or immediately respread as rehabilitation progresses.	Forms part of closure management.
22	At the completion of operations, all buildings and structures being removed from site or demolished and buried to the satisfaction of the State Mining Engineer	Forms part of closure management.
23	All rubbish and scrap to be progressively disposed of in a suitable manner.	Forms part of closure management.

24	All rubbish and scrap to be progressively disposed of in a suitable manner.	Forms part of closure management.
26	The Lessee submitting to the Executive Director, Environment Division, DMP, a brief annual report outlining the project operations, minesite environmental management and rehabilitation work undertaken in the previous 12 months and the proposed operations, environmental management plans and rehabilitation programmes for the next 12 months. This report to be submitted each year in: July.	The annual reports are submitted.
27	Operations being conducted in accordance with the Joint Working Arrangements with the Department of Conservation and Land Management.	The closure plan will be provided to DBCA.
30	The construction and operation of the project and measures to protect the environment to be carried out in accordance with the document titled: • (Reg ID 56348) "Mine Closure Plan M70/13 and M70/339" dated 28 August 2015 signed by M.J. Barzon - Deputy Registered Manager and retained on Department of Mines and Petroleum File No. EARS-MCP-56348 as Doc ID 3494696 Where a difference exists between the above document(s) and the following conditions, then the following conditions shall prevail.	Noted. This Closure Plan will supersede the listed plan.
31	A Mine Closure Plan is to be submitted in the Annual Environmental Reporting month specified in tenement conditions in the year specified below, unless otherwise directed by an Environmental Officer, DMP. The Mine Closure Plan is to be prepared in accordance with the "Guidelines for Preparing Mine Closure Plans" available on DMP's website: 2017	This Closure Plan will satisfy the condition.

TABLE 4B SUMMARY OF TENEMENT CONDITIONS RELATING TO CLOSURE		
	SUMMARY OF CONDITIONS (Check actual condition if in doubt)	**DISCUSSION**
M70/339		
2	Compliance with the provisions of the Aboriginal Heritage Act, 1972 to ensure that no action is taken which is likely to interfere with or damage any Aboriginal Site.	Noted
3	All surface holes drilled for the purpose of exploration are to be capped, filled or otherwise made safe after completion.	Forms part of closure management.
4	All costeans and other disturbances to the surface of the land made as a result of exploration, including drill pads, grid lines and access tracks, being backfilled and rehabilitated to the satisfaction of the Environmental Officer, Department of Industry and Resources (DoIR). Backfilling and rehabilitation being required no later than 6 months after excavation unless otherwise approved in writing by the Environmental Officer, DoIR	Forms part of closure management.
5	All waste materials, rubbish, plastic sample bags, abandoned equipment and temporary buildings being removed from the mining tenement prior to or at the termination of exploration programme.	Forms part of closure management.
6	Unless the written approval of the Environmental Officer, DoIR is first obtained, the use of scrapers, graders, bulldozers, backhoes or other mechanised equipment for surface clearing or the excavation of costeans is prohibited. Following approval, all topsoil being removed ahead of mining operations and separately stockpiled for replacement after backfilling and/or completion of operations.	Forms part of closure management.

8	The lessee complying with the provisions of: • the Conservation and Land Management Act, 1985 and the Regulations thereunder; • the Bush Fires Act, 1954-77 and the Regulations, and Wildlife Conservation Act, 1950; and thereunder; and Regulations thereunder.	Noted
12	The lessee at his expense carrying out all necessary measures to prevent the spread of the forests disease Phytophthora Cinnamomi (or Jarrah Dieback) on the area of the lease and liasising with the District Manager CALM before commencing exploratory work outside areas being mined.	Dieback does not impact limestone and Spearwood soil systems. Even so dieback control principles are used.
13	Lessee taking all such necessary precautions as may be indicated by the District Manager CALM to prevent the occurrence or spread of any fire within or adjacent to the leased area.	Noted and committed to.
14	The lessee at his expense rehabilitating all areas affected by mining or operations associated with mining, including the rehabilitation enrichment of dieback or other forest disease affected areas, resulting from the lessees mining or operations associated with mining. Rehabilitation being to the satisfaction of the Regional Mining Engineer and in agreement with the Regional Manager CALM.	Forms part of closure management.
19	Where reasonable, the lessee permitting CALM to remove for CALM requirements, sand, rock, clay, gravel and soil subject to a working agreement.	Noted
20	No productive mining within areas of Jarrah-banksia woodlands as defined by the District Manager, Conservation and Land Management.	Noted
22	The construction and operation of the project and measures to protect the environment being carried out generally in accordance with the document titled "Development Management Plan ML 70/339 Nowergup" received 21 September 1989, and retained on Department of Minerals and Energy File No. 339/89.Where a difference exists between the above document(s) and the following conditions, then the following conditions shall prevail.	Noted and complied with.
23	The development and operation of the project being carried out in such a manner so as to create the minimum practicable disturbance to the existing vegetation and natural landform.	Forms part of closure management.
24	All topsoil being removed ahead of all mining operations from sites such as pit areas, waste disposal areas, ore stockpile areas, pipeline, haul roads and new access roads and being stockpiled for later respreading or immediately respread as rehabilitation progresses.	Forms part of closure management.
25	At the completion of operations, all buildings and structures being removed from site or demolished and buried to the satisfaction of the State Mining Engineer.	Forms part of closure management.
26	All rubbish and scrap being progressively disposed of in a suitable manner.	Forms part of closure management.
27	Operations being conducted in accordance with the Joint Working Arrangements with the Department of Conservation and Land Management.	Forms part of closure management.
30	The Lessee submitting to the Executive Director, Environment Division, DMP, a brief annual report outlining the project operations, minesite environmental management and rehabilitation work undertaken in the previous 12 months and the proposed operations, environmental management plans and rehabilitation programmes for the next 12 months. This report to be submitted each year in: July.	The annual report is lodged each year.
31	The lessee entering into a Joint Working Arrangement with the Department of Conservation and Land Management.	Noted. The Mine Closure Plan will be supplied to DBCA for comment.

32	The construction and operation of the project and measures to protect the environment to be carried out in accordance with the document titled: • (Reg ID 56348) "Mine Closure Plan M70/13 and M70/339" dated 28 August 2015 signed by M.J. Barzon - Deputy Registered Manager and retained on Department of Mines and Petroleum File No. EARS-MCP-56348 as Doc ID 3494696 . Where a difference exists between the above document(s) and the following conditions, then the following conditions shall prevail	This Mine Closure Plan will supersede the listed plan.
33	A Mine Closure Plan is to be submitted in the Annual Environmental Reporting month specified in tenement conditions in the year specified below, unless otherwise directed by an Environmental Officer, DMP. The Mine Closure Plan is to be prepared in accordance with the "Guidelines for Preparing Mine Closure Plans" available on DMP's website: 2017	This Closure Plan is prepared to comply with this condition.

TABLE 4C SUMMARY OF TENEMENT CONDITIONS RELATING TO CLOSURE		
	SUMMARY OF CONDITIONS (Check actual condition if in doubt)	**DISCUSSION**
M70/109		
2	Compliance with the provisions of the Aboriginal Heritage Act, 1972 to ensure that no action is taken which is likely to interfere with or damage any Aboriginal site.	No recorded sites
3	Compliance with Forests and Bush Fires Act and Regulations.	Noted
4	Written approval being obtained which shall not unreasonably be withheld, of the Conservator of Forests (6) months prior to any surface clearing being undertaken for access, mineral exploration or mining, or for the construction of any building, camp, fuel depot of similar establishment.	Noted
6	All precautions being taken to minimise damage to ecological/forest values on the land and no intrusion into or damage being caused to adjoining areas of the State Forest and haul roads.	Forms part of closure management.
7	The lessee complying with reasonable instructions and provisions imposed by the Conservator of Forests or his representative, aimed at preventing the introduction and/or spread of the forest disease Phytophthora Cinnamomi (Jarrah Dieback Disease).	Dieback does not occur in Tamala – Spearwood land systems. Even so dieback management procedures are used.
8	The lessee taking all such necessary precautions as may be indicated by the Conservator of Forests or his representatives to prevent the occurrence or spread of fires within or adjacent to the lease area. In particular, it will be necessary to construct a firebreak within the lease area at a location(s) and to a standard considered appropriate by the O.I.C., Forests Department, Wanneroo.adjoining areas of the State Forest and haul roads.	Noted and committed to.
9	Approval being obtained which shall not unreasonably be withheld by the Conservator of Forests or his representative with respect to (a) levels of contours to remain after mining and (b) method of pit operation with particular reference to the removal and storage of topsoil, overburden and other quarry residues and the locations of infrastructure and access roads.	Forms part of closure management.
10	The lessee preparing plans and rehabilitating at his own expense all areas that have been damaged, cleared or mined as a result of his activities. The rehabilitation being to the direction and to the satisfaction of the Conservator of Forests or his representative. The Conservator of Forests reserving the right to decide that the Forests Department shall undertake any revegetation work on the areas concerned at the lessee's expense.	Forms part of closure management.
13	Roads used in exploration and mining being maintained in trafficable condition to the satisfaction of the Conservator of Forests or his representative.	Noted
15	The lessee maintaining the lease free of litter, rubbish and unused/derelict equipment arising from any operations and upon expiration of the lease the area being left in a rehabilitated, clean and tidy conditions to the satisfaction of the Conservator of Forests or his representative.	Forms part of closure management.
16	Subject to agreed arrangements, with the Forests Department, allow the Department to draw supplies of limestone materials for road construction, maintenance and other specified forest management operations from the land held under this lease. Such material being for use in the close vicinity of the lease area.	Noted
17	The Conservator of Forests or his representative giving notice, prior to entering the lease to inspect work carried out and/or to undertake any forest management operations.	Noted
	Unless otherwise directed by the District Mining Engineer:	Forms part of closure management.

	• Topsoil being removed and stockpiled for replacement prior to the excavation of costeans, trenches or pits; • All excavations being progressively refilled as sampling proceeds; and the topsoil returned as soon as possible. All excavation and surface disturbances made by the tenement holder being refilled and the ground rehabilitated to the satisfaction of the District Mining Engineer.	
24	The operation of the project and measures to protect the environment being carried out generally in accordance with the document titled "Development Management Plan. Mining Lease 70/109 Nowergup" received 22 February 1990 and retained on Mines Department File No. 728/90.Where a difference exists between the above documents and the following conditions, then the following conditions shall prevail.	Complied with.
25	The development and operation of the project being carried out in such a manner so as to create a minimum practicable disturbance to the existing vegetation and natural landform.	Forms part of closure management.
26	At the completion of operations, all buildings and structures being removed from site or demolished and buried to the satisfacation of the State Mining Engineer.	Forms part of closure management.
27	All rubbish and scrap to be progressively disposed of in a suitable manner.	Forms part of closure management.
28	Any expansion of operations within the lease boundaries beyond that outlined in the above document(s) not commencing until a plan of operations and a programme to safeguard the environment are submitted to the State Mining Engineer for his assessment and until his written approval to proceed has been obtained.	Noted
29	The lessee submitting to the State Mining Engineer and District Manager, CALM, in June of each year, brief annual report outlining the operations and rehabilitation work undertaken in the previous 12 months and the proposed operations and rehabilitation programmes for the next 12 months.	The annual reports are submitted.
30	A Mine Closure Plan is to be submitted in the Annual Environmental Reporting month specified in tenement conditions in the year specified below, unless otherwise directed by an Environmental Officer, DMP. The Mine Closure Plan is to be prepared in accordance with the "Guidelines for Preparing Mine Closure Plans" available on DMP's website: 2018	
31	The Lessee submitting to the Executive Director, Environment Division, DMP, a brief annual report outlining the project operations, minesite environmental management and rehabilitation work undertaken in the previous 12 months and the proposed operations, environmental management plans and rehabilitation programmes for the next 12 months. This report is to be submitted each year in: June.	See Condition 29
32	The construction and operation of the project and measures to protect the environment to be carried out in accordance with the document titled: (Reg ID 56335) "Mine Closure Plan M70/109, M70/339, M70/341 and M70/345" dated 30 July 2015 signed by Michael Falconer - Registered Manager and retained on Department of Mines and Petroleum File No. EARS-MCP-56335 as Doc ID 3468558	This Closure Plan will update the approved plan.

TABLE 4D SUMMARY OF TENEMENT CONDITIONS RELATING TO CLOSURE		
	SUMMARY OF CONDITIONS (Check actual condition if in doubt)	**DISCUSSION**
M70/341		
2	Compliance with the provisions of the Aboriginal Heritage Act, 1972 to ensure that no action is taken which is likely to interfere with or damage any Aboriginal site.	No recorded sites
3	All surface holes drilled for the purpose of exploration are to be capped, filled or otherwise made safe after completion.	Forms part of closure management.
4	All costeans and other disturbances to the surface of the land made as a result of exploration, including drill pads, grid lines and access tracks, being backfilled and rehabilitated to the satisfaction of the Environmental Officer, Department of Industry and Resources (DoIR). Backfilling and rehabilitation being required no later than 6 months after excavation unless otherwise approved in writing by the Environmental Officer, DoIR.	Forms part of closure management.
5	All waste materials, rubbish, plastic sample bags, abandoned equipment and temporary buildings being removed from the mining tenement prior to or at the termination of exploration programme.	Forms part of closure management.
6	Unless the written approval of the Environmental Officer, DoIR is first obtained, the use of scrapers, graders, bulldozers, backhoes or other mechanised equipment for surface disturbance or the excavation of costeans is prohibited. Following approval, all topsoil being removed ahead of mining operations and separately stockpiled for replacement after backfilling and/or completion of operations.	Noted
9	The lessee's complying with the provisions of: • the Conservation and Land Management Act, 1984 and the Regulations thereunder; • the Bush Fires Act, 1954-77 and Regulations; and Wildlife Conservation Act, 1950 and Regulations thereunder.	Noted
13	The lessee at his expense carrying out all necessary measures to prevent the spread of the forests disease Phytophthora Cinnamomi (or Jarrah Dieback) on the area of the lease and liasising with the District Manager CALM before commencing exploratory work outside areas being mined.	Dieback does not impact on Spearwood and Tamala Systems. Even so dieback management principles are practiced.
14	Lessee taking all such necessary precautions as may be indicated by the District Manager CALM to prevent the occurrence or spread of any fire within or adjacent to the leased area.	Noted
15	The lessee at his expense rehabilitating all areas affected by mining or operations associated with mining conducted during the term of the lease, including the rehabilitation enrichment of dieback or other forest disease affected areas, resulting from the lessees mining or operations associated with mining. Rehabilitation being to the satisfaction of the Regional Mining Engineer and in agreement with the Regional Manager CALM.	Forms part of closure management.
18	The lessee designating to the Regional Manager, CALM a responsible officer to direct and control the rehabilitation programme.	Noted
19	Exploration programmes involving vegetation disturbances are subject to the approval of the District Mining Engineer in consultation with the District Manager, CALM	Noted
20	Where reasonable, the lessee permitting CALM to remove for CALM requirements, sand, rock, clay, gravel and soil subject to a working agreement.	Noted
21	The construction and operation of the project and measures to	Complied with

	protect the environment being carried out generally in accordance with the documents titled: • "Notice of Intent" to develop Mining Lease 70/341 Nowergup" dated 1993 and retained on Department of Industry and Resources File No. 728/90. • "Letter of Intent: Proposed New Access Road - Carabooda Limestone M70/341" (NOI 4981) received 13 April 2005 and signed by Clark Scrivener and retained on Department of Industry and Resources File No. 4322/00; • (Reg ID 56335) "Mine Closure Plan M70/109, M70/339, M70/341 and M70/345" dated 30 July 2015 signed by Michael Falconer - Registered Manager and retained on Department of Mines and Petroleum File No. EARS-MCP-56335 as Doc ID 3468558 Where a difference exists between the above document(s) and the following conditions, then the following conditions shall prevail.	
22	The development and operation of the project being carried out in such a manner so as to create the minimum practicable disturbance to the existing vegetation and natural landform.	Forms part of closure management.
23	All topsoil being removed ahead of all mining operations from sites such as pit areas, waste disposal areas, ore stockpile areas, pipeline, haul roads and new access roads and being stockpiled for later respreading or immediately respread as rehabilitation progresses.	Forms part of closure management.
24	At the completion of operations, all buildings and structures being removed from site or demolished and buried to the satisfaction of the State Manager.	Forms part of closure management.
25	All rubbish and scrap being progressively disposed of in a suitable manner.	Forms part of closure management.
26	At the completion of operations, or progressively where possible, all access roads and other disturbed areas being covered with topsoil, deep ripped and revegetated with local native grasses, shrubs and trees to the satisfaction of the District Manager, CALM in consultation with the State Mining Engineer.	Forms part of closure management.
29	The Lessee submitting to the Executive Director, Environment Division, DMP, a brief annual report outlining the project operations, minesite environmental management and rehabilitation work undertaken in the previous 12 months and the proposed operations, environmental management plans and rehabilitation programmes for the next 12 months. This report to be submitted each year in: June	The annual report is completed and submitted.
30	Prior to: • clearing or disturbing natural vegetation • removal and storage of topsoil and overburden • recontouring and battering and the return of overburden and topsoil the lessee consulting with the District Manager, CALM, Wanneroo and receiving his written approval to proceed.	Forms part of closure management.
31	A Mine Closure Plan is to be submitted in the Annual Environmental Reporting month specified in tenement conditions in the year specified below, unless otherwise directed by an Environmental Officer, DMP. The Mine Closure Plan is to be prepared in accordance with the "Guidelines for Preparing Mine Closure Plans" available on DMP's website: 2018	This Closure Plan is prepared for this condition.

TABLE 4E SUMMARY OF TENEMENT CONDITIONS RELATING TO CLOSURE		
	SUMMARY OF CONDITIONS (Check actual condition if in doubt)	**DISCUSSION**
M70/345		
2	Compliance with the provisions of the Aboriginal Heritage Act, 1972 to ensure that no action is taken which is likely to interfere with or damage any Aboriginal site.	No recorded sites
3	All surface holes drilled for the purpose of exploration are to be capped, filled or otherwise made safe after completion	Forms part of closure management.
4	All costeans and other disturbances to the surface of the land made as a result of exploration, including drill pads, grid lines and access tracks, being backfilled and rehabilitated to the satisfaction of the Environmental Officer, Department of Industry and Resources (DoIR). Backfilling and rehabilitation being required no later than 6 months after excavation unless otherwise approved in writing by the Environmental Officer, DoIR.	Forms part of closure management.
5	All waste materials, rubbish, plastic sample bags, abandoned equipment and temporary buildings being removed from the mining tenement prior to or at the termination of exploration programme.	Forms part of closure management.
6	Unless the written approval of the Environmental Officer, DoIR is first obtained, the use of scrapers, graders, bulldozers, backhoes or other mechanised equipment for surface disturbance or the excavation of costeans is prohibited. Following approval, all topsoil being removed ahead of mining operations and separately stockpiled for replacement after backfilling and/or completion of operations.	Noted
8	The lessee's complying with the provisions of: • the Conservation and Land Management Act, 1984 and the Regulations thereunder; • the Bush Fires Act, 1954-77 and Regulations; and Wildlife Conservation Act, 1950 and Regulations thereunder.	Noted
9	The lessee giving the Executive Director, Department of Conservation and Land Management (CALM) three (3) months notice in writing of the intention to enter upon any uncleared area of State Forest for the purposes of mining or operations associated with mining. Rights to remove any marketable timber from such area in advance of mining operations being with the Executive Director.	Noted
12	The lessee at his expense carrying out all necessary measures to prevent the spread of the forests disease Phytophthora Cinnamomi (or Jarrah Dieback) on the area of the lease and liasising with the District Manager CALM before commencing exploratory work outside areas being mined.	Dieback is recognised as not impacting the Spearwood and Tamala Systems.
13	Lessee taking all such necessary precautions as may be indicated by the District Manager CALM to prevent the occurrence or spread of any fire within or adjacent to the leased area.	Committed to
14	The lessee at his expense rehabilitating all areas affected by mining or operations associated with mining conducted during the term of the lease, including the rehabilitation enrichment of dieback or other forest disease affected areas, resulting from the lessees mining or operations associated with mining. Rehabilitation being to the satisfaction of the Regional Mining Engineer and in agreement with the Regional Manager CALM.	Forms part of closure management.
15	The lessee designating to the Regional Manager, CALM a responsible officer to direct and control the rehabilitation programme.	Noted

16	Exploration programmes involving vegetation disturbances are subject to the approval of the District Mining Engineer in consultation with the District Manager, CALM.	Noted
17	Where reasonable, the lessee permitting CALM to remove for CALM requirements, sand, rock, clay, gravel and soil subject to a working agreement.	Noted.
18	A Mine Closure Plan is to be submitted in the Annual Environmental Reporting month specified in tenement conditions in the year specified below, unless otherwise directed by an Environmental Officer, DMP. The Mine Closure Plan is to be prepared in accordance with the "Guidelines for Preparing Mine Closure Plans" available on DMP's website: 2018	This closure plan is prepared to satisfy this condition.
19	The Lessee submitting to the Executive Director, Environment Division, DMP, a brief annual report outlining the project operations, minesite environmental management and rehabilitation work undertaken in the previous 12 months and the proposed operations, environmental management plans and rehabilitation programmes for the next 12 months. This report is to be submitted each year in: June.	The annual reporting is complied with
20	The construction and operation of the project and measures to protect the environment to be carried out in accordance with the document titled: (Reg ID 56335) "Mine Closure Plan M70/109, M70/339, M70/341 and M70/345" dated 30 July 2015 signed by Michael Falconer - Registered Manager and retained on Department of Mines and Petroleum File No. EARS-MCP-56335 as Doc ID 3468558	This closure plan will supersede the listed plan.

TABLE 4F SUMMARY OF TENEMENT CONDITIONS RELATING TO CLOSURE		
	SUMMARY OF CONDITIONS (Check actual condition if in doubt)	**DISCUSSION**
M70/346		
2	Compliance with the provisions of the Aboriginal Heritage Act, 1972 to ensure that no action is taken which is likely to interfere with or damage any Aboriginal site.	No recorded sites
3	All surface holes drilled for the purpose of exploration are to be capped, filled or otherwise made safe after completion.	The annual reporting is complied with
4	All costeans and other disturbances to the surface of the land made as a result of exploration, including drill pads, grid lines and access tracks, being backfilled and rehabilitated to the satisfaction of the Environmental Officer, Department of Industry and Resources (DoIR). Backfilling and rehabilitation being required no later than 6 months after excavation unless otherwise approved in writing by the Environmental Officer, DoIR.	The annual reporting is complied with
5	All waste materials, rubbish, plastic sample bags, abandoned equipment and temporary buildings being removed from the mining tenement prior to or at the termination of exploration programme.	The annual reporting is complied with
6	Unless the written approval of the Environmental Officer, DoIR is first obtained, the use of scrapers, graders, bulldozers, backhoes or other mechanised equipment for surface disturbance or the excavation of costeans is prohibited. Following approval, all topsoil being removed ahead of mining operations and separately stockpiled for replacement after backfilling and/or completion of operations.	Noted
	The lessee's complying with the provisions of: • the Conservation and Land Management Act, 1984 and the Regulations thereunder;	Noted

	• the Bush Fires Act, 1954-77 and Regulations; and Wildlife Conservation Act, 1950 and Regulations thereunder.	
13	The lessee at his expense carrying out all necessary measures to prevent the spread of the forests disease Phytophthora Cinnamomi (or Jarrah Dieback) on the area of the lease and liasising with the District Manager CALM before commencing exploratory work outside areas being mined.	Dieback does not impact on Spearwood or Tamala Land Systems. Even so dieback management procedures are in place.
14	Lessee taking all such necessary precautions as may be indicated by the District Manager CALM to prevent the occurrence or spread of any fire within or adjacent to the leased area.	Noted.
15	The lessee at his expense rehabilitating all areas affected by mining or operations associated with mining conducted during the term of the lease, including the rehabilitation enrichment of dieback or other forest disease affected areas, resulting from the lessees mining or operations associated with mining. Rehabilitation being to the satisfaction of the Regional Mining Engineer and in agreement with the Regional Manager CALM.	The annual reporting is complied with
18	The lessee designating to the Regional Manager, CALM a responsible officer to direct and control the rehabilitation programme.	Noted
19	Exploration programmes involving vegetation disturbances are subject to the approval of the District Mining Engineer in consultation with the District Manager, CALM.	Noted
20	Where reasonable, the lessee permitting CALM to remove for CALM requirements, sand, rock, clay, gravel and soil subject to a working agreement.	Noted
21	The construction and operation of the project and measures to protect the environment being carried out generally in accordance with the document titled: • "Letter of Intent - Processing Plant on Lease M70/346" dated 21 February 1997 and retained on Department of Minerals and Energy File No. 728/90; • (Reg ID 56335) "Mine Closure Plan M70/109, M70/339, M70/341 and M70/345" dated 30 July 2015 signed by Michael Falconer - Registered Manager and retained on Department of Mines and Petroleum File No. EARS-MCP-56335 as Doc ID 3468558 Where a difference exists between the above document(s) and the following conditions, then the following conditions shall prevail.	The operations comply with these documents.
22	The lessee submitting to the State Mining Engineer and District Manager, CALM in June of each year, a brief annual report outlining operations and rehabilitation work undertaken in the previous 12 months and the proposed operations and rehabilitation programmes for the next 12 months.	The annual reporting is complied with.
23	A Mine Closure Plan is to be submitted in the Annual Environmental Reporting month specified in tenement conditions in the year specified below, unless otherwise directed by an Environmental Officer, DMP. The Mine Closure Plan is to be prepared in accordance with the "Guidelines for Preparing Mine Closure Plans" available on DMP's website: 2018	This Mine Closure Plan is to satisfy this condition.
24	The Lessee submitting to the Executive Director, Environment Division, DMP, a brief annual report outlining the project operations, minesite environmental management and rehabilitation work undertaken in the previous 12 months and the proposed operations, environmental management plans and rehabilitation programmes for the next 12 months. This report is to be submitted each year in: June.	See Condition 22

TABLE 4G SUMMARY OF JOINT WORKING ARRANGEMENTS - 12 OCTOBER 1988		
	SUMMARY OF CONDITIONS (Check actual condition if in doubt)	**DISCUSSION**
M70/13 (M70/339)		
	All topsoil is to be recovered and used for rehabilitation	Superseded by approved 2001 completion criteria and Rehabilitation Management Plan.
	The restored land surface is to be natural in appearance with maximum batter slopes of 1 : 3 to 1 : 5 vertical to horizontal.	
	The restored land surface is to be deep ripped at intervals of 0.5 to 1.0 metres.	
	Rehabilitation will be to 600 trees per hectare randomly spaced.	

TABLE 4H SUMMARY OF REHABILITATION MANAGEMENT PLAN – APPROVED, 7 MARCH 2001		
	SUMMARY OF CONDITIONS (Check actual condition if in doubt)	**DISCUSSION**
M70/339		
	The restored land surface will have a maximum slope of 1 : 4 vertical to horizontal.	Incorporated into the Current Completion Criteria.
	Approved completion criteria of local native plants Plant Density 200 perennial plants /100 m^2. Species Richness 10 species /100 m^2.	
	Seed, tube plants and topsoil are to be used.	

TABLE 4I SUMMARY OF REHABILITATION MANAGEMENT PLAN – APPROVED MINE CLOSURE PLAN DATED 28 AUGUST 2015		
	SUMMARY OF CONDITIONS (Check actual condition if in doubt)	**DISCUSSION**
M70/013, M70/339		
	The restored land surface will have a maximum slope of 1 : 4 vertical to horizontal.	Updates the completion criteria from 1988 and 2001. Incorporated into the Current Completion Criteria.
	Approved completion criteria of local native plants Plant Density 100 perennial plants /100 m^2. Species Richness 10 species /100 m^2.	

TABLE 4J SUMMARY OF REHABILITATION MANAGEMENT PLAN – APPROVED MINE CLOSURE PLAN DATED 30 JULY 2015		
	SUMMARY OF CONDITIONS (Check actual condition if in doubt)	**DISCUSSION**
M70/109, M70/341, M70/345 and M70/346		
	The restored land surface will have a maximum slope of 1 : 4 vertical to horizontal.	Incorporated into the Current Completion Criteria.
	Approved completion criteria of local native plants Plant Density 100 perennial plants /100 m^2. Species Richness 10 species /100 m^2.	
	Seed, tube plants and topsoil are to be used.	

4.0 STAKEHOLDER ENGAGEMENT

Planned or unplanned mine closure has the potential to affect both internal and external stakeholders who may have an interest in how and when the Project is completed and decommissioned.

Stakeholder engagement is therefore undertaken to ensure the requirements of stakeholders are able to be incorporated into the closure planning.

The engagement is an ongoing process to ensure that changing circumstances can be incorporated into the closure. These changes might include planning policies, requirements for future land use, financial and operational planning.

There has been consultation over the years between the Department of Biodiversity, Conservation and Attractions, under the various previous names of the department such as DPAW, DER, DEC and some interested members of the local community, during the approvals for the past activities on site.

A list of stakeholders is shown below and will be updated as required, as additional consultation is needed prior to and during operations.

During the operation of the facilities it is anticipated that additional consultation will be required with the listed stakeholders and the relevant Government departments, to discuss future planning and end use.

TABLE 5 STAKEHOLDER REGISTER

Stakeholder	Date - Timing	Issues Raised	Proponent Response - Outcome
Internal Stakeholders			
Internal Management	Ongoing	Day to day management of the operations,	The methods, scale and scope of the operations are not proposed to change.
External Stakeholders			
DMIRS	During the assessment of the Mining Proposal and Mine Closure Plan, through 2017 - 2018.	Conditions on tenement. Controls the safety and methods of excavation through the *Mines Safety and Inspection Act 1994.* Responsible for regulation of mines under the *Mining Act 1978*.	Currently no known restrictions but advice will be obtained during the assessment of the Mining Proposal and Mine Closure Plan.
	2019	Discussions relating to the provision of a joint Mine Closure Plan for all tenements was accepted by DMIRS.	This Mine Closure Plan complies with DMIRS discussions.
DMIRS	Ongoing	The Project Management Plans in place and approved for both the eastern and western tenements. Discussions areas, ongoing as appropriate on the safety of the operations.	Inspections by officers from DMIRS are conducted regularly.
DMIRS	Continuous through the years.	There have been many discussions relating to the use of Clearing Permits.	A new Clearing Permit is to be applied for which will lead to further discussions.
Department of Biodiversity Conservation and Attractions	Past and proposed future consultations relating to excavation in environmentally sensitive area.	There have been many discussions and negotiations over the years, relating to Clearing Permits.	Discussions will be held as required.
DBCA Sandra Thomas and DBCA Forests	2018	The MCP was referred to DBCA for input, including completion criteria.	DBCA are to accept the completion criteria once the MCP is referred to them

(Wanneroo)			
DBCA	Nick Wolfrey	The MCP has been sent to Nick Wolfrey.	
City of Wanneroo	Meeting in July 2018. As required in the future. 2018 - 2019	General discussions on limestone resources and extraction. Discussions on the use of inert materials within the limestone reconstituted blocks.	
Department of Premier and Cabinet – Strategic Assessment process.	2014 and ongoing.	Extensive discussions have been held with the Department of Premier and Cabinet with respect to the sterilisation of most of the remaining limestone resource by conservation and development. Tengraph FNA 12231, 12671, 12689 FNA 12689, lists the site as a Basic Raw Materials Exclusion Area, although that decision has not been finalised and discussions and reviews are continuing and the nomination may change	It is unclear whether SAPPR will be accepted, implemented and in what form.
Strategic Assessment Review Committee	13 April 2019 20 June 2019 1 August 2019	Strategic Assessment Tengraph FNA 12231 Perth to Peel Green Growth Plan, shown as a Future Resource Extraction Area in the Draft Planning. Tengraph FNA 12690 Discussions have been held with the SAPRA Review Committee to update them on the industry needs for limestone. The SAPRA process has only delivered limited limestone resources for around 20 years and this resource is considered vital by the Industry for ongoing community needs of limestone which in the northern Perth area vary from around 1 million tonnes per year to 2 million tonnes per year in the last development boom. The draft Green Growth Plan identified the end land use as Conservation but that may have changed.	It is unclear whether SAPPR will be accepted, implemented and in what form.
Sand and Limestone Association Inc	2014 - 2019	The Sand and Limestone Association represents the sand and limestone industries for the supply of construction materials	Discussions will continue on access, end use and closure.
Concrete Construction Aggregates Australia (CCAA)	2014 - 2019	Limestone is required for concrete manufacture and the manufacture of reconstituted limestone blocks which are used for all retaining wall structures on houses and other developments.	Discussions will continue on access, end use and closure.
Department of Environment and Energy Commonwealth	At this stage not required but may be required in the future.	Any matters of National significance will be determined at the time of application for a Clearing Permit and are not generally relevant to mine closure.	Noted
Department of Lands Planning and Heritage (DAA) and traditional land holders	2019 As required in the future	Department of Planning Lands and Heritage database has been searched and no sites have been found.	There are no known registered sites on the tenements.

5.0 POST MINING LANDUSE AND CLOSURE OBJECTIVES

5.1 Post Mining Landuse and Closure Planning

The closure planning will be updated from time to time as the excavation progresses forwards. This will include both anticipated costs and procedures.

There are a number of management actions that can be taken in quarries to maximise rehabilitation effort and these will be used wherever possible. The general management actions are summarised below and will be used where applicable and as the opportunity presents.

The site specific issues that relate to this site are also listed to explain how this site compares to the general rehabilitation guidelines.

The end use is yet to be determined under the SAPPR process.

Land Use Policies

When the *Perth to Peel Green Growth Plan* (SAPPR) is signed off it will carry pre- approval from the Commonwealth under the *EPBC Act 1999.* The plan will also provide guidance and approval for the extraction of limestone and sand and the future end use as conservation.

As the Green Growth Plan has not yet been signed off an interim cover of native plants will be provided. Once the Green Growth Plan is signed off the Mine Closure Plan can be adjusted accordingly at the next review or earlier.

End Use

The end use is related to and compatible with current State Planning.

The Perth and Peel Green Growth Plan provided for the land uses and consideration for end uses to this and other locations. Currently the Plan is on hold pending a review.

As the limestone resource remains predominantly not excavated across the tenement there is currently no ground available for rehabilitation, because the final floor elevation is some 20 metres below the current land surface. Currently there are no concept final contours to be formed and the land is therefore not available for rehabilitation and unlikely to be able to be rehabilitated for some years.

The end use is yet to be determined under the SAPPR process. In the meantime the interim revegetation to local native species will be provided.

At this stage the end use of the land appears to be continued State Forest and the site will be rehabilitated to that purpose, being rehabilitated to local native vegetation. At the end of excavation, any overburden will be used to reform the land surface and then limestone shrubland and heathland will be reinstated unless Government directs otherwise.

Limestone Building Blocks will work with Department Biodiversity Conservation and Attractions and Department of Mines Industry Regulation and Safety to ensure that the end use is to local native limestone vegetation.

Species selected in the rehabilitation will be designed to match the pre-excavation communities.

Final Contours

The end use is yet to be determined under the SAPPR process so the final contours are not available.

The final contours will be formed in compliance with the safety considerations of the *Mines Safety and Inspection Act 1994* and the requirements and guidelines of the DMIRS; for example *Guidelines on Safety Bund Walls Around Abandoned Open Pits 1991* unless over-riding contour plans are provided by Government.

When the final excavation is reached, the excavated land surface will be contoured to a similar landform to that in the pre – excavation situation except that the landform will be some 20 metres lower.

Areas excavated will be gently battered to the natural land surfaces at slopes of 1 : 2 to 1 : 4 vertical to horizontal.

5.2 Domains to be Closed

There are no Key Mine Activities.

During each annual extraction campaign, the excavated area will be opened and closed within the one campaign.

The domains identified for this site are;

- Pit - excavation areas.
- Transport Corridor
- Laydown hardstand
- Building other than workshop
- Workshop
- Other cleared land)

5.3 Mine Closure Considerations

The tenements lie within State Forest 65, adjacent to a pine plantation to the north, which remains active.

Limestone Building Blocks will work with Department of Biodiversity Conservation and Attractions and Department of Mines Industry Regulation and Safety to ensure that the end use is to local native limestone vegetation.

The excavated land surface will be contoured to a similar landform to that in the pre – excavation situation except that the landform will be some 10 metres lower.

Areas excavated will be gently battered to the natural land surfaces at slopes of 1 : 2 to 1 : 4 vertical to horizontal.

Species selected in the rehabilitation will be designed to match the pre-excavation communities.

5.4 Mine Closure Objectives

The key objective is to return the mined land surface to low level limestone and sand that will be capable of developing a similar species richness, plant diversity and habitat to that of the pre-mined limestone shrubland.

In order to achieve the key objective, the following Closure Objectives have been identified as being necessary to ensure the key objective is met.

Then **General Mine Closure Objectives** are;

1. All legally binding conditions and commitments relevant to mine closure and rehabilitation will be met.
2. All hazardous material is removed from site and disposed of appropriately.
3. All non natural structures, associated with mining will be removed.
4. All wastes will be removed from site, reused or placed in an approved offsite landfill.
5. The final land surface is to be formed to the agreed form.
6. Re-constructed soils will be formed on the surface that are to be capable of supporting a return to local native vegetation and habitat.
7. The final land surface will be a stable surface resistant to water or wind erosion and not cause dust that will adversely impact on adjoining vegetation or human health or amenity.
8. The site will be left safe for humans and wildlife.
9. The reformed surface will be free draining with no surface water ponding.
10. Weeds will not impact on revegetation.
11. The interests of all relevant stakeholders will be considered during operations, closure planning and closure.
12. Rehabilitation objectives will be met.

From the general mine objectives, additional **Domain Specific Closure Objectives** have been developed to provide auditable and measurable closure actions.

Open limestone and sand excavations including access roads.

13. Hard limestone areas will be made suitable for rehabilitation

Laydown hardstand, workshop, batching and site facilities

14. All hard stand will be picked up and if foreign will be removed from site.
15. All contaminated limestone or sand will be remediated or removed from site to an approved disposal area.
16. All infrastructure is to be removed from site, reused or placed in an approved offsite landfill.

Bush Forever Site

17. Vegetation within the Bush Forever Site 290 will not be disturbed unless through approval under a Clearing Permit or other process.

18. Weeds will be controlled so they will not impact on the Bush Forever Site 290.

6.0 DEVELOPMENT OF COMPLETION CRITERIA

Completion criteria are developed to measure the degree of compliance with the closure objectives.

The DMIRS/EPA (2015) and ANZMEC/MCA (2000) principles for development of completion criteria, are used to develop the completion criteria.

These provide for the completion criteria being;

- Developed in consultation with key stakeholders.
- Specific enough to address the unique environmental, social and economic circumstances of each site.
- Achievable and realistic.
- Relevant to the closure objectives.
- Based on performance indicators that allow trends to be identified.
- Flexible enough to adapt to changing circumstances, while still meeting agreed objectives.
- Measured over appropriate timeframes.
- Subject to periodic review and change as additional knowledge becomes available and circumstances change.
- Developed and refined over the life of the project.

Completion Criteria are then developed and will be monitored and adjusted as necessary during the life of the project based on stakeholder input, data collected on the existing environment, the results of research, and any implications that arise from excavation.

Completion Criteria

The Completion Criteria are identified below as auditable tasks developed from the Closure Objectives.

The Aims of Rehabilitation were approved by DBCA (CALM) and DMIRS in 1997 and are to; • Produce a land surface compatible with the surrounding area. • Restore a self sustaining shrubland ecosystem of local indigenous vegetation. • Establish the highest standard of rehabilitation in the eastern areas that are closest to the *Community Type FCT 26a* populations. **The Completion Criteria approved by**	The approved completion criteria are incorporated into the Mine Closure Plan.	During operations and at closure

DBCA (CALM) and DMIRS (DMP), ***Perennial Plant Density*** *200 perennial shrub plants per 100 m^2, (2 plants per m^2)* ***Species richness*** *10 species per 100 m^2* **but as this was a "Perennial" plant criteria the plant density was reduced to the following in the 2015 Mine Closure Plans.** ***Perennial Plant Density*** *100 perennial shrub plants per 100 m^2, (1 plants per m^2)* ***Species richness*** *10 species per 100 m^2*		

Table 6 – Closure Objectives and Completion Criteria

	CLOSURE OBJECTIVE	Completion Criteria	Measurement Tools	Performance Indicators to meet Completion Criteria
General Mine Closure Objectives				
1	All legally binding conditions and commitments relevant to mine closure and rehabilitation will be met.	• All legally binding conditions and commitments are complied with	• Audit of rehabilitated ground, to verify compliance with all legally binding conditions and commitments	• All legally binding conditions and commitments are complied with.
2	All hazardous material is removed from site and disposed of appropriately.	• There are no hazardous materials remaining at closure. • There are no contaminated materials remaining at closure	• If contaminated sites are identified, ensure that the contaminated sites classification does not impact on suitability of the Project area for proposed post-mining land use in accordance with the Contaminated Sites Act 2003 (WA). • Visual audits • Soil testing and remediation as required.	• No hazardous materials or soils. • with criteria in excess of the levels specified in the Contaminated Sites Act 2003 (WA) will remain at closure.
3	All non natural structures, associated with mining will be removed.	• No non natural structures will be retained on site.	• Visual audit of completed ground, to verify compliance.	• No buildings, concrete, metal and other non natural materials will remain at closure.
4	All wastes will be removed from site reused or placed in an approved offsite landfill.	• No waste materials will remain at closure.	• Visual audit of completed ground, to verify compliance. • Discussion with staff and operators.	• No wastes or rubbish will remain on site.

5	The final land surface is to be formed to the agreed form.	• The land surface will comply with Government - Stakeholder Guidelines. • In the absence of definitive Government Guidelines, the excavated land surface will be reformed to visually match local landforms.	• Visual audit of completed ground, to verify compliance. • Discussion with staff and operator and Stakeholders. • Provide site survey to verify compliance to Government or Stakeholder requirements.	• No obvious visual evidence of hardstand or roads in areas not required by Government. • The land surface will comply with Government - Stakeholder Guidelines. • In the absence of Government – Stakeholder Guidelines the excavated land surface will be reformed to visually match local landforms.
6	Re-constructed soils will be formed on the surface that are to be capable of supporting a return to local native vegetation and habitat	• Soil properties will be appropriate to sustaining local native species.	• Visual observations of the reconstructed oils prior to rehabilitation. • Field assessment of the growth rates of the revegetation. • Ongoing photographic record of rehabilitation.	• Soils are reconstructed on the limestone floor and batter slopes. • Vegetation grows well on the reconstructed soils.
7	The final land surface will be a stable surface resistant to water or wind erosion and not cause dust that will adversely impact on adjoining vegetation or human health or amenity.	• Slopes are to be stable and free from erosion.	• Annual site observations and as required.	• Absence of visible dust blowing from the surface. • Absence of significant rills and erosion channels.
8	The site will be left safe for humans and wildlife.	• The disturbed land will be made safe and in compliance with the *Mines Safety and Inspection Act 1994* and DMIRS *Mine Closure Guidelines*.	• Site inspections by company management and as necessary independent auditors.	• Faces and the landform are to comply with DMIRS Guidelines. • Signs will be provided as required. • Fencing will be provided and maintained as required.
9	The reformed surface will be free draining with no surface water ponding.	• Constructed soils will enable infiltration of precipitation in a similar manner to the natural conditions.	• Audit of completed ground, to verify compliance. • Visual observations of the landforms.	• The reformed surface will be free draining with no surface water ponding.
10	Weeds will not impact on revegetation.	• Revegetation will be free from Declared or Significant Environmental weeds that could compromise the success of the revegetation or spread into adjoining native vegetation.	• During Spring and Autumn conduct an on site audit of completed rehabilitation for species richness, diversity and structure using standard 100m^2 plots of rehabilitation.	• No obvious sign of impact on revegetation, or adjoining native vegetation by weed species.
11	Dieback and other diseases may be introduced and impact on revegetation and adjoining vegetation.	• There will be no introduced plant diseases that will significantly impact on revegetation or adjoining native vegetation.	• Annually conduct a review of the relevant vegetation for disease introductions.	• No obvious sign of impact on revegetation, or adjoining native vegetation by introduced plant diseases.
12	The interests of all relevant	• The final land surface and rehabilitation	• Prior to closure, consult the stakeholders to check	• Verify the closure plan against the Stakeholder interests.

	stakeholders will be considered during operations, closure planning and closure.	comply with Stakeholder requirements.	whether the closure planning, where possible, considers their interests. • Liaison with stakeholders. • Provide annual reports and closure reports to stakeholders are necessary. • Invite Stakeholders to inspect the closure progress as necessary.	• Liaise with Stakeholders to confirm compliance.
13	Rehabilitation objectives will be met.	• Re-establish vegetation as required by Government Guidelines or agreements. • In the absence of any Government Guidelines or Agreement, re-establish local provenance, self-sustaining, resilient ecological communities on disturbed areas.	• Conduct an on site audit of completed rehabilitation for species richness, diversity and structure using standard 100m^2 plots of rehabilitation and adjoining vegetation if required to verify success. • Conduct audits of the completion criteria upon the completion of each stage of rehabilitation and annually until sign off. • Check for exotic animal impacts such as goat or stock and treat accordingly through control, additional planting or other measures. • Maintain ongoing records.	In the absence of any Government Guidelines or Agreement. ***Plant Density*** *200 perennial shrub plants per 100 m^2, (2 plants per m^2)* ***Species richness*** *10 species per 100 m^2*
Open limestone and sand excavations including access roads.				
14	Hard limestone areas will be made suitable for rehabilitation.	• All roads will be picked up, and if foreign will be removed from site. • All compacted limestone will be deep ripped	• Site inspection prior to the construction of soils.	• Limestone is to be deep ripped at intervals of 1 metre in a cross pattern on the floor and along contour on batter slopes.
Laydown hardstand and site facilities				
15	Hard stand will be picked up and if foreign will be removed from site.	• All hardstand will be picked up, and if foreign will be removed from site. • All compacted limestone will be deep ripped	• Site inspection prior to the construction of soils.	• Limestone is to be deep ripped at intervals of 1 metre in a cross pattern on the floor.
16	All contaminated limestone or sand will be remediated or removed from site to an approved disposal area.	• There are no contaminated materials remaining at closure.	• If contaminated sites are identified, ensure that the contaminated sites classification does not impact on suitability of the Project area for proposed post-mining land use in accordance with the Contaminated Sites Act 2003 (WA). • Visual audits • Soil testing and remediation as required.	• No hazardous materials or soils. • No materials in excess of the levels specified in the Contaminated Sites Act 2003 (WA) will remain at closure.
Bush Forever Site				
17	Vegetation within the Bush Forever Site will not be disturbed.	• There will be no disturbance of the Bush Forever Site. • Disturbed areas attributed to mining	• Provide annual inspections at the appropriate time of the year, but in general Autumn and Spring.	• There are no new disturbances to the Bush Forever Site. • Disturbed areas will be rehabilitation to the completion

		or related activities will be rehabilitated.		criteria for local native vegetation.

7.0 COLLECTION AND ANALYSIS OF CLOSURE DATA

7.1 Research

Level 2 Flora and Vegetation Study and Fauna studies have been completed for the tenements dated 2010 and 2011.

The vegetation of the local area and for use in rehabilitation is therefore well known. A copy of those reports completed by Coffey Environments, 2009 to 2011 are attached. Fauna studies have been completed by Western Wildlife.

Ongoing research will generally take the form of assessing the methods of rehabilitation and the success against the completion criteria once rehabilitation is able to commence. Observations and new rehabilitation procedures will be tried and used as required to achieve a final cover of self sustaining vegetation of local species.

On this site and at other locations on limestone and sand such as this, rehabilitation has demonstrated that the excavated substrate is capable of supporting local species on M70/339 undertaken by other operators and at the intersection of Forrest Highway, Old Coast Road for example. See attached Figures.

Observations and new rehabilitation procedures will be tried and used as required to achieve a final cover of self sustaining vegetation of local species.

7.2 Baseline Data Collection and Analysis Summary

The flora study by Coffey environments 2010/2011 provides the data on species type, communities and other aspects of vegetation prior to excavation.

For example;

The vegetation recently approved to be cleared through CPS 6203/1 is *Banksia sessilis* shrubland vegetation on sand and limestone on M70/013.

The vegetation was subject of a study by Coffey Environments, *Flora and Vegetation Assessment, M70/013 Hopkins Road, Nowergup,* 2011.

Coffey Environments was commissioned, to undertake a flora and vegetation report for the land. Coffey Environments, 2010, Flora and fauna Assessment, M70/341 and M70/345, Cutler Road, Carabooda.

All the information on flora is taken from Coffey Environments 2010. A copy of the study is attached.

The vegetation was burnt in the summer of 2014 – 2015

The data in that study will inform the completion criteria with respect to plant community, species type and vegetation cover.

The soil will be slightly different to the pre- excavation soil in that the depth to limestone will be less variable as there will be no pinnacle limestone within the reconstructed soil structure. This will however be replicated by retaining some loose limestone rock within the profile. The sand covering the limestone will also be brown and earthy and resemble Cottesloe soils.

To achieve a good vegetation cover the revegetation will use the same local species but will be skewed towards more limestone type communities.

The same species from Coffey environments will be used as a baseline, but additional species from limestone areas will be added.

Gap Analysis

A large amount of material is already available through the vegetation studies, listed under Baseline Data Collection and Analysis. This included rehabilitation of some areas on M70/339. Some of that rehabilitation was removed in later years to enable further resources to be extracted, but the rehabilitation demonstrated that the proposed methods are capable of providing a good return of local native vegetation.

Any further material collected during the life of the operations will be stored in the records for the operation and included in any Mine Closure Plan updates.

At this stage the gaps in the knowledge base relate to the methods of rehabilitation. Observations can be made from other operations and incorporated into closure planning prior to the commencement of site restoration and rehabilitation.

The revisions of the Closure Plans will be used to provide a database of rehabilitation techniques to be used and modified from time to time as new techniques become available.

Ongoing monitoring of the end land uses for the site will be undertaken to ensure that rehabilitation and land restoration matches the most recent plans for end use. This relates to monitoring Government Policy planning and land zoning for the site and working with any authority charged with overseeing the future land use. Any changes or requirements can be incorporated into the revisions of the closure planning.

7.3 Existing Environment – Pre Mining

7.3.1 Climate

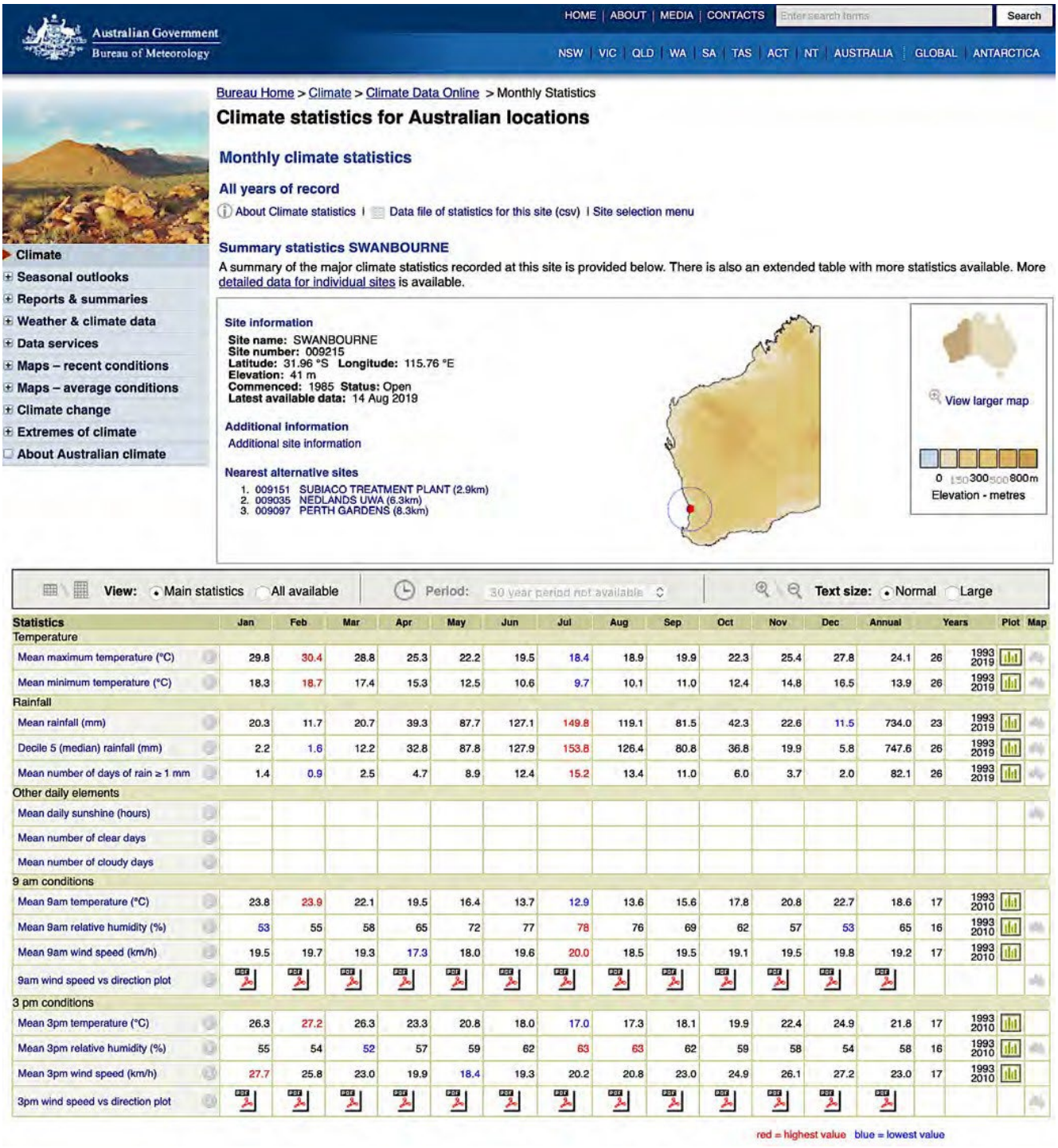
The climate of the area is Mediterranean with warm to hot summers and cool wet winters.

The closest recording station was Beenyup (Wanneroo), although averages of only six years' data have been recorded. Nowadays data is recorded at Swanbourne which is likely to be more influenced by the ocean than the actual site.

The highest average temperatures are in February with 30.0 maxima and the lowest averages are recorded in July with maxima of 18 degrees Celsius and 7.4 degrees C minima, average.

Rainfall for the area is slightly less than Perth at 722 mm compared to Perth's 869 mm of which more than 90% falls in the months April to October inclusive. Rainfall has also been recorded at Yanchep with an annual average of 755 mm per year. Evaporation is high and exceeds rainfall in all but the four wettest months, May to September.

The prevailing winds are from the south west, particularly in the afternoon. In summer the easterly in the mornings and the sea breeze in the afternoon can be quite strong. At 3.00 pm wind speeds exceed 10 kph for 80 % of the time in summer but only 30 % to 40 % in winter. At other times the wind speed is calm for 30 % of the time in winter at 9.00 am and 10 % in summer with 40 % of the time exceeding 10 kph in summer and 20 % in excess of 10 kph in winter.



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Summary statistics SWANBOURNE

A summary of the major climate statistics recorded at this site is provided below. There is also an extended table with more statistics available. More detailed data for individual sites is available.

Site information

Site name: SWANBOURNE
Site number: 009215
Latitude: 31.96 °S **Longitude:** 115.76 °E
Elevation: 41 m
Commenced: 1985 **Status:** Open
Latest available data: 14 Aug 2019

Additional information

Additional site information

Nearest alternative sites

1. 009151 SUBIACO TREATMENT PLANT (2.9km)
2. 009035 NEDLANDS UWA (6.3km)
3. 009097 PERTH GARDENS (8.3km)

View larger map

0 150 300 500 800m
Elevation - metres

View: Main statistics / All available | Period: 30 year period not available | Text size: Normal / Large

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years		Plot	Map
Temperature																	
Mean maximum temperature (°C)	29.8	30.4	28.8	25.3	22.2	19.5	18.4	18.9	19.9	22.3	25.4	27.8	24.1	26	1993 2019		
Mean minimum temperature (°C)	18.3	18.7	17.4	15.3	12.5	10.6	9.7	10.1	11.0	12.4	14.8	16.5	13.9	26	1993 2019		
Rainfall																	
Mean rainfall (mm)	20.3	11.7	20.7	39.3	87.7	127.1	149.8	119.1	81.5	42.3	22.6	11.5	734.0	23	1993 2019		
Decile 5 (median) rainfall (mm)	2.2	1.6	12.2	32.8	87.8	127.9	153.8	126.4	80.8	36.8	19.9	5.8	747.6	26	1993 2019		
Mean number of days of rain ≥ 1 mm	1.4	0.9	2.5	4.7	8.9	12.4	15.2	13.4	11.0	6.0	3.7	2.0	82.1	26	1993 2019		
Other daily elements																	
Mean daily sunshine (hours)																	
Mean number of clear days																	
Mean number of cloudy days																	
9 am conditions																	
Mean 9am temperature (°C)	23.8	23.9	22.1	19.5	16.4	13.7	12.9	13.6	15.6	17.8	20.8	22.7	18.6	17	1993 2010		
Mean 9am relative humidity (%)	53	55	58	65	72	77	78	76	69	62	57	53	65	16	1993 2010		
Mean 9am wind speed (km/h)	19.5	19.7	19.3	17.3	18.0	19.6	20.0	18.5	19.5	19.1	19.5	19.8	19.2	17	1993 2010		
9am wind speed vs direction plot																	
3 pm conditions																	
Mean 3pm temperature (°C)	26.3	27.2	26.3	23.3	20.8	18.0	17.0	17.3	18.1	19.9	22.4	24.9	21.8	17	1993 2010		
Mean 3pm relative humidity (%)	55	54	52	57	59	62	63	63	62	59	58	54	58	16	1993 2010		
Mean 3pm wind speed (km/h)	27.7	25.8	23.0	19.9	18.4	19.3	20.2	20.8	23.0	24.9	26.1	27.2	23.0	17	1993 2010		
3pm wind speed vs direction plot																	

red = highest value blue = lowest value

Figure 5 Climate Data

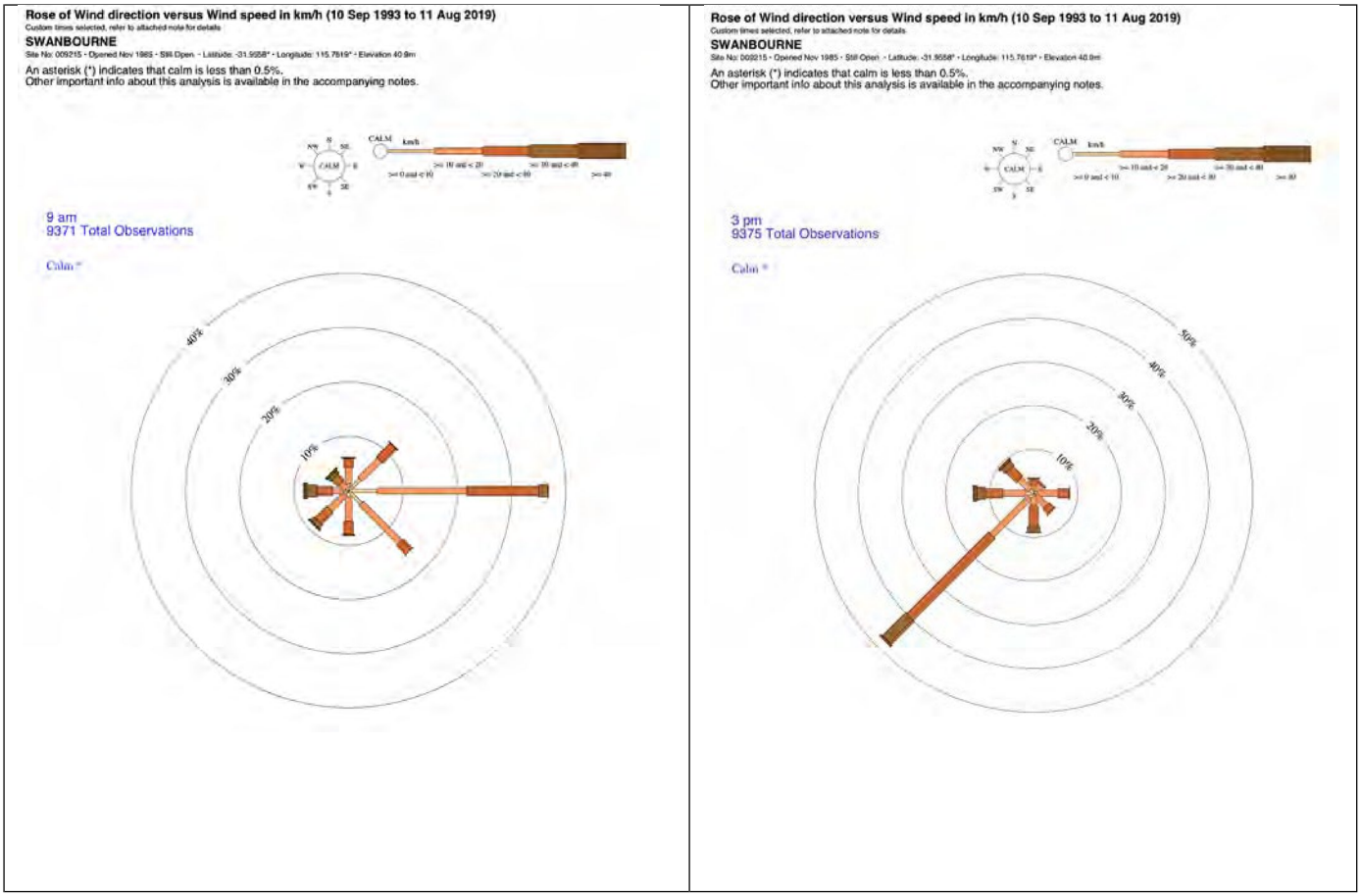


Figure 6 Wind Roses

7.3.2 Visual Landscape

WAPC 2007, *Visual Landscape Planning in Western Australia* provides an assessment methodology for the visual impacts from roads, developed and recreational areas and sensitive premises.

This policy has been viewed and the project considered against that document. The relevant section is Part Three, pages 144 to 152 of the Guideline and the site has been assessed against the Guideline**.**

- *Visual Impact can occur in a number of circumstances, by the operation being set too high in the landscape, by being too close to neighbours and by insufficient visual protection.*

- *There are a number of management actions that can be taken in quarries to minimise visual impact and these will be used wherever possible. The general management actions are summarised below together with the visual impact issues that relate to this site. The actions will be used where applicable and as the opportunity presents to minimise visual impact.*

Visual Assessments have been considered from site inspections by Lindsay Stephens of Landform Research.

The quarry and processing activities comply with the WAPC Guideline and .

The site not visible from Local Roads including Hopkins Road.

7.3.3 Geology – Geomorphology

The limestone and sand formed as aeolian dune deposits behind a shoreline during the Pleistocene. The limestone is ascribed to the Tamala Limestone and consists of foraminifer, shell fragments and quartz grains, and therefore variation in the quality of the stone is normal both laterally and vertically.

It lies on Geological Survey of Western Australia, Perth 1 : 250 000 geological mapsheet; SH 50 14.

The geology is also shown on the Geological Survey of Western Australia 1 : 50 000 Environmental Geology Series, Perth and Muchea Sheets.

In other localities dates of between 25 000 over 350 000 plus years have been obtained for similar limestone.

The resource is essentially a ridge of limestone with overlying lenses of yellow sand.

The variations in the limestone occur because of the changes in the proportion of calcium carbonate and quartz sand during the formation of the original dunes, even though the limestone is of high grade and up to >75% calcium carbonate.

The degree of lithification (hardness) changes over the resource, and determines the use to which each type of limestone can be put. On this site the rock is hard and recalcified.

The sand is quartz sand containing small amounts of clay and iron oxide staining

7.3.4 Soils and Soil profiles

Soils were recorded by Lindsay Stephens of Landform Research during the various times the site has been visited. They are part of the Spearwood land system.

Limestone dominates the site with sand becoming dominant to the north.

All soils are natural and contain no adverse minerals or conditions such as acidity or potential acidity that will impede surface restoration.

The excavation only intersects natural materials of yellow earthy sand and limestone. The natural sands typically have a grey surface topsoil underlain by white sand grading to yellow and dark yellow earthy sand. The depths of sand is variable with the sand being browner and more stony the closer it is associated with limestone outcrop.

The nature of the sand relates to small amounts of 1 to 3% clay present within the sand. The colour relates to the species and intensity of iron oxide present.

7.3.5 Hydrogeology

Surface water

There is no surface drainage due to the porosity and permeability of the limestone, with precipitation draining to the water table. There are no watercourses and no wetlands.

Groundwater

Government Policies currently provide for a separation of 2 metres to the water table outside Priority 1 Groundwater Protection Areas.

The natural land surface lies at an elevation of around 50 – 60 metres AHD and the groundwater lies at 27 metres AHD in the east dropping to 21 metres AHD in the west.

It is anticipated that limestone will be extracted to depths of 10 metres, around 25 – 30 metres above water table.

With such depths to the groundwater it is estimated that 5% of the rainfall will currently reach the water table based on the depth of the water table and the rainfall.

Groundwater is confined to the underlying sand and limestone and these have high vertical and lateral transmissivity.

Limestone and sand excavation does not affect the quality of water in the shallow ground water system because the only chemicals used are normal fuels and lubricants; a fact that is recognised by the Department of Water, Environment Regulation who permit extractive industries in Priority Groundwater 1 areas. See WPQN 15, 2019.

7.3.6 Flora

Flora

Plant Communities

Coffey Environments was commissioned to undertake a Level 2 flora and vegetation report for the land. Coffey Environments, 2010, *Flora and Vegetation Assessment, M70/013 and M70/339 Hopkins Road, Nowergup.*

Coffey Environments was commissioned, to undertake a flora and vegetation report for the land. Coffey Environments, 2010, *Flora and fauna Assessment, M70/341 and M70/345, Cutler Road, Carabooda.*

All the information on flora is taken from Coffey Environments 2010. A copy of the study is attached.

A total of 98 native vascular plant taxa, were recorded within the survey area with an additional 37 exotic species on the old Urbanstone tenements and a total of 100 native vascular plant taxa were recorded within the survey area with an additional 18 exotic species on the Limestone Building Blocks tenements.

The majority of the taxa recorded were representative of the Fabaceae, Proteaceae and Myrtaceae and Paplionaceae.

All the information on flora is taken from Coffey Environments 2011. A copy of the study is attached.

A total of 100 native vascular plant taxa, were recorded within the survey area with an additional 18 exotic species.

The majority of the taxa recorded were representative of the Fabaceae, Proteaceae and Myrtaceae and Paplionacea. These were;

TABLE 7 SIGNIFICANT FLORA	
Significant Flora	
Acacia benthami	Priority 2
Jacksonia sericea	Priority 4
Petrophile axillaris -	Bush Forever significant flora
Acacia alata var. *tetrantha*	Bush Forever significant flora
Lechenaultia linearis	Bush Forever significant flora
Conostylis aculeata subsp *cygnorum*	Bush Forever significant flora

The site lies in the Swan Coastal Plain Unit of the Drummond Botanical Subdistrict, part of the greater South-West Botanical District (Beard 1990).

More recently, the vegetation of Western Australia has been assigned to bioregions and subregions under the Interim Biogeographic Regionalisation for Australia (IBRA), with the project area being within the Swan Coastal Plain subregion.

The Drummond Botanical Subdistrict is characterised by low *Banksia* woodlands on leached sands; *Melaleuca* swamps on poorly-drained depressions; and *Eucalyptus gomphocephala* (tuart), *Eucalyptus marginata* (jarrah) and *Corymbia calophylla* (marri) woodlands on less leached soils (Beard 1990). The Drummond Botanical Subdistrict comprises of twelve physiographic units (systems), with the survey area situated within the Spearwood System.

The Spearwood System comprises of shore-line parallel calcarenite ridges mantled with yellow sands which gradually become more bleached and less calcareous to the east of the system. The vegetation is typified by the Karrakatta Complex – Central South and the Cottesloe Complex - Central and South.

The vegetation has limited clearing under CPS 6203/1 and is *Banksia sessilis* shrubland vegetation on sand and limestone on M70/013.

The vegetation was subject of a study by **Coffey Environments, *Flora and Vegetation Assessment, M70/013 Hopkins Road, Nowergup,* 2011.**

They determined the area to be cleared is predominantly BsXp, Closed Tall Scrub of *Banksia sessilis* over Open Shrubland to Tall Shrubland of *Xanthorrhoea preissii* with Tall Open Shrubland to Tall Shrubland of *Acacia rostellifera* and scattered shrubs of *Melaleuca systena, Melaleuca huegelii* and *Hakea trifurcata* over Low Shrubland of *Jacksonia sericea* and *Hibbertia hypericoides* over Very Open Sedgeland of *Mesomelaena pseudistygia* and *Lepidosperma ? pubisquameum* over Very Open Herbland of *Conostylis candicans* and *Desmocladus flexuos*us with scattered tall trees of *Eucalyptus gomphocephala*.

There is a small area of EmBa, Open Woodland to Woodland of *Eucalyptus marginata* over Low Woodland of *Banksia attenuata* and Low Open Woodland to Low Woodland of *Allocasuarina fraseriana* over Open Shrubland of *Xanthorrhoea preissii* and *Macrozamia riedlei* over Low Shrubland to Open Low Heath of *Hibbertia hypericoides* over Very Open Sedgeland of *Mesomelaena pseudostygia* and Very Open Herbland of *Desmocladus flexuosus* with scattered patches of *Banksia menziesii* and *B. grandis*.

Coffey Environments was commissioned, to undertake a flora and vegetation report for the land. Coffey Environments, 2010, Flora and fauna Assessment, M70/341 and M70/345, Cutler Road, Carabooda.

All the information on flora is taken from Coffey Environments 2010. A copy of the study is attached.

A total of 98 native vascular plant taxa, were recorded within the survey area with an additional 37 exotic species.

The majority of the taxa recorded were representative of the Fabaceae, Proteaceae and Myrtaceae and Paplionaceae.

Several vegetation communities were delineated and mapped within the survey area. PATN analysis showed that the vegetation had some affinity to four FCT Communities, FCT 24, FCT 26a, FCT 27 and FCT 28.

Low Open Forest of *Banksia attenuata* and *Allocasuarina fraseriana* over *Xanthorrhoea preissii, Hibbertia hypericoides* and *Hakea prostrata*. This is ascribed to FCT Community Type 28.

Low Woodland of *Banksia attenuata, Banksia menziesii* and *Allcasuarina fraseriana* over *Xanthorrhoea preissii*, *Hibbertia hypericoides* and *Hakea prostrata*. This is ascribed to FCT Community Type 28.

Woodland of *Eucalyptus marginata* over Low Open Woodland of *Banksia attenuata* and Open Shrubland dominated by *Xanthorrohea preissii*. This is ascribed to have affinities with FCT Community Type 28.

Woodland of *Eucalyptus marginata* over Open Woodland of *Banksia attenuata* and Open Shrubland dominated by *Xanthorrohea preissii*. This is ascribed to FCT Community Type 28.

Tall Open Scrub of *Banksia sessilis* over Open Shrubland of *Xanthorrhoea preissii, Hakea trifurcata and Melaleuca systena* over Low Open Shrubland of *Hibbertia hypericoides* and *Jacksonia sericea.* This is ascribed to FCT Community Type 24 (P3).

Tall Open Scrub of *Banksia sessilis* over Open Shrubland of *Xanthorrhoea preissii* over Low Open Shrubland of *Hibbertia hypericoides* and *Jacksonia sericea.* This is ascribed to FCT Community Type 24 (P3).

Tall Open Scrub of *Xanthorrhoea preissii* and *Banksia sessilis* over Low Shrubland of *Hibbertia hypericoides*. This is ascribed to FCT Community Type 28.

The vegetation was burnt in the summer of 2014 – 2015

The data in that study will inform the completion criteria with respect to plant community, species type and vegetation cover.

The soil will be slightly different to the pre- excavation soil in that the depth to limestone will be less variable as there will be no pinnacle limestone within the reconstructed soil structure. This will however be replicated by retaining some loose limestone rock within the profile. The sand covering the limestone will also be brown and earthy and resemble Cottesloe soils.

To achieve a good vegetation cover the revegetation will use the same local species but will be skewed towards more limestone type communities.

The same species from Coffey environments, will be used as a baseline but additional species from limestone areas will be added.

Vegetation Condition

The vegetation condition is variable, ranging from Excellent - Very Good to Good – Degraded.

Conservation Status of the Flora

There is a small community of threatened Ecological Community FCT 26a to the east of the M70/339 near Hopkins Road and at the southern end of M70/013.

Other plant communities are considered as Priority Communities on State databases.

There are some *Banksia* Woodlands on the tenements, outside the extraction areas. Banksia Woodlands are listed as Threatened under Commonwealth legislation, but Priority under State legislation.

Clearing

A Clearing Permit will be required prior to the disturbance of any other vegetation and the current vegetation and its conservation status will be considered at that time.

The future end use is currently listed as Conservation, but the Green Growth Plan has not been finalised and will need to be signed off by both the State and Commonwealth.

In the Green Growth Plan the excavated area is shown as “green” able to be extracted”, whereas the remainder is coloured “amber” and remains to be finalised and signed off.

The Closure Commitments will therefore depend on the finalisation of the Green Growth Plan. and may change in the future. Any such changes can be dealt with through the Mine Closure Plans that will be required to be reviewed every three years.

CPS 2303/2 is in place on M70/013 covering 4.999 hectares.

7.3.7 Fauna

Fauna studies were completed in 2008 by Western Wildlife.

The main impact on fauna is clearing and habitat removal, albeit temporary, with a return to local native vegetation.

No further clearing can occur without a Clearing Permit issued under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004.*

Amphibians and Reptiles

See fauna study completed in 2008 by Western Wildlife.

TABLE 8A SIGNIFICANT REPTILES

Species	Common Name	Comments	EPBC	State
Morelia spilota imbricate	Carpet Python	The Carpet Python may occur in rocky areas		WC Act (Sched 4)
Neelaps calonotos	Black-striped Snake			Priority 3

Conservation Status

1A	Protected under International Agreement
T	Rare or likely to become extinct
X	Presumed Extinct
S	Other specially protected fauna
P1	Priority 1

P2 Priority 2
P3 Priority 3
P4 Priority 4
P5 Priority 5

Birds

See fauna study completed in 2008 by Western Wildlife.

TABLE 8B SIGNIFICANT BIRDS

Species	Common Name	Comments	EPBC	State
Falco peregrinus	Peregrine Falcon			WC Act (Sched 4)
Calyptorhynchus latirostris	Carnaby's Black-Cockatoo	Carnaby's Black-Cockatoo is likely to occur, foraging in the *Banksia* woodland and limestone heath. Any large Tuarts with nesting hollows may be potential breeding habitat	Endangered	WC Act (Schedule 1)
Merops ornatus	Rainbow Bee-eater	The Rainbow Bee-eater may occur, potentially breeding in sandy areas	migratory	
Tyto novaehollandiae	Masked Owl			Priority 3
Falsistrellus mackenziei	Western False Pipistrelle			Priority 4

Conservation Status
1A Protected under International Agreement
T Rare or likely to become extinct
X Presumed Extinct
S Other specially protected fauna
P1 Priority 1
P2 Priority 2
P3 Priority 3
P4 Priority 4
P5 Priority 5

Mammals

See fauna study completed in 2008 by Western Wildlife.

TABLE 8C SIGNIFICANT MAMMALS

Species	Common Name	Comments	EPBC	State
Isoodon obesulus	Quenda / Southern Brown Bandicoot	May occur		Priority 5
Macropus irma	Western Brush Wallaby	May occur in *Banksia* Woodland		Priority 4

Conservation Status
1A Protected under International Agreement
T Rare or likely to become extinct
X Presumed Extinct
S Other specially protected fauna
P1 Priority 1
P2 Priority 2
P3 Priority 3
P4 Priority 4
P5 Priority 5

7.3.8 Wetlands

There are no wetlands or wet materials on site.

7.3.9 Short Range Endemics and Subterranean Fauna

Short range endemic (SRE) species are defined as terrestrial and freshwater invertebrates that have naturally small distributions of less than 10,000 km^2.

Within this distribution, the actual areas occupied may be small, discontinuous or fragmented.

Subterranean fauna are defined as fauna that live their entire lives below the surface of the earth. They are divided into two groups:

- Stygofauna, are aquatic subterranean animals, found in a variety of groundwater systems".
- Troglofauna are air breathing and occur in air chambers in underground caves or smaller voids

Short range endemic species have the potential to be restricted to small areas and are generally at a greater risk of changes in conservation status and local or taxon extinctions if their key habitats are relatively isolated and are to be impacted.

EPA 2016, Technical Guidance Terrestrial Fauna Surveys considers the requirements for surveys and refers to EPA Guidance 54, which concentrates on Stygofauna. EPA Guidance Statement 20 and Environmental Assessment Guideline 12 provide guidance on subterranean fauna impacts.

The likelihood of this fauna occurring on site has been assessed by Lindsay Stephens of Landform Research during the site inspections, and, on the basis of the geology and geomorphology as well as the reports by other researchers that show that the site lies well east of the Karst risk zone and that the water table is 20 to 30 m deep beneath the site, the risk of finding stygofauna is reduced. With such separation to the water table there will be no impact on any organisms at or near the water table.

The tenements are located on the eastern side of the limestone ridges away from any wetland or lake from which a source of acidic water will originate. The water tables are over 20 metres below ground surface and there are no indicator large Tuart trees apart from the north eastern corner of M70/339.

In all the excavations, there have been no indication of dissolution structures, such as cavities and caves.

The limestone on the ridges, of which only one low ridge remains in the east of M70/339, do contain surface cavities in amongst small surface karst features. That ridge has FCT 26a on it and is not available for excavation. The ridge is felt to be sufficiently close to other limestone to the south for there to be no isolated populations.

Limestone in the south is connected to higher limestone ridges to the south and west.

The chance of any site specific trogofauna is very low. At the end of excavation, and during rehabilitation, additional cavities will be created from the limestone boulders which will provide replacement habitat.

7.3.10 Wild Fires

Wild fires can potentially occur during summer when the site is being operated. The two main aspects of fire are the operations starting a fire and secondly how the operations will respond in the face of a wildfire. There have been occasional wild fires in recent years with the last on the southern portion of M70/013 three years ago.

The pit will be accessed by limestone based roads which are already in place.

The risk of fire commencing from operational equipment and spreading to the environment is low. Whilst fire certainly can occur on mine sites, mine sites have large areas of bare active ground that act as a fire break.

Any fire in a vehicle is dealt with, by all vehicles being equipped with communications and fire extinguishers. A site water truck equipped with a water canon will be available to deal with fire. Where a vehicle or other fire is not able to be extinguished the fire will be contained by parking the vehicle on bare ground and providing whatever treatment can safely be applied to the fire.

The quarry is bare from vegetation, and what does occur is often low fire risk and unlikely to support fire. The risk is therefore not environmental but rather Occupational Health and Safety.

Fire management forms part of the Project Management Plan in which a Fire Emergency and Preparedness plan is an integral part and must be approved by the Mines Safety Division. A summary of the main points is presented here.

The main issue though is egress which can either be west and then north to Cutler Road or east to Hopkins Road or west through pasture land.

Therefore protection from wild fire relies on the vigilance of all staff on site, preparation of the buffers and fire breaks and in the event of not being able to contain the fire, by evacuation.

Effective communications to the outside and on site, including the preparedness for fire and the accounting of all personnel prior to evacuation, are the key aspects of the wild fire management. On site equipment can be used to provide additional fire breaks as required.

7.3.11 Social Environment

Planning

The State Planning Policy Framework provides for the implementation of a planning framework through the recognition and implementation of Regional Planning Policies above Local Planning Schemes and Policies.

Within each layer of planning, there are a number of key policies and strategies to provide guidance to planning and development to enable sustainable communities to develop, expand and prosper without compromising the environment and future generations.

Planning is governed under the *Planning and Development Act 2005.* This Act enables Government to introduce State and Regional Planning Schemes, Policies and Strategies to provide direction for future planning. The State and Regional Schemes sit above Town Planning Schemes and Strategies introduced by Local Government.

The policies have little relevance over mining tenements on Crown Land in State Forest, but they do have relevance to the local roads, and the recognition of the need for limestone for dwellings, roads and construction.

Even though they are implemented under the *Planning and Development Act 2005,* over which the *Mining Act 1978* prevails, the policies have some relevance in providing guidance on the provision of basic raw materials for the community. They also have relevance in that the DMIRS seeks advice from the Local Authority when assessing mining proposals.

Some policies do have relevance such as the State Industrial Buffer Policy and Basic Raw Materials Policy.

With respect to the supply of sand and limestone, the overarching document is the;

- State Planning Policy 1.0 State Planning Framework.

Complementing this are a number of Relevant State Policies;

- State Planning Policy 2.0, Environment and Natural Resources Policy
- State Planning Policy 2.4, Basic Raw Materials
- State Planning Policy 4.1, State Industrial Buffer Policy

The end use is related to, and is to be compatible with the current land tenure of State Forest, under the control of DBCA.

As part of the SAPPR investigations and considerations, Bush Forever is also being reviewed. Unless directed otherwise the Bush Forever Site across the tenements as Site 290 will be retained as local native vegetation and will not be impacted unless available under alternative land use and tenure.

However this end use is still being determined by Government and no definitive end use is available at this time.

Therefore, as an interim, the end use as specified and committed to in the Notice of Intent, of a return to local native vegetation, as party of State Forest 65 will be applied.

As the limestone resource remains predominantly not excavated across the tenement there is currently a smaller area of ground available for rehabilitation, because the final floor elevation is some 20 metres below the current land surface. Currently there are no concept final contours to be formed and the land is therefore not available for rehabilitation and unlikely to be able to be rehabilitated for some years.

The end use is yet to be determined under the SAPPR process. In the meantime the interim revegetation to local native species will be provided.

Limestone Building Blocks will work with Department of Biodiversity Conservation and Attractions and Department of Mines Industry Regulation and Safety to ensure that the end use is to local native limestone vegetation in the absence of State Government plans for the area. Completion criteria were approved by CALM (DBCA).

Heritage

Indigenous Heritage

The State *Aboriginal Heritage Act 1972* and *Heritage of Western Australia Act 1990* and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* have been considered within this proposal.

A search of the Department of Planning Lands and Heritage database did not reveal any listed heritage places.

European Heritage

As far as is known, there are no known local areas of European heritage. There are no lime kilns on the tenements.

7.4 Materials Balance

Materials Balance (Total for all tenements)		
Materials Balance **(2018 - 2019)**	Total m^3	Available m^3
• Volume of waste rock (m^3 or tonnes)	No waste	
• Volume of topsoil	2000	2000
• Volume of growth medium (if required)	15 000	15 000
• Volume of suitable capping material (overburden)	NA	NA

7.5 Other Available Data

There is no other data.

8.0 IDENTIFICATION AND MANAGEMENT OF CLOSURE ISSUES

8.1 Issues to be Managed During Closure

The issues to be managed during closure are listed in the Risk Assessment, Closure Task Register and the Domains in Section 8.6 Closure Task Identification.

8.2 Risk Assessment

A Risk Assessment is attached.

The risk assessment is based on principles set out in AS/NZS ISO 31000:2009 *Risk Management - Principles and Guidelines*, and adopts definitions of likelihood and consequence that have been used to evaluate each risk prior to management and the anticipated risk following management.

Risk Management is covered in Table 16 located at the end of this closure plan.

Table 17 shows the monitoring with the repair detailed in the event that the monitoring identifies inconsistencies or failure to reach the completion criteria.

In Table 17 the Risks identified in Table 16 have been used as the general headings, and the completion criteria added from Table 7 to ensure that the Potential Environmental Risks are all addressed by the proposed closure.

8.3 Closure Task Register

Table 9 – Closure Task Register

Activity	Area	Issues relating to closure	Methods of closure
DOMAIN 1 Pit - excavation areas	Approximately 21.0 hectares	• See Section 8.6 Closure Task Identification.	• See Section 9.4 Land Restoration and Rehabilitation and Tables 12 and 13.
DOMAIN 2 Transport Corridor	Approximately 2.5 hectares	• See Section 8.6 Closure Task Identification.	• See Section 9.4 Land Restoration and Rehabilitation and Tables 12 and 13.
DOMAIN 3 Laydown hardstand	Approximately 12.0 hectares	• See Section 8.6 Closure Task Identification.	• See Section 9.4 Land Restoration and Rehabilitation and Tables 12 and 13.
DOMAIN 4 Building other than workshop	Approximately 0.4 hectares	• See Section 8.6 Closure Task Identification.	• See Section 9.4 Land Restoration and Rehabilitation and Tables 12 and 13.
DOMAIN 5 Workshop	Approximately 0.2 hectares	• See Section 8.6 Closure Task Identification.	• See Section 9.4 Land Restoration and Rehabilitation and Tables 12 and 13.
DOMAIN 6 Other cleared land	Approximately 2.7 hectares	• See Section 8.6 Closure Task Identification.	• See Section 9.4 Land Restoration and Rehabilitation and Tables 12 and 13.

8.4 Materials Characterisation

Table 10 – Materials Inventory

Type	Comment	Discussion	Reference
Soil	Topsoil is pushed to the side and stored separately	These are natural products found on site.	Field examination by Landform Research
Subsoils - Overburden	The overburden is then pushed to a separate bund for use in the site restoration	These are natural products found on site.	Field examination by Landform Research
Subgrade limestone	Subgrade limestone will normally be taken as a lower quality resource, but if not required will be stored separately and used with the limestone for rehabilitation of the substrate.	These are natural products found on site.	Field examination by Landform Research
Saline surface water	There is no surface water on site. Soils are not saline, being in a high rainfall area.	No treatment necessary	Field examination by Landform Research
Ground water	Groundwater is fresh. The water table will not be intersected.	No treatment necessary	Field examination by Landform Research
Acidic materials and drainage	Not present. The limestone is alkaline and highly neutralising towards acids	No treatment necessary. as excavation will not go below the water table. No risk for materials above the water table. See *Nattaporn-Prakongkep N, R J Giles, B Singh and S Wong, 2011, Mineralogy and chemistry of sandy acid sulphate soils in the Perth metropolitan area of the Swan Coastal Plain, Report to Department of Environment and Conservation June 2011.*	Field examination by Landform Research
Sodic or dispersive materials	No clay materials present that might be dispersive	No treatment necessary	Field examination by Landform Research
Asbestos – asbestiform minerals	None present.	No treatment necessary	Field examination by Landform Research
Radioactive materials	Not present	The site shows as “low” on WA Geological Survey radiometric mapping with similar background to the Spearwood Sands and Tamala limestone along the coast. There is an absence of deposits of heavy minerals within the sand resource apart from a few traces.	Field examination by Landform Research Published WA Geological Survey radiometric mapping
Metallic or chemical materials	Not present	No metallic or sulfidic materials or minerals are present	Field geological examination and experience and published information.
Tailings storage	No waste materials. All materials are natural.	No treatment necessary	
Ablutions waste		An approved serviced toilet is	

		installed on M70/339 and will be removed from site.	
Dangerous Goods and Hazardous Materials	***None will remain on closure***.	There are normally no hazardous materials used for limestone mining apart from fuel, and servicing. The only other materials are for tasks such as weed management and are dealt with under those sections.	
	FUEL The various plant will be refueled from mobile tanker. ***None will remain on closure***.	Any soil or other materials with drips and spills will be removed offsite to an approved waste site or location. A bunded lined fuel facility is located on site but has not been used by Limestone Building Blocks who bring fuel to site as required. All contaminated soils will be removed from site on closure and the ground tested for an absence of hydrocarbons.	
	SERVICE MATERIALS Only minor lubrication will be conducted on site All major servicing will be conducted offsite. ***None will remain on closure***	Any wastes will be collected and removed from site promptly to an approved recycling or waste disposal area. Only minor servicing is conducted on site. All major servicing is conducted offsite at Limestone Building Blocks facilities.	Water Management Plan – attached
General waste		Regularly removed from site to an approved disposal area	Water Management Plan – attached

8.5 Geotechnical

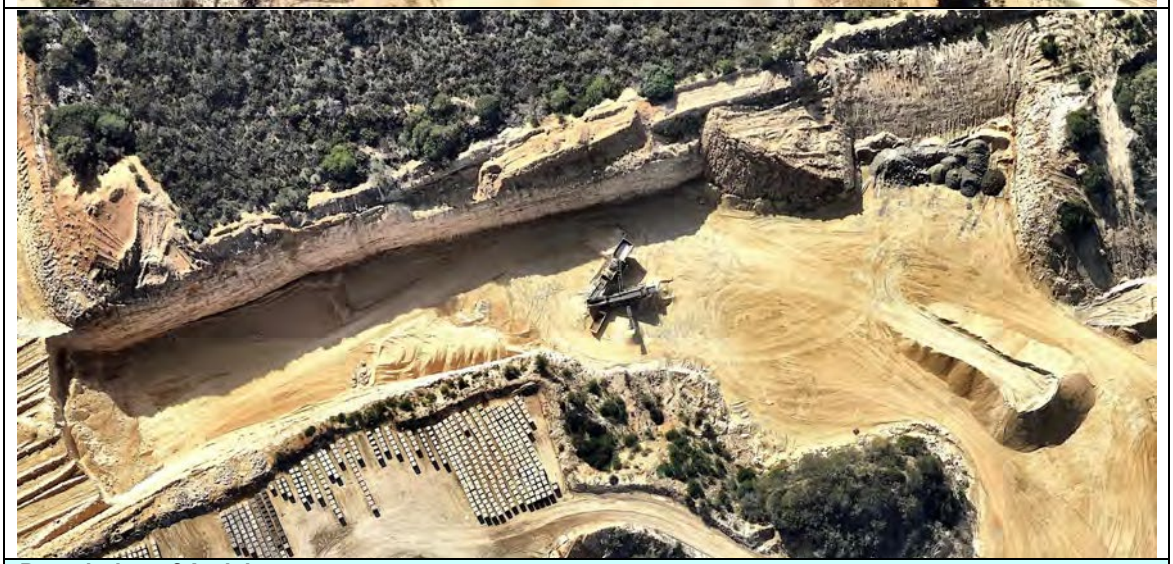
The batter slopes of the excavated pit will be retained as slopes of 1 – 4 to 1 : 2 in compliance with geotechnical standards and DMIRS Guidelines that will carry no significant geotechnical issues or risks.

At this time it remains unclear what the end use will be, but as the land lies within State Forest 65 a conservation land use is anticipated through a return to local native vegetation.

As this stage the end use has not been determined by the State and until such time as that decision is made revegetation will be to a natural landform covered by local native vegetation.

8.6 Closure Task Identification

The domains identified for this site are;

DOMAIN 1 – Pit and excavation areas	
	
Description of Activity	
Excavation consists of pit floor, batter slopes, access roads across the floor, crushing and screening by mobile gear that moves across the floor as excavation progresses, followed by rehabilitation.	
Domain Specific Closure Factors and Risks	**Works Program**
The excavation presents a safety risk	Table 11 and 12 - Safety
Ground too hard and not adequately ripped.	Table 13 – Soil Restoration
Shortage of overburden for soil restoration	Table 13 – Soil Restoration

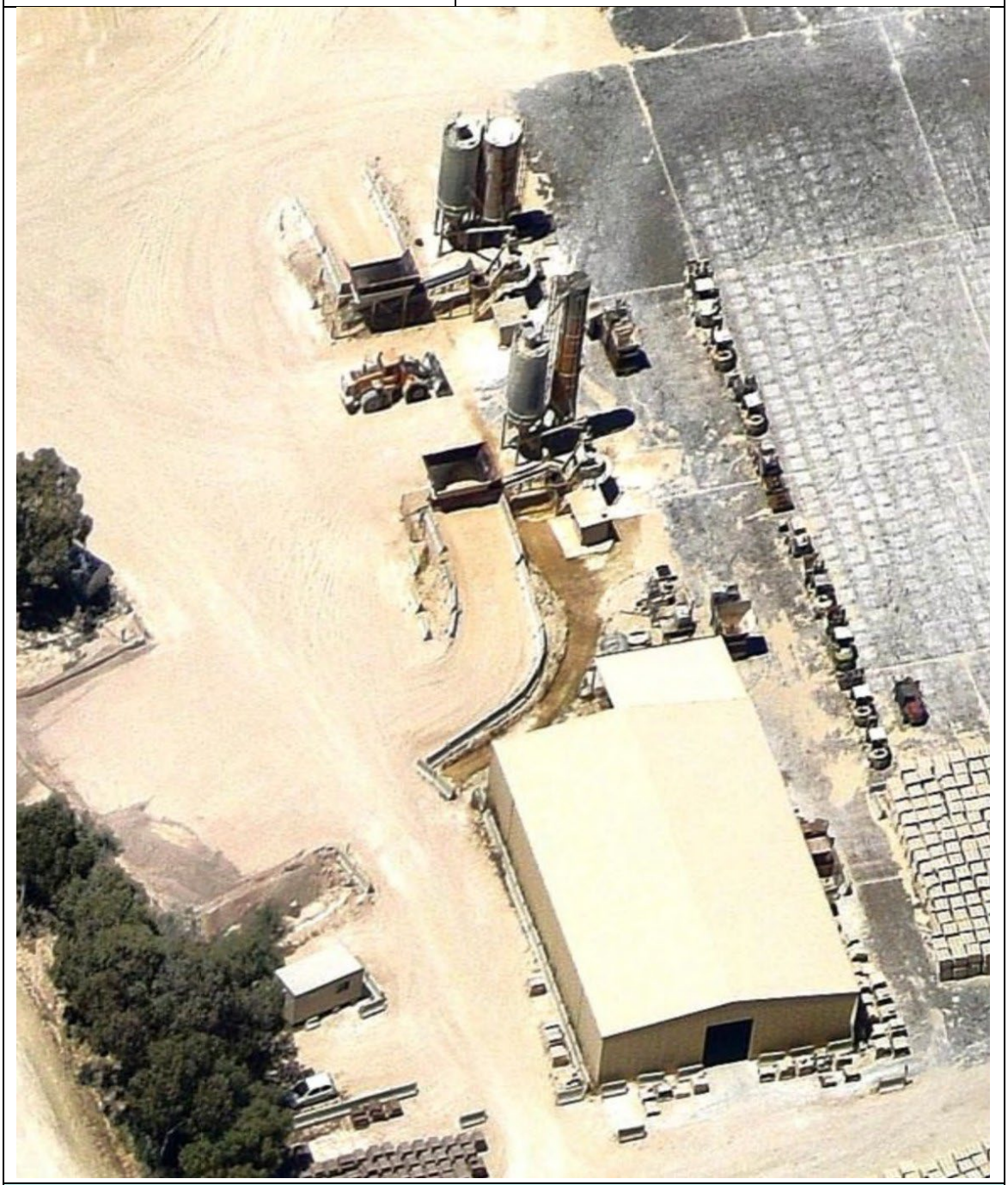
	Increase the ripping and breaking up of the limestone substrate as local native vegetation have been found to grow successfully at other sites where the limestone substrate has been crushed in the absence of sufficient overburden.
Insufficient topsoil.	Table 13 – Soil Restoration and Revegetation. Increase the seeding, and tube planting rates as local native vegetation have been found to grow successfully at other sites in the absence of sufficient topsoil. Increase the return of vegetation fragments
Presence of weeds.	See Table 13 – Weed Control
Closure Methodology	See Table 13
Monitoring and Maintenance	See Table 17

DOMAIN 2 – Transportation corridors – access roads	
Description of Activity	
Excavation consists of existing limestone roads.	
Domain Specific Closure Factors and Risks	**Works Program**
Ground too hard and not adequately ripped.	Table 13 – Soil Restoration
Shortage of overburden for soil restoration	Table 13 – Soil Restoration Increase the ripping and breaking up of the limestone substrate as local native vegetation have been found to grow successfully at other sites where the limestone substrate has been crushed in the absence of sufficient overburden.
Insufficient topsoil.	Table 13 – Soil Restoration and Revegetation. Increase the seeding and tube planting rates as local native vegetation have been found to grow successfully at other sites where the in the absence of sufficient topsoil. Increase the return of vegetation fragments
Presence of weeds.	See Table 13 – Weed Control
Closure Methodology	See Table 13
Monitoring and Maintenance	See Table 17

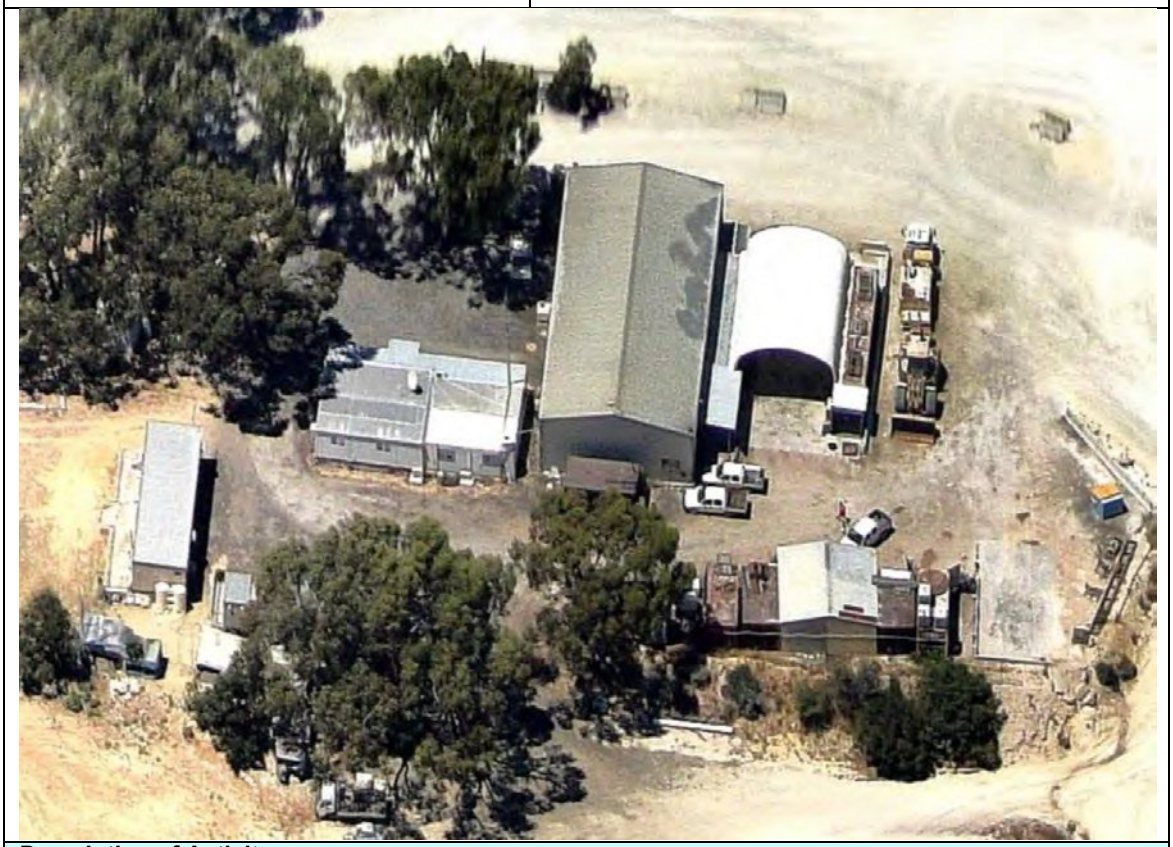
DOMAIN 3 - Laydown hardstand	

Description of Activity
The hard stand has a variety of hard stands and the concrete slabs for reconstituted block making. Batching plants, stockpiles and raw material storage bins.

Domain Specific Closure Factors and Risks	Works Program
Concrete infrastructure is to be removed.	Table 11 and 12
Soil at the refueling area and batching plants may be contaminated.	
Waste and rubbish may remain on site.	
Ground too hard and not adequately ripped.	Table 13 – Soil Restoration
Shortage of overburden for soil restoration	Table 13 – Soil Restoration Increase the ripping and breaking up of the limestone substrate as local native vegetation have been found to grow successfully at other sites where the limestone substrate has been crushed in the absence of sufficient overburden.
Insufficient topsoil.	Table 13 – Soil Restoration and Revegetation. Increase the seeding and tube planting rates as local native vegetation have been found to grow successfully at other sites where the in the absence of sufficient topsoil. Increase the return of vegetation fragments
Presence of weeds.	Table 13 – Weed Control
Closure Methodology	Table 13
Monitoring and Maintenance	Table 17

DOMAIN 4 – Building other than workshop	
	
Description of Activity	
The hard stand has a variety of steel and limestone buildings and transportable buildings with related infrastructure, lined fuel tank batching plants. Electricity supply. Water bore. Transportable site office. Transportable ablutions and accommodation.	
Domain Specific Closure Factors and Risks	**Works Program**
Infrastructure is to be removed.	Table 11 and 12
Soil at the refueling area and batching area may be contaminated.	
Waste and rubbish may remain on site.	
Ground too hard and not adequately ripped.	Table 13 – Soil Restoration
Shortage of overburden for soil restoration	Table 13 – Soil Restoration

	Increase the ripping and breaking up of the limestone substrate as local native vegetation have been found to grow successfully at other sites where the limestone substrate has been crushed in the absence of sufficient overburden.
Insufficient topsoil.	Table 13 – Soil Restoration and Revegetation Increase the seeding and tube planting rated as local native vegetation have been found to grow successfully at other sites where the in the absence of sufficient topsoil. Increase the return of vegetation fragments
Presence of weeds.	Table 13 – Weed Control
Closure Methodology	Table 13
Monitoring and Maintenance	Table 17

DOMAIN 5 – Workshop	
	
Description of Activity	
The hard stand has a variety of metal and limestone buildings and transportables with related infrastructure, lined fuel tank batching plants Water bore. Transportable site office. Transportable ablutions and accommodation.	
Domain Specific Closure Factors and Risks	**Works Program**
Infrastructure is to be removed.	Table 11 and 12
Soil at the refueling area and workshop may be contaminated.	
Waste and rubbish may remain on site.	
Ground too hard and not adequately ripped.	Table 13 – Soil Restoration
Shortage of overburden for soil restoration	Table 13 – Soil Restoration Increase the ripping and breaking up of the limestone substrate as local native vegetation have been found to grow successfully at other sites where the limestone

	substrate has been crushed in the absence of sufficient overburden.
Insufficient topsoil.	Table 13 – Soil Restoration and Revegetation. Increase the seeding and tube planting rates as local native vegetation have been found to grow successfully at other sites where the in the absence of sufficient topsoil. Increase the return of vegetation fragments
Presence of weeds.	Table 13 – Weed Control
Closure Methodology	Table 13
Monitoring and Maintenance	Table 17

DOMAIN 6 – Other cleared land	
Description of Activity	
Ground that has been opened and partially excavated. To be treated the same as the excavations and/or transport corridors.	
Domain Specific Closure Factors and Risks	**Works Program**
Presence of weeds.	Table 13 – Weed Control
Presence of cleared or disturbance areas, such as tracks	Liaise with the Stakeholders to determine and complete rehabilitation of the disturbances as required.
Monitoring	Table 17

Overview of rehabilitation facing south

10 month old rehabilitation

Figure 7 Young rehabilitation on M70/339 in 2008

Figure 8 Five year old rehabilitation on M70/339

9.0 CLOSURE IMPLEMENTATION

9.1 Background to Permanent Closure Implementation

The Closure Implementation describes the methods of permanent closure, progressive closure of each stage of the operation and at the end of mining and site activities.

Maintenance and monitoring will be conducted until completion criteria is met.

The following procedures have been selected from observation of the existing operations and experience in the rehabilitation of other limestone operations, both current and past operations, by Landform Research.

Progressive rehabilitation of completed land will have taken place previously wherever possible.

Rehabilitation is to occur as soon as possible following the end of excavation on each stage of pit floor. This is to be completed progressively by the normal plant that operates on site during campaigns.

Land restoration and rehabilitation of any completed stages or areas will be conducted prior to the ground being vacated.

Unexpected or early closure will be completed in the same way as permanent closure below but the full rehabilitation will be completed as one operation. See also Section 8.0

Section 8.0 forms an important part of Permanent Closure, in particular Section 8.3 Closure Task Register.

With progressive rehabilitation and closure, vegetation clearing and the recovery of topsoil and overburden is an important part of the process whereby these materials are transferred directly from an area of ground being opened where possible.

9.2 Temporary Closure

The nature of the temporary closure will depend on the circumstances and the time frame when activity is proposed to recommence. The table below relates to seasonal and campaign operations.

If the operations were placed under “Care and Maintenance” a plan of management would be submitted to the DMIRS prior to the operations being placed under that process.

The key issues are to;

- Make the site safe,
- Ensure no impact on the environment or amenity as a result of temporary closure.

The following actions will be undertaken prior to temporary or seasonal closure.

Table 11 - Management of Temporary Closure

Item	Actions	Timing
Documentation	• The latest documentation will be reviewed to assess compliance with the conditions and commitments. • Comply with the requirements of the Mining Tenement and any other conditions such as on Clearing Permits, DWER Licences	• Prior to temporary closure.

	and other approvals.	
Safety	• Secure the site and any plant or structures to be left. • The site is to be cleaned and structures will be removed. • Mobile plant and other equipment not required will be removed from site. • The disturbed land will be made safe and in compliance with the *Mines Safety and Inspection Act 1994* and DMIRS *Mine Closure Guidelines*. • The reformed land surface will be porous and resistant to wind or water erosion. • Faces will left stable. • Faces are to be made safe in the event of public use. • Provide, bunding and warning signs above faces as required. • Signage will be installed and maintained as appropriate to warn of potential risks. • Fences are to be installed above vertical or steep faces as required to minimise illegal access. • Temporary faces and excavations will be made safe with barriers, fences, gates and signs as necessary • Holes, sumps drains, ditches and the like will be filled, fenced, signed, marked or removed if they present a short term safety hazard.	• Prior to temporary closure. • Safety inspections are to be conducted as a minimum twice annually.
Security	• Complete activities to make the site safe. • Provide, bunding and warning signs above faces as required. • Provide locked gates or log access restraints as required or maintain staff on site. • Visual audit of completed ground, to verify compliance	• Prior to temporary closure.
Pollution	• Remove all hydrocarbons and other fluids. • Remove all waste products. • Remove contaminated soils spills and other contaminants.	• Prior to temporary closure.
Land stability	• The pit faces will be stable and not pose a significant geotechnical risk. • The reformed land surface will be porous and resistant to wind or water erosion. • Provide management as necessary to prevent excessive dust lift off. • Faces will left stable.	• Prior to temporary closure.
Rehabilitation	• Complete land restoration and revegetation of any ground that has reached final contours. • Undertake weed inspections and control.	Prior to temporary closure. Weed management is to be conducted in Spring and Autumn.

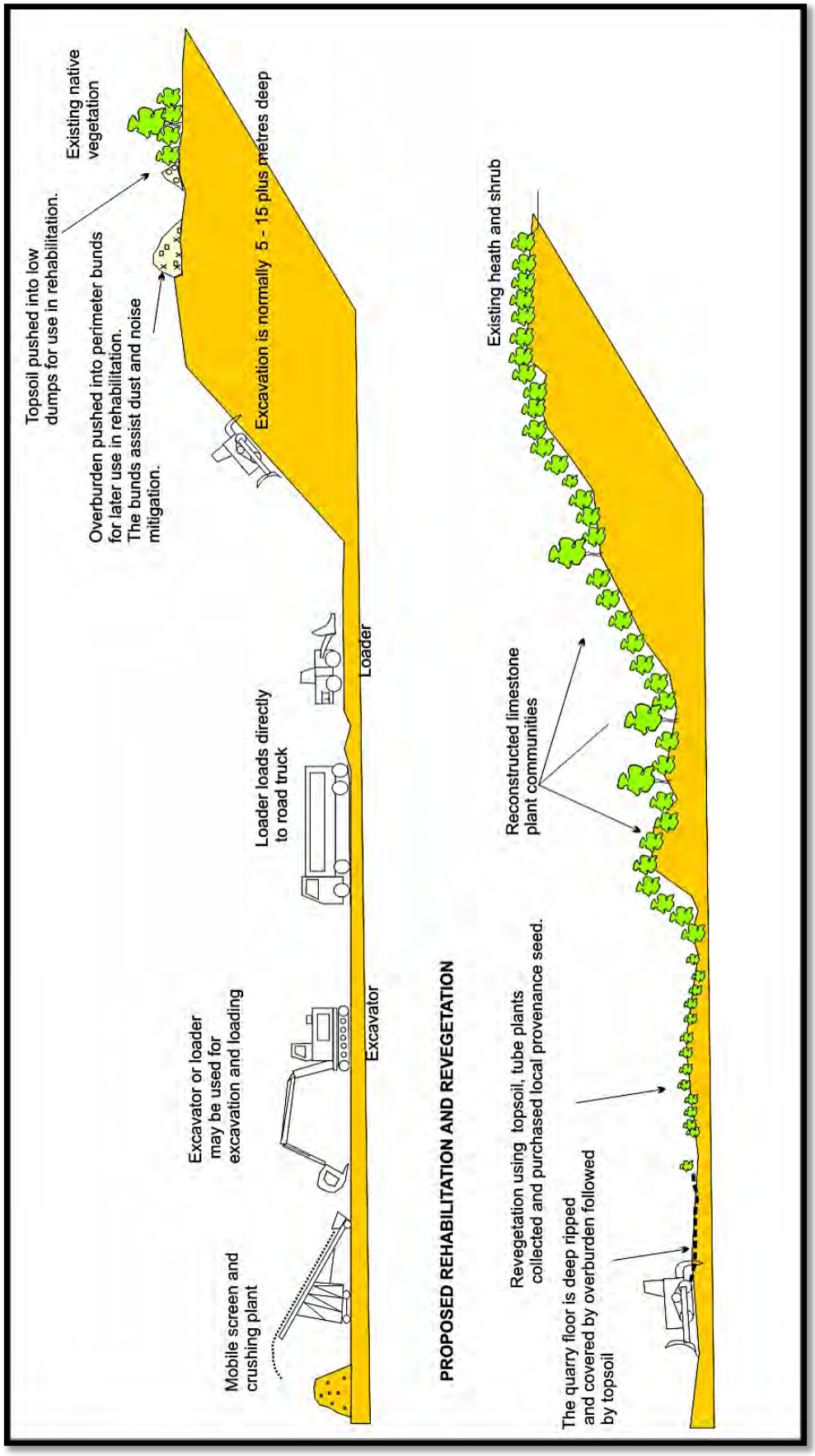


Figure 9 Concept operation and rehabilitation

9.3 Permanent Closure

Table 12 - Management of Permanent Closure

Item	Actions	Timing
Documentation	• The latest documentation will be reviewed to assess compliance with the conditions and commitments. • Comply with the requirements of the Mining Tenement and any other conditions such as on Clearing Permits, DWER Licences and other approvals. • Review the latest documentation. • Assess compliance with the conditions and commitments and end use. • Faces and the landform are to comply with DMIRS Guidelines and be stable for the long term. • The land surface is to have a landform similar to the natural form but at a lower elevation. • Design the rehabilitation to comply with, and be able to achieve the completion criteria and commitments. • Compile an audit table of all conditions and commitments that relate to closure and conduct an audit of those items upon the completion of each stage of rehabilitation and annually until sign off. • Comply with any Clearing Permit Conditions or DWER Licence Conditions. • Visually audit against all conditions.	• Prior to closure.
Safety	• Secure the site and any plant or structures to be left. • The site is to be cleaned and structures will be removed. • Mobile plant and other equipment not required will be removed from site. • The disturbed land will be made safe and in compliance with the *Mines Safety and Inspection Act 1994* and DMIRS *Mine Closure Guidelines*. • The reformed land surface will be porous and resistant to wind or water erosion. • Faces will left stable. • Faces are to be made safe in the event of public use. • Provide, bunding and warning signs above faces as required. • Signage will be installed and maintained as appropriate to warn of potential risks. • Fences are to be installed above vertical or steep faces as required to minimise illegal access. • Temporary faces, and excavations will be made safe with barriers, fences, gates and signs as necessary • Holes, sumps drains, ditches and the like will be filled, fenced, signed, marked or removed if they present a short term safety hazard.	• Prior to closure. • Safety inspections are to be conducted as a minimum twice annually.
Security	• Complete activities to make the site safe. • Visual audit of completed ground, to verify compliance	• Prior to closure.
Infrastructure Removal	• All non natural inert materials will be collected and removed from site. • Remove all infrastructure. • All structures, plant, equipment and other features not required for safety are to be removed from site. • Visual audit of completed ground, to verify compliance.	• Prior to closure of each stage of excavation.
Wastes	• Remove and or recycle all waste products and containers.	• Ongoing
Pollution	• Remove all hydrocarbons and other fluids. • Remove all waste products. • Remove contaminated soils spills and other contaminants.	• Prior to closure.

	• Visual audit of completed ground, to verify compliance with "no contamination to be left". • Soil testing will be undertaken if there is evidence of adverse materials remaining such as fuel spills. • As a result of any testing remediation will be undertaken to ensure that the site is not contaminated.	
Land stability	• The reformed surface will be geotechnically stable and in compliance with DMIRS landform closure requirements. • The reformed land surface will be porous and resistant to wind or water erosion. • Provide management as necessary to prevent excessive dust lift off. • Faces will left stable.	• Prior to closure of each stage and final closure.
Rehabilitation	• Complete land restoration and revegetation of any ground that has reached final contours. • Undertake weed inspections and control.	Prior to temporary closure. Weed management is to be conducted in Spring and Autumn.

9.4 Land Restoration and Rehabilitation

Table 13 - Rehabilitation Methods and Plant Re-establishment

Steps in Rehabilitation and Revegetation	Activity	Specifications
	To be completed as soon as site activities have been completed on any area and that area will not be required for future operations.	
• **Land Clearing**	***Land clearing is included in closure planning because it provides the source of topsoil and seeds for revegetation. Without effective land clearing and recovery of materials the revegetation effort is likely to be compromised.*** ***Vegetation*** • A Clearing Permit will be required for areas of native vegetation to be cleared under *Section 46 of the Environmental Protection Act 1984.* CPS 6203/2 is in place for 4.999 hectares on M70/013. • Dieback management will be undertaken as outlined in the attached Dieback Management. • Topsoil clearing will be progressive and minimised to that required for each stage of excavation. • A bulldozer or loader will be used to remove any vegetation by pushing it into windrows. • Any large logs will be either recovered for useable purposes or to form barriers. • Smaller vegetation will be track crushed and directly transferred to areas under rehabilitation to assist soil and habitat generation. The vegetation contains a significant seed source, because of the contained seed on many species, it is also a source of microbial material for soil formation, adds to habitat and assists in managing wind erosion. • Essentially all topsoil, vegetation fragments and any overburden will be recovered from cleared areas and retained for use in rehabilitation. The vegetation will be stored with the topsoil in low dumps <1 metre high around the perimeter of the pit. ***Topsoil*** • The topsoil cover of 50 – 100 mm will be pushed to the edge of the current excavation in separate windrows where available.	

	• Topsoil will be pushed to one side and formed into low storage dumps for later use for rehabilitation using either a loader or bulldozer. • If direct transfer is not possible the vegetation will be stored in low dumps to 1 metre high or swapped with a nearby operator to try and ensure that the material is not wasted. • The vegetation will be used on the batters to minimise soil erosion and spreading on the final land surface as part of the final rehabilitation. • Studies have shown that topsoil stripping and placement is best undertaken in summer for maximum germination and this will be done, but this raises the potential for additional dust generation from the fine humus particles. ***Overburden*** • Overburden, as yellow and brown sand and low grade limestone, will then be pushed to the perimeters, normally by bulldozer, to form bunding around the active area.	
• **Landform restoration**	• Land restoration and rehabilitation of any completed areas will be conducted prior to the site being vacated following the yearly excavation campaign at the end of autumn which is an appropriate time for rehabilitation. • The final land surface will be smoothed to be compatible with the existing natural landform of the area. • However where slopes and faces exist they will be battered down 1 : 4 to 1 : 6 vertical to horizontal. • The land surface will be formed to be geotechnically stable to the requirements of the *Mines Safety and Inspection Act 1994 and Regulations 1995* as a final land surface. • The landform will be formed to the approved Contours, Government or Stakeholder Guidelines where available. • When no Guidelines are available the land surface will been reformed to match the adjoining excavated and non excavated surfaces. • Experience by Landform Research on limestone shows that good revegetation can be achieved by seeding into soft overburden and deep ripped limestone floor, if suitable local species are used. • Where possible any disturbed areas that are no longer required will be rehabilitated using the methods described above within 12 months of becoming available.	
• **Soil Restoration**	• The floors will be deep ripped at 1 metre intervals in a cross pattern unless a more appropriate spacing or management is required. The batter slopes will be deep ripped along contour. • Access roads and hard stand will be removed and deep ripped. • Overburden, as yellow and brown sand and low grade limestone, will then be pushed from the perimeter bunding across the area under restoration. • A minimum of 300 mm of overburden will be spread over the surface where available to provide a substrate for revegetation. On limestone, rehabilitation can be very successful with minimum overburden when the floor is adequately deep ripped. • Topsoil followed by the vegetation will be spread across the excavated area as the key part of the final rehabilitation. • When stored topsoil is used it may be diluted and mixed with fresh topsoil.	
• **Erosion control**	***Water Erosion*** • Soil erosion occurs when soil is exposed and disturbed by wind or water erosion. • As the limestone is porous there will be no need for upslope contour or diversion banks to prevent water entering the void.	

	Similarly there will be no need for drainage works on the floor of the void. The floor will be formed to drain to low points to manage storm events. • Limestone readily crusts and aggregate is left and is resistant to wind erosion unless disturbed by vehicle activities. On closure there will be no further vehicle activities associated with mining apart from auditing and upgrading rehabilitation. • Water erosion on the batter slopes can be avoided by the permeability of the materials and by leaving the surface soft, rough and undulating, with the undulations running along contour. The final machinery run should be along contour and not down slope. • Wind erosion is not observed to be an issue on limestone soils such as this, but some sand soils may be susceptible under certain conditions. ***Wind Erosion*** • If wind erosion and soil stability become an issue measures will be taken to stabilise the soils. These could include but not be limited to fence wind breaks, spray mulching, cover crops, interim native vegetation or spreading mulch and vegetation. • For rehabilitation areas, interim revegetation will take place as soon as possible following landform and soil reconstruction. • Control of wind erosion potential will be assisted by spreading brush and vegetation across the topsoil on the batter slopes and reconstructed soils where local native vegetation is to be established. •	
• **Revegetation**	***General*** • The following procedures have been selected from observation of the existing operations and experience in the rehabilitation of other limestone and limesand quarries by Landform Research. • Progressive rehabilitation of completed land will have taken place previously. • Rehabilitation will take place during the first months following the restoration earth works of each particular section of quarry. Leaving the completed earth works for one season will reduce the success of rehabilitation by at least 50%, due to compaction effects. ***Revegetation*** • Rehabilitation is to occur as soon as possible following the end of excavation on each stage of pit floor and batter slope. This is to be completed progressively by the normal plant that operates on site during campaigns. A loader will be able to undertake this. • Topsoil and vegetation fragments will be transferred directly from an area being cleared and spread across the surface to provide seed sources and habitats wherever possible. If direct transfer is not possible, any material stored in dumps will be respread. • Topsoil provides a useful source of seed for rehabilitation when the correct handling of the topsoil is used, stripped and replaced dry (autumn direct return). Maximum depth of 50 mm can be used to optimise revegetation of species-rich plant communities. However weed affected topsoil can create additional issues and may not be used. • Topsoil will be spread directly from an area being cleared where possible, otherwise reclaimed from a topsoil dump. • Larger vegetation will be formed into occasional piles for habitat creation on the lower elevations. • Methods of sourcing seed will be; o Direct transfer of topsoil. o Brushing by cutting branches of adjoining and suitable local vegetation where available on areas approved for clearing prior to clearing and on	

	rehabilitated sites. For example branches of *Melaleuca* hold their seed and provide a good seed source when placed across the land surface. o Sourcing and planting additional tube plants as required as a result of site trials. o Collecting and or purchasing local provenance seed at the rate of about 500g/ha if required. Additional species that do not readily germinate from topsoil are Proteaceous and *Eucalyptus* species, which will be overseeded or tube planted. Species can also be taken from Coffey Environments 2009 and 2010, o Local leguminous species will be over seeded at the rate of 500 g per hectare to mimic the regeneration following fire as required. • Seeding conducted in summer will use scarified leguminous seeds that have been "dry smoked". Seeding conducted in July to August will have the leguminous seeds heat treated and all seeds will be smoke treated by soaking in "smoke water" for 24 hours prior to seeding. • Seed spreading will be achieved either using mechanical seed dispersal equipment or using manual methods. Bulking with a spreading agent such as sawdust, vermiculite or sand is desirable. ***Native vegetation Completion Criteria*** ***Plant Density*** *100 perennial shrub plants per 100 m^2, (1 plants per m^2)* ***Species richness*** *10 species per 100 m^2* ***Species List*** • See the10Environments 2009 and 2011 reports for species lists. ***Weed Control*** • See the Weed Management Plan below at 9.5. • Pre-seeding weed control is only likely to be required where topsoils are used that contain weed species. This is unlikely to be the case on this site where the existing vegetation is in excellent condition even though some exotic species are currently present within the "natural" vegetation. • In May, after the first autumn rains, check for weed germination. • Any weeds likely to significantly impact on the rehabilitation will be sprayed with Roundup or similar herbicide or grubbed out, depending on the species involved. Fusilade will be used where grasses present an impediment to rehabilitation Weed affected topsoil and overburden will be buried. • All species used in rehabilitation are to be local provenance species suited to local soils.	

9.5 Weed Management

Exotic and weeds species have not been observed on site apart from near public roads, but may be introduced in the future through illegal dumping or other means.

However the risk of weed incursion is not high because of the hostile soil conditions of high alkalinity. Even so weed management principles will be used.

Department of Environment and Energy, Arrive Clean, Leave Clean, provides guidelines on weed and disease management which have been incorporated into this management of exotic species.

Currently there are minor weeds or weed incursions on the tenements, although the proportion of exotic species is high.

The surrounding land has been cleared and developed for pines and agriculture, both of which lead to the introduction of exotic species. In addition mining has been undertaken locally for many years and that has also contributed to the number of exotic species.

The main weed risk currently is along the access roads, from adjoining properties and illegal dumping.

Weed management is to be used to minimise impact on site and remnant vegetation. Good management practices are to be used as part of the ongoing normal quarry operations.

The management of weeds therefore is to ensure that weeds are controlled, that there are no Declared or Significant environmental weeds that compromise the existing vegetation and the rehabilitated native vegetation, and that weed levels are not sufficient to impede future conservation land uses.

The main sources of weeds are;

- Ongoing visual assessment needs to be made on the type of weeds and the potential impact of each species. This provides a guidance on the methods of treatment.
- Weeds from edge effects from access roads and disturbed areas that may be carried to site.
- Gradual creep of weeds along access roads and in particular on the ridge soils.
- Illegal rubbish dumped by the public, such as along Hopkins Road.\.
- Materials inadvertently brought to site by employees.
- Parking and amenity areas.
- Soil and seeds from vehicles arriving at site. This often applies to trucks that have carried something else such as grain, or vehicles to be used in earthworks.
- Wind blown or seed from outside the site.
- Disturbed areas such as overburden dumps, topsoil stockpiles
- Birds and other vectors. This is more common than is often given credit for. eg *Solanum* species.

Weed management is to be used to minimise impact on site, remnant vegetation and on adjoining properties. Good management practices are to be used as part of the ongoing normal quarry operations.

The management of weeds therefore is to ensure that weeds are controlled, that there are no Declared or Significant environmental weeds that compromise the existing vegetation and the rehabilitated native vegetation, and that weed levels are not sufficient to impede future conservation land uses.

Currently the site is largely weed free. A weed management plan will be implemented during the life of the operations.

Weeds that are either “Declared” or are classified as a “significant environmental” weed will be treated as appropriate by either grubbing out or spot spraying.

- The Weed Management Plan will contain regular monitoring.
- Generally if the actions taken for plant pathogens are applied they will also control weeds.
- The greatest potential impacts are from road trucks, which may be carrying seed from farm transport. Trucks must be clean prior to arriving on site or they will not be permitted to enter. A dedicated clean out area will be provided at the entrance to the tenement where any weeds can be contained and treated.
- All vehicles and equipment to be used during land clearing or land reinstatement, will be clean and free from soil or plant material when arriving at site.
- Vehicles accessing the site, whether they be road trucks or light vehicles, will be required to be clean prior to leaving developed areas. Dirty vehicles will not be permitted to enter the site. This particularly applies to farm trucks or trucks used to carry other soil materials.
- All vehicles and equipment to be used during excavation or land reinstatement are to be clean and free from soil or plant material prior to arriving at a site. Normally the only vehicle used will be a loader or excavator that is retained on site, but service vehicles and road trucks will access the site.
- Vehicles and earth moving equipment are required to be clean prior to entering the site if they originate from another site. This is conducted offsite, independent of the tenement, by either brushing or washing. No dirty vehicle will be permitted onto the tenement.
- No soil and vegetation will be brought to the site apart from that to be used in rehabilitation.
- Plants and seeds to be used in rehabilitation will be free from weeds.
- Vegetated ahead outside the disturbance footprint and areas of excavation will be quarantined to onsite access.
- Excavation vehicles will be restricted to the excavation footprint apart from clearing land. Unwanted access to vegetated areas is discouraged through no access tracks, signage, site marking and operator induction and training.
- A split operation is to be worked, where the road transport vehicles only access one side of the stockpile area and excavation vehicles operate on the other side of the stockpiles reducing the risk of contamination from road transport.
- Weed affected materials will be taken offsite, used in weed affected areas, buried by 500 mm soil/overburden.
- Illegally dumped rubbish is a potential major source of weeds although the risk of dumping is reduced in locations remote from main roads. Any such waste is to be removed promptly.
- When clearing land or firebreaks vehicles are to work in conjunction with plant pathogen principles and push from areas of better vegetation towards areas of lower quality vegetation.

- Weeds will be sprayed as necessary with broad spectrum spray prior to planting or seeding in weed affected soils.
- Unwanted grasses will be sprayed as necessary with grass selective spray prior to seeding or rehabilitation
- Weed management will work from least affected areas to most affected.
- Declared weeds will be treated promptly by digging out or spraying.
- Inspections conducted to monitor the presence and introduction of weeds will be carried out on an annual or more frequent basis. On identification, introduced weeds will either be removed, buried, or sprayed with a herbicide.

9.6 Dieback Management

It is recognised that dieback, *Phytophthora cinamomi,* will not be an issue on this site because of rainfall, the alkaline and limestone soils.

However other plant pathogens do exist and whilst not currently present may be introduced in the future through public or other activity such as the illegal dumping of rubbish.

DBAC generally recognises that Dieback is less likely to impact on vegetation on calcareous Land Systems, Podger F D and K R Vear, 1998*, Management of Phytophthora and disease caused by it*, IN *Phytophthora cinnamomi* and the disease caused by it - protocol for identifying protectable areas and their priority for management, EPA 2000 and the same will apply on this site.

Good hygiene principles are therefore to be used, with the best and most well known methodology normally based on Dieback Management and therefore those techniques are listed below as a contingency.

In most cases vegetation death is caused by a pathogen which infects the plant and causes it to lose vigour, with leaves dying, and, overtime, may kill the plant. As such the management of plant disease is essentially related to plant hygiene when coming onto a site and within a site.

Therefore there is the potential for plant pathogens to be spread with the movement of soil and plant materials, so good plant hygiene is desirable.

There are several guides to the management of plant hygiene (Dieback).

- Dieback Working Group, (undated) *Management of Phytophthora Dieback in Extractive Industries.* It is noted that this Guideline applies to extraction in native vegetation on clay and gravel soils and therefore not all aspects of the document are applicable.
- Dieback Working Group, 2000, *Managing Phytophthora Dieback, Guidelines for Local Government.*
- *Department of Environment and Energy, Arrive Clean, Leave Clean.*

Vegetation Hygiene Management will be implemented to prevent the introduction and or spread of plant diseases.

The following procedures are proposed to be used to limit and restrict the introduction and spread of plant diseases, although not all potential impacts will apply to all parts of the proposed quarry operations.

- All vehicles and equipment to be used during excavation or land reinstatement are to be clean and free from soil or plant material prior to arriving at a site. Normally the only vehicle used will be a loader or excavator that is retained on site, but service vehicles and road trucks will access the site.

- Vehicles and earth moving equipment are required to be clean prior to entering the site if they originate from another site. This is conducted offsite, independent of the tenement, by either brushing or washing. No dirty vehicle will be permitted onto the tenement.

- No soil and vegetation will be brought to the site except certified and brought to site for rehabilitation and revegetation.

- Excavation vehicles will be restricted to the excavation footprint apart from clearing land. Unwanted access to vegetated areas is discouraged through no access tracks, signage, site marking and operator induction and training.

- A split operation is to be worked, where the road transport vehicles only access one side of the stockpile area and excavation vehicles operate on the other side of the stockpiles reducing the risk of contamination from road transport.

- Illegally dumped rubbish is to be removed promptly.

- Roads are to be maintained as free draining and hard surfaced. All road vehicles will be confined to the dedicated roads.

10.0 CLOSURE MONITORING AND MAINTENANCE

Monitoring

1. During late summer an assessment of the success of the rehabilitation will be made to determine the rehabilitation requirements for the following winter.

2. Monitoring includes visual assessments and, where necessary, counts to determine the success of the rehabilitation and restoration, as follows;

   - plant density
   - plant growth
   - plant deaths
   - regeneration
   - weed infestation

3. As necessary steps will be taken to correct any deficiencies in the vegetation.

4. Rehabilitation of each stage will be monitored to ensure satisfactory establishment of native vegetation.

5. The revegetation will be monitored for 3 years post closure of each part of the pit or until completion criteria are achieved and the operation has been signed off by DMIRS.

6. The monitoring should be conducted to the Completion Criteria.

7. A decommissioning audit will be conducted after decommissioning of the site in order to confirm the performance indicators and completion criteria have been satisfied. Remediation with then be carried out and a further audit completed to verify satisfactory completion.

Risk Management is covered in Table 16 located at the end of this closure plan.

Table 17 documents the Monitoring and Repair that is proposed in the event that the monitoring identifies inconsistencies or failure to reach the completion criteria.

The Risks identified in Table 16 have been used as the general headings in Table 17, with the completion criteria added from Table 7 to ensure that the Potential Environmental Risks are all addressed by the monitoring and repair commitments and programs..

11.0 FINANCIAL PROVISION FOR CLOSURE

Financial provisioning at this time can only be indicative. Costs will change over the life of the operations, and costs outlined now will have to take account of inflation and other potential changes.

Costings of closure relate to the actual cost of closure at any time if the project was closed for whatever reason. The cost of closure should only reflect the risk of closure cost at the three year time period and should not reflect ground already rehabilitated or ground not even opened.

Mine Closure Plans are required to be updated every three years. That means that the financial provisioning for closure should reflect the cost of closure during the three year period that the closure plan refers to.

This pits have a life of 20 plus years with around 20 hectares open at any one time. That is, as ground is opened ground will be closed and rehabilitated.

The financial provisioning provided therefore is appropriate from a risk based approach to the amount of ground open and cost of closure within the next three years.

As part of its financial risk management, Limestone Building Blocks intends to always have sufficient liquidity to meet its obligations as they fall due.

Table 14 – Financial Cost Estimates

Actions to be Completed for Final Closure	Estimated Cost
Removal of Infrastructure • Liaise with DBCA, DWER and DMIRS. It may be possible that a stakeholder may require the facility for public purposes. • Removal of structures, buildings and fences required. These will be discussed with stakeholders. If stakeholders have no need for the facilities Limestone Building Blocks will remove the facilities or use a local contractor to remove and sell the facilities. • Removal of any wastes and contaminated soil and surface materials. • Spreading any organic and plant matter across the top of the restored surface. • Use of Limestone Building Blocks plant at the end of excavation or a local contractor. Mobile plant is available at Neerabup and Nowergup – Carabooda.	$ 50 000
Reforming of land surface after excavation • Pushing back limestone and sand at the end of excavation, recontouring, deep ripping and spreading of topsoil • Use of Limestone Building Blocks plant at the end of excavation or a local contractor. Mobile plant is available at Neerabup and Nowergup – Carabooda.	$100 000
Removal of access roads • Liaise with DBCA, DWER and DMIRS. It may be possible that a stakeholder may require the facility for public purposes. • Removal of any contaminated materials, and waste. • If it is to be removed, treatment will consist of removal of the access road materials. • Use of Limestone Building Blocks plant at the end of excavation or a local contractor. Mobile plant is available at Neerabup and Nowergup – Carabooda.	$ 50 000
Stakeholder engagement	$ 10 000

• Stakeholders will be liaised with prior to and during closure.	
Specialist Fees • Environmental consultant to provide input to the species and methods to be used for rehabilitation.	$ 20 000
Monitoring • Monitoring and restoration contingency where possible. • Weed control, using mechanical removal, hand pulling and glyphosphate/Fusilade control. • Annual inspections and tasks by local contractor/consultant. Consultant fees, weed monitoring and treatment, until completion criteria is met	$ 20 000
Updating • Reviewing and restoring areas that do not meet the completion criteria. • Use of Limestone Building Blocks plant at the end of excavation or a local contractor. Mobile plant is available at Neerabup and Nowergup – Carabooda.	$ 40 000
Administration • Administration, travel and other contingencies, from Perth office.	$20 000
TOTAL	**$ 310 000**

Seasonal and short term closures are funded from normal operating costs and expenditure requirements on the tenement and completed at the end of each campaign of excavation.

At all times a close level of communication and contact with DMIRS, DBCA/DWER will be undertaken to ensure a satisfactory level of compliance. The cost of rehabilitation will be reviewed regularly, every time the Mine Closure Plan is revisited; that is every three years.

TEMPORARY CLOSURE COST ESTIMATES

Actions to be Completed for Temporary Closure	Estimated Cost
Removal of structures and plant that will not be secure	$ 20 000
Ensuring that faces and operations are geotechnically safe	$ 10 000
Removal of wastes and any potentially adverse materials	$ 2 000
Maintenance and upgrade of safety and security features such as fences, gates, trenches and bunding.	$ 10 000 plus $ 4 000 annually
Administration and review of site.	$ 4 000 annually
TOTAL	**$ 50 000 plus up to $ 8 000 annually**

12.0 MANAGEMENT OF INFORMATION AND DATA

All data relating to the operations will be retained as hard copies and electronic copies by Limestone Building Blocks. The data will include all materials relating to the project and include updated aerial and ground photography.

Limestone Building Blocks and their consultants will retain digital copies, backed by paper copies as applicable.

Should the tenement be operated under contract a copy of all relevant documentation will be supplied to the contracting party.

An annual environmental report will be prepared and submitted to the DMIRS in accordance with the tenement conditions when the conditions are known.

Limestone Building Blocks will maintain, within a suitable document/data management system, a library of documents relevant to the closure of the project in a digital database and as necessary paper copies, duplicated by back up technology.

Data will also be stored on EARS2 and the MRF. Any relevant documentation will be entered on the EARS2 system to ensure its retention.

Material retained will include;

- The MCP and each of its revisions.
- Technical reports from baseline and closure studies,
- Annual environmental and monitoring reports to regulators (EARS2).
- Correspondence, records of meetings, and consultation with regulators and other stakeholders.
- Decommissioning and closure works cost estimates, and (when developed) schedules.
- Current site plans and landform designs.
- Life of mine schedules and current mine plans.
- Plans of electrical, water, gas, and other buried services.
- Contaminated sites investigations and reports, if any.
- Current and relevant past aerial photographs.
- Areas of disturbance (EARS2).
- Documentation of Inventories of rehabilitation materials used.
- Records of any environmental incidents, restoration and mitigation.
- Data from baseline studies, operations monitoring, closure studies, post-closure monitoring, including laboratory certificates where relevant.
- Photographs documenting pre- and post-closure inspections and monitoring.

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Table 15 - Environment Risk and Management

Identified Risk	**Untreated Risk** Unmanaged **Risk Pathwav**	Domain	Likelihood	Conse auence	**Risk**	**Treated Risk** **Management**	Likeli hood	Conse auence	Treated **Risk**
COMPLIANCE									
Closure of each stage and at completion operation	All legally binding conditions and commitments relevant to mine closure and rehabilitation will be met.	All domains	C	2	MEDIUM	• All legal requirements and commitments are to be complied with. • Auditing at least annually and monitor for 3 years	E	2	LOW
LANDFORM AND SOILS									
Closure of each stage and at completion operation	All non natural structures, with mining will be removed. All wastes and access/transport facilities will be removed from site.	Domains 2-5	C	2	**MEDIUM**	• All non local structures will be removed. • Audits will be conducted at closure. • Any potential contaminated areas such as refueling zones will be assessed and sample tested as necessary and any contaminated materials removed and the area remediated. • All structures and plant from the previous operator, apart from the existing metal shelter have been removed. The remainder will be removed on closure subject to DBCA and DWER requirements.	D	2	LOW
	The land surface will be visually similar to the surrounding landform.	**All** domains	D	2	**LOW**	• The site will be contoured to limestone habitat as the end use is to be a return to natural vegetation as part of State Forest 65. • Slopes and landforms will be compatible with similar Tamala Limestone geology in other locations. • Although there will be differences they will be compatible. When resource is removed and the land surface is lowered the exact same land surface cannot be returned. However the proposed landform will provide enhanced and secure water bird breeding habitat. • The land surfaces will be visually audited at closure and the surface reformed if it does not	D	2	LOW

						meet the completion criteria.			
	The land surface and soils are to be capable of supporting local vegetation and habitat.	All domains	C	3	HIGH	• The pits, hard stand, roads and other such surfaces will be deep ripped and spread with overburden and topsoil. • The rehabilitation will be audited and if not growing satisfactorily the earthworks will be repeated.	D	2	LOW
WATER QUALITY - HYDROGEOLOGY									
Operation Closure of each stage and at completion operation	The final land surface will be stable surface resistant to water and wind erosion.	All domains	C	2	MEDIUM	• The limestone is stable and readily crusts after any rain, making the surfaces stable. • The final surface will be located some 20 plus metres from the water table. • The slopes are reduced to a maximum of around 1 : 4 vertical to horizontal. • Limestone is porous and generally generates low volumes of runoff.	D	2	LOW
BIODOVERSITY									
Operation Closure of each stage and at completion operation	**VEGETATION MANAGEMENT**								
	Dieback may be introduced.	Domains 1, 2 and 6	E	3	LOW	• Although the risk from dieback is minimal from the alkaline, hostile soils there is a small risk of introduction of other plant pathogens. • Dieback and plant pathogen management will be incorporated into both the operations and closure activities. • See Section 9.5 Dieback Management, which will be implemented to generally manage the potential introduction of plant pathogens.	E	2	LOW
	The re-established surface will be free from Declared or Significant Environmental weeds that could compromise the success of the rehabilitation or impact on adjoining vegetation.	All domains	C	3	MEDIUM	• The risk of weed incursion is potentially less than some other sites because of the hostile soil conditions of high alkalinity and dry soils. • No weed impacted materials will be brought to site. • Land restoration activities will work from low weed loads to high weed load areas, infested to infested ground. • Weeds will be removed or sprayed. • See Section 9.6 for Weed Management which will be implemented.	D	2	LOW
	The local native vegetation will not re-	All	C	3	MEDIUM	• There has been little potential for revegetation	D	2	LOW

	establish to suitable quality.	domains				on this site because the resources remain to be taken. • However on M70/339 it has been demonstrated by Landform Research that revegetation to a high standard is possible when rehabilitation is completed well.			
	Threatened Communities may be impacted by inadvertent impacts.	Domains 1 and 6	C	3	MEDIUM	• The end use and Government decisions will determine what long term impacts there will be to flora. • The Threatened Communities and Priority Communities are composed of common plant species, but it's their combination and location which is significant. The main patch of vegetation (FCT 26a) is located in the east of M70/339 and is currently excluded from excavation and clearing. • It is not proposed the clear or disturb *Banksia* Woodland which is listed as Threatened on the *Commonwealth EPBC Act 1999*. • The end use to limestone substrate is the specific habitats that the significant species grow on and therefore similar mixes of species are readily able to be returned to replicate the significant communities.	D	2	LOW
	Threatened Species may be impacted by inadvertent impacts	Domains 3 and 4	E	2	MEDIUM	• The end use and Government decisions will determine what long term impacts there will be to flora. • The main Threatened vegetation are not species but Communities as FCT 26a and *Banksia* Woodland. • There are no known Threatened species on the tenements.	E	2	LOW
	FAUNA MANAGEMENT								
	Communities and fauna and/or biodiversity may be significantly impacted by clearing, and degradation by weeds and dieback.	Domains 3 and 4	C	3	MEDIUM	• The end use and Government decisions will determine what long term impacts there will be to fauna. As the end use is to State Forest 65 then the loss of habitat can be compensated for, or offset by Government to ensure sufficient feeding habitat is available for fauna • The main significant fauna are Black Cockatoos	D	2	LOW

						and their feeding habitat. The food species are Proteaceous species which will be included in revegetation to local native species. • How much of the habitat vegetation that is cleared, will be determined by the Applications for clearing.			
STAKEHOLDERS									
Operation, prior to and at closure	The interests of all relevant stakeholders will be considered during operations, closure planning and closure	All domains	D	2	LOW	• A stakeholder consultation program is proposed during operations and prior to closure of each stage to determine any requirements of the various stakeholders. • The Mine Closure Procedures commit to implement the requirements of the stakeholders.	E	2	LOW

RISK MATRIX			**Effect / Consequence**				
			1	2	3	4	5
Type			Insignificant	Minor	Moderate	Major	Severe
Environmental Impact			No discernible, adverse impact, individuals of species may be affected locally.	Discernible effect on the environment but no adverse impact, minor number of individuals of species may be affected locally	Minor adverse effect to the environment (including public amenity), moderate loss of individuals of species locally.	Moderate damage to ecosystem function, major loss of individuals of species locally, loss of public amenity.	Significant long-term damage/loss to ecosystem function, extinction of a species locally
Likelihood	A Almost Certain	Likely that the unwanted event could occur often (once per week) during the life of an individual item or system	Medium **11**	High **16**	High **20**	Very High **23**	Very High **25**
	B Likely	Likely that the unwanted event could occur several times per year during the life of an individual item or system.	Medium **7**	Medium **12**	High **17**	High **21**	Very High **24**
	C Possible	Likely that the unwanted event could occur sometime (once per year) during the life of an individual item or system.	Low **4**	Medium **8**	High **13**	High **18**	High **22**
	D Unlikely	Unlikely, but possible for the unwanted event to occur once in the life of an individual item or system.	Low **2**	Low **5**	Medium **9**	High **14**	High **19**
	E Rare	Highly unlikely that the unwanted event could ever occur in the life of an individual item or system.	Low **1**	Low **3**	Medium **6**	Medium **10**	High **15**

Table 16 – Monitoring and Repair							
Identified Risk	**Closure Objective**	**Completion Criteria**	**Domains**	**Measurement Tools**	**Performance Indicators to Meet Completion Criteria**	**Monitoring and Remediation**	**Timing**
COMPLIANCE							
All legally binding conditions and commitments relevant to mine closure and rehabilitation will be met.	1 All legally binding conditions and commitments relevant to mine closure and rehabilitation will be met.	• All legally binding conditions and commitments are complied with	All Domains	• Audit of rehabilitated ground, to verify compliance with all legally binding conditions and commitments	All legally binding conditions and commitments relevant to mine closure and rehabilitation will be met.	• Site auditing at least annually and monitor for 3 years, by a review of the tenements, conditions and discussions as necessary with on site staff, sublease holders and stakeholders.	• Annually for 3 years
LANDFORM AND SOILS							
All non natural structures, associated with mining will be removed.	3 All non natural structures, associated with mining will be removed.	• No non natural structures will be retained on site.	Domains 3, 4 and 5	• Visual audit of completed ground, to verify compliance.	• No buildings, concrete, metal and other non natural materials will remain at closure.	• Audits will be conducted at closure. • All structures and plant have been removed. • The site has been cleaned of all wastes and foreign matter. • All contaminated sols and materials have been removed	• At closure of each portion of each Domain and final closure.

Identified Risk	Closure Objective	Completion Criteria	Domains	Measurement Tools	Performance Indicators to Meet Completion Criteria	Monitoring and Remediation	Timing
The land surface will be visually similar to the surrounding landform.	5 The final land surface is to be formed to the agreed form.	• The land surface will comply with Government - Stakeholder Guidelines. • In the absence of definitive Government Guidelines, the excavated land surface will be reformed to visually match local landforms.	All domains	• Visual audit of completed ground, to verify compliance. • Discussion with staff and operator and Stakeholders. • Provide site survey to verify compliance to Government or Stakeholder requirements.	• No obvious visual evidence of hardstand or roads in areas not required by Government. • The land surface will comply with Government - Stakeholder Guidelines. or • In the absence of Government – Stakeholder Guidelines the excavated land surface will be reformed to visually match local landforms.	• The land surfaces will be visually audited at closure and the surface reformed if it does not meet the completion criteria. • The site will be re-contoured to limestone habitat as the end use is to a return to State Forest, unless the State determines another end use. • If the landform is non compliant the earthworks and site preparation for rehabilitation will be repeated.	• At closure of each portion of each Domain.
The land surface and soils are to be capable of supporting local vegetation and habitat.	2 All hazardous material is removed from site and disposed of appropriately.	• There are no hazardous materials remaining at closure. • There are no contaminated materials remaining at closure	All domains	• If contaminated sites are identified, ensure that the contaminated sites classification does not impact on suitability of the Project area for proposed post-mining land use in accordance with the Contaminated Sites Act 2003 (WA). • Visual audits • Soil testing and remediation as required.	• No hazardous materials or soils. • No matertials with criteria in excess of the levels specified in the *Contaminated Sites Act 2003 (WA*) will remain at closure.	• Visual monitoring and audit. • Soil testing as required. • Any potential contaminated areas such as refueling and batching zones will be assessed and sample tested as necessary. • Any contaminated materials will be removed and the area remediated and retested as necessary.	• At closure of each portion of each Domain.

Identified Risk	Closure Objective	• Completion Criteria	Domains	Measurement Tools	Performance Indicators to Meet Completion Criteria	Monitoring and Remediation	Timing
	4 All wastes will be removed from site reused or placed in an approved offsite landfill.	• No waste materials will remain at closure.	All domains	• Visual audit of completed ground, to verify compliance.	• No waste materials will remain at closure.	• Visual audit of completed ground, to verify compliance. • Discussion with staff and operators. • Any wastes found will be removed to an approved facility and the site tidied.	• At closure of each portion of each Domain.
	16 All contaminated limestone or sand will be remediated or removed from site to an approved disposal area.	• There are no contaminated materials remaining at closure.	Domains 3 and 4	• Visual audits. • Soil testing and remediation as required.	• No hazardous materials or soils with criteria in excess of the levels specified in the *Contaminated Sites Act 2003 (WA)* will remain at closure.	• Visual monitoring and audit. • Soil testing as required. • If contaminated sites are identified, ensure that the contaminated sites classification does not impact on suitability of the Project area for proposed post-mining land use in accordance with the *Contaminated Sites Act 2003 (WA).* • Visual observation backed by soil sampling as necessary and through discussions with internal stakeholders. • The site will be cleaned and retested as necessary to ensure compliance. • Any potential contaminated areas such as refueling and batching zones will be assessed and sample tested as necessary. • Any contaminated materials will be removed and the area remediated and retested as necessary.	• At closure of each portion of each Domain.
	6 Re-constructed soils will be formed on the surface that are to be capable of supporting a return to local native vegetation and habitat	• Soil properties will be appropriate to sustaining local native species.	All domains	• Visual observations of the reconstructed soils prior to rehabilitation. • Field assessment the growth rates of the revegetation. • Ongoing photographic record of rehabilitation.	• No obvious visual evidence of hardstand or roads in areas not required by Government. • The land surface will comply with Government - Stakeholder Guidelines. OR	• Review by company officials and as necessary experienced consultants. • Undertake earthworks as required, which may include deep ripping, spreading overburden and topsoil and revegetation until satisfactory revegetation can be achieved.	• At closure of each portion of each Domain and for a period of 3 years.

					• In the absence of Government – Stakeholder Guidelines the excavated land surface will be reformed to visually match local landforms		
Identified Risk	**Closure Objective**	**Completion Criteria**	**Domains**	**Measurement Tools**	**Performance Indicators to Meet Completion Criteria**	**Monitoring and Remediation**	**Timing**
	14 Hard limestone areas will be made suitable for rehabilitation.	• All roads will be picked up, and if foreign will be removed from site. • All compacted limestone will be deep ripped	All domains	• Site inspection prior to the construction of soils.	• Limestone is to be deep ripped at intervals of 1 metre in a cross pattern on the floor and along contour on batter slopes.	• Review by company officials and as necessary experienced consultants. • Review the rehabilitation for growth rates and compliance. • Undertake earthworks as required, which may include deep ripping, spreading overburden and topsoil and revegetation until satisfactory revegetation can be achieved.	• At closure of each portion of each Domain and for a period of 3 years.
	15 Hard stand will be picked up and if foreign will be removed from site.	• All hardstand will be picked up, and if foreign will be removed from site. • All compacted limestone will be deep ripped.	All domains	• Site inspection prior to the construction of soils.	• Limestone is to be deep ripped at intervals of 1 metre in a cross pattern on the floor.	• Review by company officials and as necessary experienced consultants. • Undertake earthworks as required, which may include deep ripping, spreading overburden and topsoil and revegetation until satisfactory revegetation can be achieved.	• At closure of each portion of each Domain.
WATER QUALITY - HYDROGEOLOGY							
The final land surface will be stable surface resistant to water and wind erosion.	7 The final land surface will be a stable surface resistant to water or wind erosion and not cause dust that will adversely impact on adjoining vegetation or human health or amenity.	• Slopes are to be stable and free from erosion.	All domains	• Annual site observations and as required.	• Absence of visible dust blowing from the surface. • Absence of significant rills and erosion channels.	• Review by company officials and as necessary experienced consultants. • Undertake earthworks as required, to prevent water erosion and treat exposed surfaces with wind breaks, vegetation dust suppression or water to mitigate dust lift off. • Ensure maximum slopes are around 1 : 4 vertical to horizontal.	• At closure of each portion of each Domain and for a period of 3 years.

Identified Risk	Closure Objective	Completion Criteria	Domains	Measurement Tools	Performance Indicators to Meet Completion Criteria	Monitoring and Remediation	Timing
	9 The reformed surface will be free draining with no surface water ponding.	• Constructed soils will enable infiltration of precipitation in a similar manner to the natural conditions.	All domains	• Audit of completed ground, to verify compliance. • Visual observations of the landforms.	• The reformed surface will be free draining with no surface water ponding.	• Review by company officials and as necessary experienced consultants. • Undertake earthworks as required, to prevent water erosion.	• At closure of each portion of each Domain and for a period of 3 years. • After storm events for up to 3 years until stable.
BIODOVERSITY							
VEGETATION MANAGEMENT							
Dieback or plant diseases may be introduced.	11 Dieback and other diseases may be introduced and impact on revegetation and adjoining vegetation.	• There will be no introduced plant diseases that will significantly impact on revegetation or adjoining native vegetation.	All domains	Annually conduct a review of the relevant vegetation for disease introductions.	• No obvious sign of impact on revegetation, or adjoining native vegetation by introduced plant diseases.	• Review by company officials and as necessary experienced consultants. • Treat plant diseases according to Section 9.5 Dieback Management. • Continue monitoring and management for longer to ensure compliance.	• Annually
The re-established surface will be free from Declared or Significant Environmental weeds that could compromise the success of the rehabilitation or impact on adjoining vegetation.	10 Weeds will not impact on revegetation.	• Revegetation will be free from Declared or Significant Environmental weeds that could compromise the success of the revegetation or spread into adjoining native vegetation.	All domains	• During Spring and Autumn conduct an on site audit of completed rehabilitation for species richness, diversity and structure using standard 100m^2 plots of rehabilitation.	• No obvious sign of significant impact on revegetation or adjoining vegetation by weed species.	• Twice yearly field review by company officials and as necessary experienced consultants. • Treat weeds according to Section 9.4 Weed Management. • Continue monitoring and management for longer to ensure compliance.	• Spring and Autumn

Identified Risk	Closure Objective	Completion Criteria	Domains	Measurement Tools	Performance Indicators to Meet Completion Criteria	Monitoring and Remediation	Timing
The local native vegetation will not re-establish to suitable quality.	13 Rehabilitation objectives will be met.	• Re-establish vegetation as required by Government Guidelines or agreements. • In the absence of any Government Guidelines or Agreement, re-establish local provenance, self-sustaining, resilient ecological communities on disturbed areas.	All domains	• Conduct an on site audit of completed rehabilitation for species richness, diversity and structure using standard 100m^2 plots of rehabilitation and adjoining vegetation if required to verify success. • Audits of the completion criteria upon the completion of each stage of rehabilitation and annually until sign off.	In the absence of any Government Guidelines or Agreement. ***Plant Density*** *100 perennial shrub plants per 100 m^2, (1 plants per m^2)* ***Species richness*** *10 species per 100 m^2*	• Conduct audits of the completion criteria upon the completion of each stage of rehabilitation and annually until sign off. • Check for exotic animal impacts such as goat or stock and treat accordingly through control, additional planting or other measures. • Maintain ongoing records. • Where deficient, provide additional topsoil or seed to increase the number and diversity of plants, spread vegetation fragments or harvested branches capable of providing seed sources from brushing. • Review future rehabilitation techniques.	• Annually in auumn
Threatened Communities may be impacted by inadvertent impacts.	17 Vegetation within the Bush Forever Site will not be disturbed.	• There will be no disturbance of the Bush Forever Site. • Disturbed areas attributed to mining or related activities will be rehabilitated.	Domains 1, 2 and 6	• Provide annual inspections at the appropriate time of the year, but in general Autumn and Spring.	• There are no new disturbances to the Bush Forever Site. • Disturbed areas will be rehabilitation to the completion criteria for local native vegetation.	• Visual examination of the Bush Forever and other significant sites. • Add fences, protection, staff education, signage, goat and vermin protected as required.	• Annually

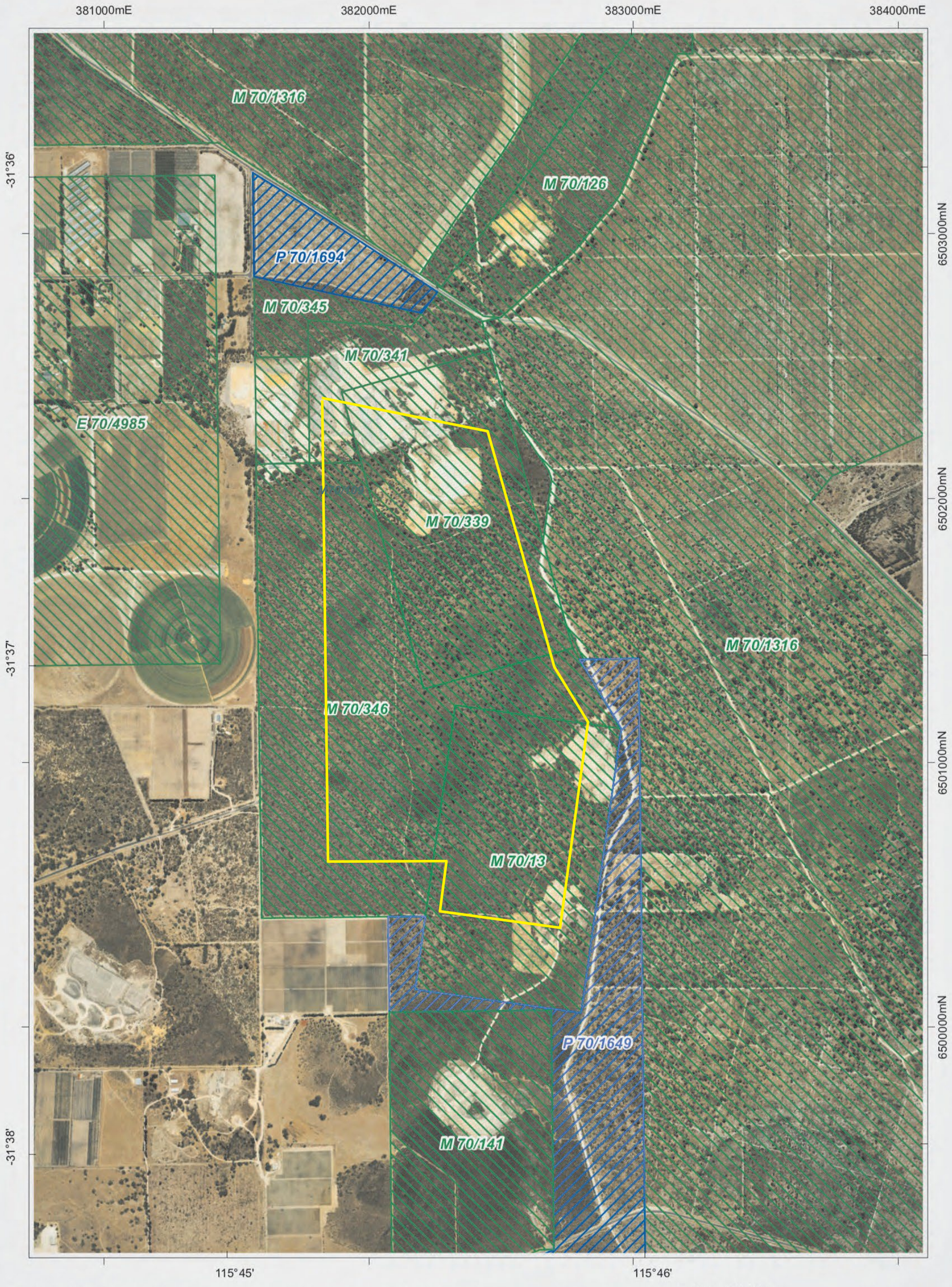
Identified Risk	Closure Objective	Completion Criteria	Domains	Measurement Tools	Performance Indicators to Meet Completion Criteria	Monitoring and Remediation	Timing
FAUNA MANAGEMENT							
Communities and fauna and/or biodiversity may be significantly impacted by clearing, and degradation by weeds and dieback.	8 The site will be left safe for humans and wildlife.	• The disturbed land will be made safe and in compliance with the *Mines Safety and Inspection Act 1994* and DMIRS *Mine Closure Guidelines*.	All domains	Site inspections by company management and as necessary independent auditors.	• Faces and the landform are to comply with DMIRS Guidelines. • Signs will be provided as required. • Fencing will be provided and maintained as required.	• Conduct additional monitoring and weed control.	• At closure of each portion of each Domain and twice annually for a period of 3 years.
STAKEHOLDERS							
The interests of all relevant stakeholders will be considered during operations, closure planning and closure.	12 The interests of all relevant stakeholders will be considered during operations, closure planning and closure.	• The final land surface and rehabilitation comply with Stakeholder requirements.	All domains	• Prior to closure, consult the stakeholders to check whether the closure planning, where possible, considers their interests. • Liaison with stakeholders. • Provide annual reports and closure reports to stakeholders as necessary. • Invite Stakeholders to inspect the closure progress as necessary.	• Verify the closure plan against the Stakeholder interests. • Liaise with Stakeholders to confirm compliance.	• Undertake any action that is necessary to bring the site into compliance. • Repeat as necessary the various steps in the closure planning and revegetation.	• 6 months prior to closure and as required for followup.
	8 The site will be left safe for humans and wildlife.	• The disturbed land will be made safe and in compliance with the *Mines Safety and Inspection Act 1994* and DMIRS *Mine Closure Guidelines*.	All domains	• Site inspections by company management and as necessary independent auditors.	• Faces and the landform are to comply with DMIRS Guidelines. • Signs will be provided as required. • Fencing will be provided and	• Review by company officials and as necessary experienced consultants. • Undertake earthworks as required, to prevent water erosion and treat exposed surfaces with wind breaks, vegetation dust suppression or water to mitigate dust lift off. • Ensure maximum slopes are around	• At closure of each portion of each Domain and annually for a period of 3 years. • After storm

					maintained as required.	1 : 4 vertical to horizontal.	events for up to 3 years until stable.

Government of **Western Australia**
Department of **Mines, Industry Regulation and Safety**

Cutler and Hopkins Road Pits

Geological Survey of Western Australia



The data presented herein are interpreted, and made available in good faith and derived from sources believed to be reliable and accurate at the time of release. You should not solely rely on this information when making a commercial decision.

Recommended Reference for this map is:
Geological Survey of Western Australia 2019, extracted from GeoVIEW.WA. on 22/08/2019
Perth, Western Australia:
Department of Mines, Industry Regulation and Safety.

Scale: 1:18,076

0 0.35 0.7 1.05 1.4 1.75km

GDA 1994 MGA Zone 50 01:10 PM, 22/08/2019

FIGURE 10 LOCATION OF TENEMENTS

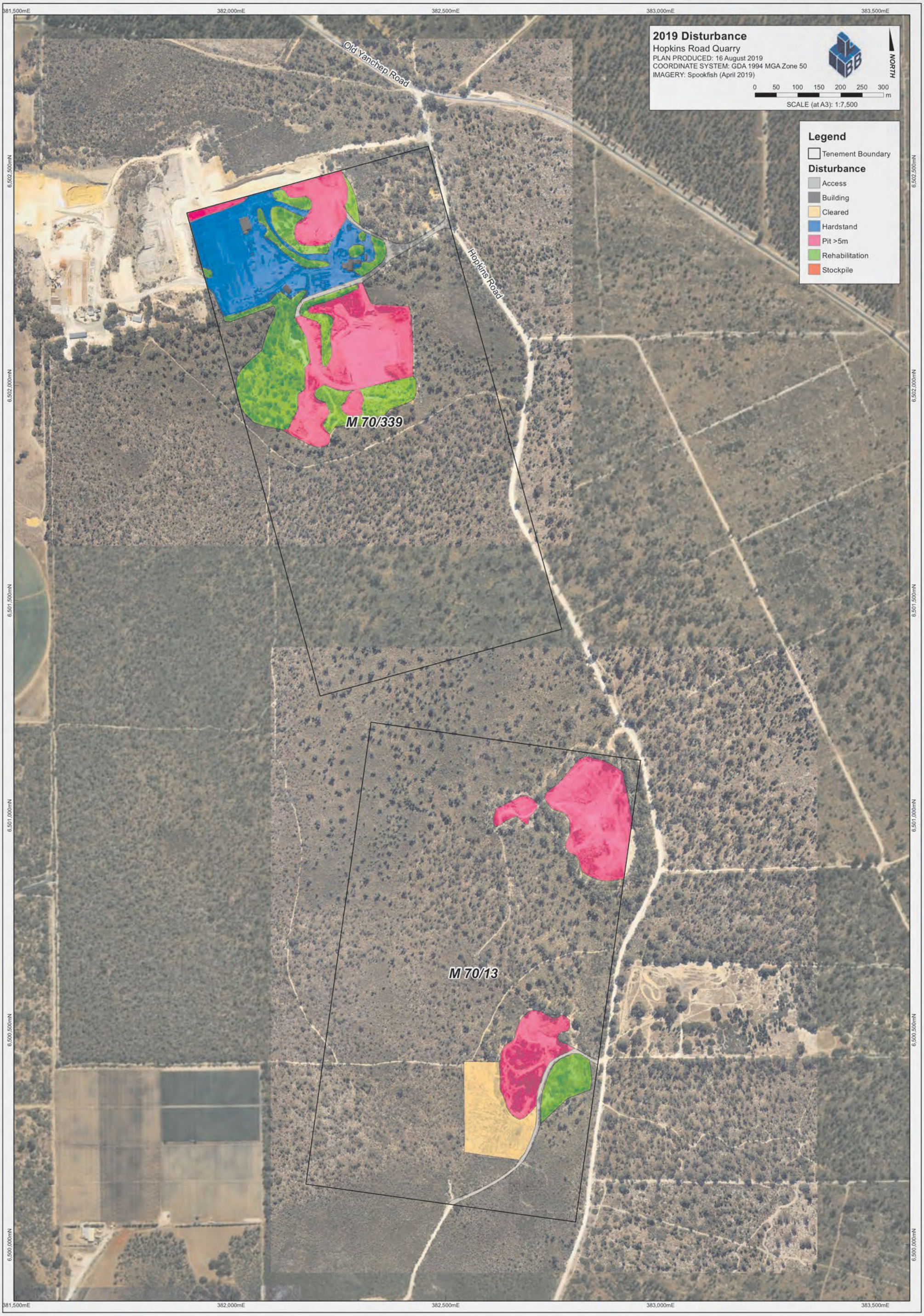
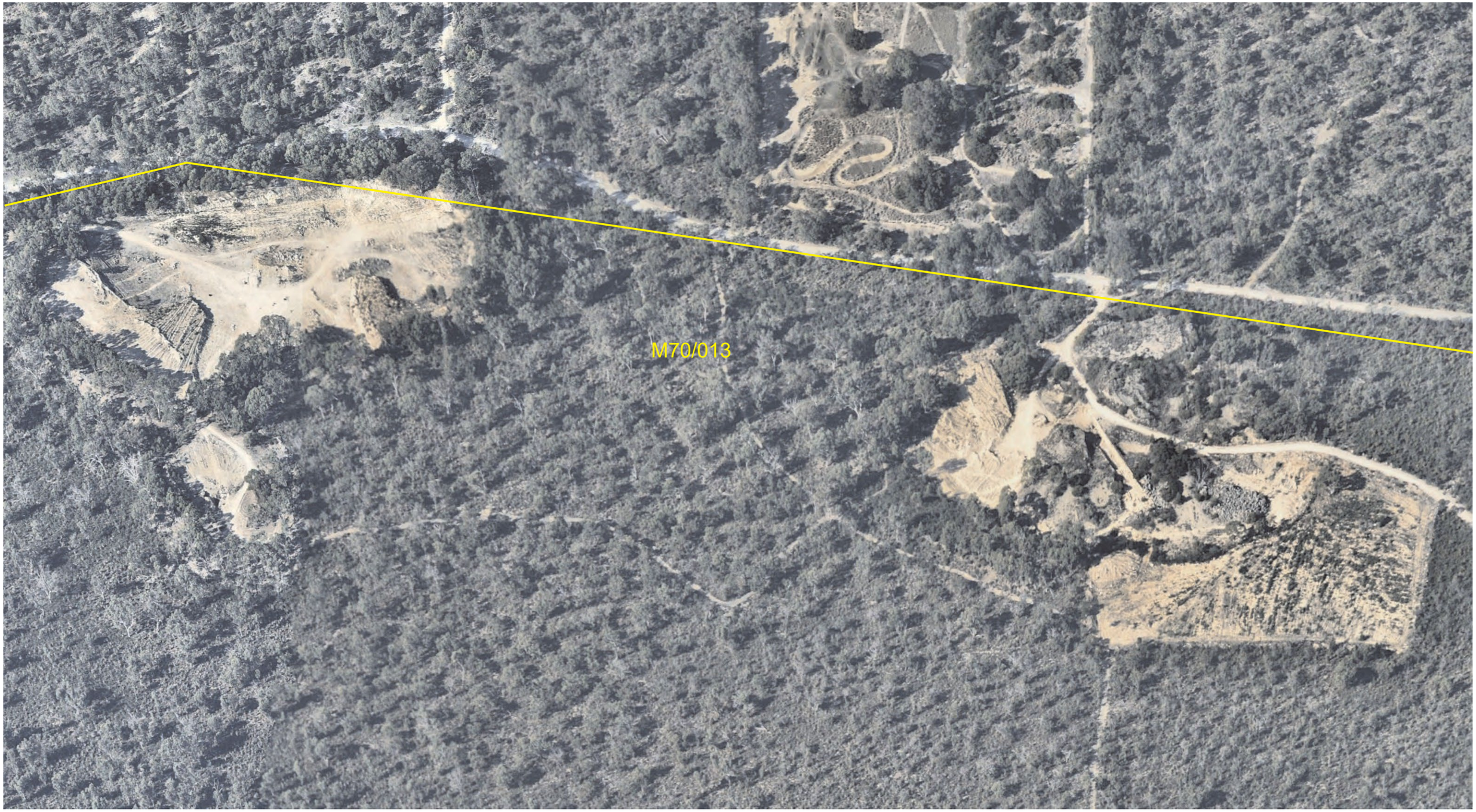


FIGURE 11 DISTURBANCE FOOTPRINTS - M70/013 and M70/339

	Area (Ha)
M 70/109	**7.8567**
Access	0.5377
Building	0.0559
Hardstand	3.8826
Pit >5m	1.7226
Rehabilitation	1.6579
M 70/341	13.5333
Access	**0.7065**
Building	0.0294
Hardstand	1.6948
Pit >5m	3.8975
Rehabilitation	7.2052
M 70/345	**0.6349**
Rehabilitation	0.6349
M 70/346	**0.5885**
Building	0.0623
Hardstand	0.5261
Grand Total	**22.6134**

FIGURE 12 DISTURBANCE FOOTPRINTS - M70/109, M70/341, M70/345 and M70/346

FIGURE 13 OBLIQUE AERIAL PHOTOGRAPH OF THE MAIN OPERATIONS



View east

N

FIGURE 14 OBLIQUE AERIAL PHOTOGRAPH OF THE PITS ON M70/013

Appendix F
Environmental Management Plan

Carabooda Quarry (EPBC 2023/09554)

Environmental Management Plan

Western Environmental Pty Ltd
(08) 6162 8980
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Carabooda Quarry
(EPBC 2023/09554)

Environmental Management Plan

Report No:
A23.020_RPT-EMP_0
Issue Date:
7-Jun-2024
Status
FINAL

Prepared for:
Roger Stephens
301 Spearwood Ave
Bibra Lake, WA

Prepared by
Western Environmental Pty Ltd
Unit 5, 162 Colin Street
West Perth WA 6005
westenv.com.au

Project Details

Project Details	
EPBC Number	EPBC 2023/09554
Project name	Carabooda Quarry Expansion
Proponent/approval holder and ACN or ABN	P.M.R Quarries Pty Ltd (T/A WA Limestone) 08 866 448
Proposed action	Proposed expansion of Carabooda Quarry which requires the clearing of 3.99 ha of native vegetation to facilitate an extension of the existing quarry pit, additional stockpile, storage and laydown areas, and construction of associated quarry infrastructure.
Location of the action	Within M 70/341 on Hopkins Road, Nowergup WA 6032.
Date of Environmental Management Plan preparation	20/06/2024
Person accepting responsibility for the Environmental Management Plan	Roger Stephens

Declaration of Accuracy

In making this declaration, I am aware that section 491 of the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) makes it an offence in certain circumstances to knowingly provide false or misleading information or documents to specified persons who are known to be performing a duty or carrying out a function under the EPBC Act or the *Environment Protection and Biodiversity Conservation Regulations 2000* (Cth). The offence is punishable on conviction by imprisonment or a fine, or both. I am authorised to bind the approval holder to this declaration and that I have no knowledge of that authorisation being revoked at the time of making this declaration.

Signed _____

Full name (please print) _____

Organisation (please print) _____

Date _____/_____/_____

Internal Review/

Author	Reviewed by	Approved by
Hannah Sullivan Senior Consultant	**Shannan Groves** Senior Consultant	**Dale Newsome** Director
5-Jun-2024	**11-Jun-2024**	**18-Jun-2024**

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Scope of Services

This environmental report ("this report") has been prepared for the sole benefit and exclusive use of the Client for the purpose for which it was prepared in accordance with the agreement between the Client and WEPL ("the Agreement"). WEPL disclaims any and all liability with respect to any use of or reliance upon this report for any other purpose whatsoever.

In particular, it should be noted that this report is based on a scope of services defined by the Client, and is limited by budgetary and time constraints, the information supplied by the Client (and its agents) and, in some circumstances, access and/or site disturbance constraints.

Reliance on Data

In preparing this report, WEPL has relied on data, surveys, analyses, designs, plans and other information provided by the Client (or its agents), other individuals and organisations ("the data").

Except as otherwise stated in this report, WEPL has not verified the accuracy or completeness of the data. WEPL does not represent or warrant that the data is true or accurate, and disclaims any and all responsibility or liability with respect to the use of the data.

To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in this report ("conclusions") are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data.

WEPL does not accept any responsibility or liability for any incorrect or inaccurate conclusions should any data be incorrect, inaccurate or incomplete or have been concealed, withheld, misrepresented or otherwise not fully disclosed to WEPL.

The conclusions must also be considered in light of the agreed scope of services (including any constraints or limitation therein) and the methods used to carry out those services, both of which are as stated or referred to in this report.

Environmental Conclusions

In accordance with the scope of services, WEPL has conducted environmental field monitoring and/or testing in the preparation of this report. The nature and extent of monitoring and/or testing conducted is described in this report.

The conclusions are based on the data and the environmental field monitoring and/or testing actually undertaken, and are therefore merely indicative of the environmental condition of the site at the time of preparing this report.

Within the limitations imposed by the scope of services, the monitoring, testing, sampling and preparation of this report have been undertaken and performed in a professional manner, in accordance with generally accepted practices and using a degree of skill and care ordinarily exercised by reputable environmental consultants under similar circumstances. To the maximum extent permitted by law, no other warranty, express or implied, is made.

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Appendices

Appendix A Mine Closure Plan

1. Introduction

1.1 Project Description

P.M.R Quarries Pty Ltd (T/A WA Limestone) proposes to expand the Carabooda Quarry to access and extract limestone and sand resources (the 'proposed action') within M 70/341 on Hopkins Road, Nowergup approximately 40 km north of Perth within the City of Wanneroo (Figure 1). The site is accessed via an access road that runs from Hopkins Road.

The proposed action has a total disturbance footprint of 4.55 ha and includes activities to be undertaken during a construction phase and operational phase. The following activities will be undertaken during the construction phase:

- Clearing of native vegetation.
- Extension of existing quarry pit.
- Designation of stockpile, storage, and laydown areas.
- Construction of associated quarry infrastructure.

The operational phase includes the sequential excavation of limestone and sand resources from the quarry.

Given the early stage of the proposed action, that the proposed expansion has a small footprint and is immediately adjacent to existing quarry activities, a mine layout plan has not been prepared. It is expected that the majority of the site will be used for extraction, and that access, stockpiling, and laydown areas will be defined within the adjacent cleared areas.

The proposed action will necessitate the removal of 3.99 ha of native vegetation and 0.36 ha of highly modified vegetation. The entirety of the disturbance footprint was cleared in approximately 2000, was not quarried, and has since regenerated to its current condition.

The proposed action has the potential to cause direct impacts to the following species protected under the *Biodiversity Conservation Act 2016* (BC Act) and *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act):

- Carnaby's black cockatoo (*Zanda latirostris*): listed as Endangered under the BC Act and EPBC Act.

The proposed action has the potential to cause indirect impacts to the following ecological communities protected under the BC Act and EPBC Act:

- Banksia woodlands of the Swan Coastal Plain ecological community: listed as Priority 3 by the Department of Biodiversity, Conservation and Attractions (DBCA) and Endangered under the EPBC Act.

- Tuart woodlands and forests of the Swan Coastal Plain ecological community: listed as Priority 3 by DBCA and Critically Endangered under the EPBC Act.

1.2 Overview of Activities

Mining activities will be undertaken in accordance with the Mine Closure Plan (MCP) for existing operations of the Carabooda Quarry within M 70/341 (Appendix A). These activities are summarised in Table 1-1.

The site is typically worked by up to 35 personnel, where the operator has radio contact with any vehicles and can be contacted regularly throughout the working day. Most vehicles remain within view of each other. Truck drivers regularly arrive at the site during the working day.

Table 1-1. Summary of Activities

Stage	
Clearing	1. A bulldozer or loader is used to remove any vegetation by pushing it into windrows. 2. Smaller vegetation is track crushed and directly transferred to areas under rehabilitation (when available) to assist soil and habitat generation. The vegetation contains a significant seed source, because of the contained seed on many species. It is also a source of microbial material for soil formation, adds to habitat and assists in managing wind erosion. 3. The vegetation is to be used on the batters to minimise soil erosion and spreading on the final land surface as part of the final rehabilitation. 4. Topsoil is pushed to one side and formed into low storage dumps for later use for rehabilitation using either a loader or bulldozer. Topsoil that is to be stored is located in separate dumps, pushed to the outside of the disturbance area from where it can be spread during the final reconstruction of the land surface. 5. Overburden as yellow and brown sand and low grade limestone is then pushed into bunds and dumps around the perimeter of the disturbance, inside the topsoil bunds, normally by bulldozer. In some locations the dumps and bunds are pushed across low areas to provide flat and level working surfaces. 6. The bunds and dumps can be up to 5 metres high depending on the surrounding landform and security requirements and provide a barrier to define the operations. 7. This bunding is extended along the perimeters to provide screening and assist in security. 8. At the end of excavation the floor of the quarry will be deep ripped, covered by a layer of overburden and top soil and rehabilitated with indigenous tree/shrub species. 9. As noted above, subgrade material not used in reconstituted block manufacture will normally be stored in the bunds around the perimeter of the pit and then used to recontour the completed pit as the first stage of rehabilitation. 10. After mining through of the faces, the final slopes are to be levelled, with some bunds and batters at 1:4 or between 1:6 vertical to horizontal in compliance with the *Mines Safety and Inspection Act 1994* and *Regulations 1995*. 11. The final slopes and land surface will be reviewed in the light of any future changes to the end use and where possible will be formed to that future end use. Rehabilitation will progressively follow mining, with completed areas of the excavation being revegetated as soon as practicable.
Dewatering	No dewatering required.
Excavation	Road base and limestone for reconstituted blocks:

Stage	
	1. Excavation is carried out as a sequence. 2. Where sand overlies the limestone, sand will be taken at this point to expose the limestone. Mostly on site the sand forms overburden and is stored with the overburden. 3. The void to be left at the end of limestone extraction will normally have a flat floor rising gently to natural land surface and bunds at the perimeter of the excavations. 4. During excavation for rubble the limestone is deep ripped with a bulldozer pushing down a sloping face below the elevation of the perimeter bunding. This track rolls and crushes the limestone. 5. Rubble is then pushed into a stockpile from which it is loaded directly into a mobile crushing plant and screening plant. 6. Water is used for dust suppression, to reduce the potential for dust generation from the movement of machinery and the effect of wind. 7. Blasting is not part of the normal operations. 8. Depending on the depth of the resources, the nature and grade of the resources and their thickness, benches may be required to differentiate product and assist safety. <u>Natural Dimension Stone</u>: 1. A bulldozer is used to remove the cap rock and surface limestone, to produce a relatively flat cutting floor of soft limestone. 2. Finally, a grader is used to smooth and level the floor, as flat as possible, to allow the installation of rails and cutting machines. 3. When dimension stone is cut, sections of the floor are lowered by the depth of one block until the whole floor is lowered. The next set of blocks is cut by the re-installation of the rails and cutting machines on the lowered floor and the process repeated. This method of excavation means that the cutting floor is gradually lowered below the land surface. The cutting saws are electric, using air cooling for the blades. 4. Water is used for dust suppression, to reduce the potential for dust generation from the movement of machinery and the effect of wind. 5. All static and other equipment such as cutting machines, are located on the floor of the quarry or screened by earth bunds where possible to provide visual and acoustic screening. There is currently no proposal to change the location of the existing facilities on site.
Processing	<u>Limestone products:</u> 1. A mobile plant is used to prepare limestone rubble for raw feed for use in the manufacture of reconstituted blocks. 2. The crushing plant will normally consist of a mobile crusher together with screens and stackers to sort the products into various sizes. The units fit together linked by conveyors. 3. The crusher is fed by a loader, which collects the raw materials from the face and also loads road trucks. 4. The mobile plant is located on the floor of the pit, some 5 - 10 metres below natural ground level. 5. All crushers, screens and stockpiles are to be equipped with water sprays, sprayed, enclosed or the stockpiles wetted down depending on the nature of the materials to be processed. This is the same management as for the approved extractive industry. 6. A limestone batching plant with associated hoppers is located on M70/339 to produce mix for the reconstituted limestone blocks with a second plant on M70/109. 7. At times a small amount of natural laterite gravel is introduced to the limestone blocks to change the colour of the blocks to a more brown colour to better match the soils in hills locations or for landscaping. <u>Sand:</u>

Stage	
	1. Sand is not normally screened but is when required to be of a particular grade and will be screened on the floor of the pit.
Stockpiles	1. The only stockpiles are limestone and other materials waiting to be used, and the stored reconstituted blocks waiting for shipment. 2. Stockpiles are located in the active working area on excavated ground and, like the excavation, will move across the site as excavation progresses. 3. A rubber tyred loader or bobcat is be used to load each road truck.
Tailings Storage	1. There are no tailings. All limestone is used in the reconstituted blocks. Broken and subgrade blocks are broken up and added to the manufacture of new blocks. 2. Any limestone or sand that is not of suitable grade is used to restore the land surface for rehabilitation.

1.3 Approvals Context

The proposed action was referred under the *Environment Protection and Biodiversity Act 1999* (EPBC Act) (EPBC 2023/09554) as Not a Controlled Action. The clock is currently stopped on the referral decision, with information having been requested to inform the Minister's decision.

The proposed action also requires approval under Part V Division 2 of the *Environmental Protection Act 1986* (EP Act). If the proposed action is determined to be a Controlled Action under the EPBC Act, WA Limestone seeks to have the proposed action assessed under the accredited assessment process under Part V Division 2 of the EP Act.

1.4 Purpose and Scope

The purpose of this Environmental Management Plan (EMP) is to describe how the proposed action will be implemented, in both its construction and operational phases, to avoid and mitigate potential direct, indirect and cumulative environmental impacts. The EMP will mitigate impacts to matters protected under both State and Commonwealth legislation.

1.5 Objectives

The objectives of this EMP are as follows:

- Avoid indirect impacts to the patches of Banksia woodlands of the Swan Coastal Plain and Tuart woodlands and forests of the Swan Coastal Plain that occur within 10 m of the proposed action.
- Minimise the risk of dust emissions, erosion and sedimentation, and contamination arising from the proposed action.
- Avoid adverse impacts to groundwater from the proposed action.
- Avoid adverse impacts arising from improper stormwater management.

Figure 1. Location of the Proposed Action

2. Existing Environment

2.1 Soil Systems and Topography

The site forms part of the Karrakatta system. Two soil landscape units have been mapped within the site (DPIRD-027) which are shown in Figure 2 and described as:

- Karrakatta shallow soils phase (211Sp_Kls): Low hills and ridges. Bare limestone or shallow siliceous or calcareous sand over limestone. Dense low shrub dominated by *Dryandra sessilis* (now *Banksia sessilis*), *Melaleuca huegellii* and species of Grevillea.
- Karrakatta sand yellow phase (211Sp_Ky): Low hilly to gently undulating terrain. Yellow sand over limestone at 1-2 m. *Banksia* spp. woodland with scattered emergent *Eucalyptus gomphocephala* and *E. marginata* and a dense shrub layer.

The site slopes downward from the southwest to the northeast, ranging from 56 m Australian Height Datum (AHD) to 68 m AHD (DPIRD-072) as shown on Figure 2.

The site is not at risk of Acid Sulfate Soils (ASS) occurrence.

2.2 Hydrology

2.2.1 Wetlands and Surface Water Features

There are no wetlands or surface water features mapped within or adjacent to the site.

2.2.2 Ground Water

Groundwater lies at approximately 34 to 47 m AHD, which is around 20 to 22 m below the ground surface (DWER, 2023) as shown on Figure 3. Groundwater flows generally towards the west.

Based on Davidson (1995), the average percentage of rain recharge to groundwater per unit area (rounded to nearest whole number) is between 2% and 12%, depending on the measure. Groundwater recharge rates are detailed in Table 2-1.

Table 2-1. Groundwater Recharge Rates Relevant to the Site (adapted from Davidson, 1995)

Measure of Recharge	Description	Value for Gnangara Mound (South) at 40 m AHD
T_R	Total recharge as a percentage of rainfall	12%
L_{DR}	Leakage down as a percentage of rainfall	2%
N_R	Net throughflow as a percentage of rainfall	10%

Figure 2. Soils and Topography

Figure 3. Groundwater and topography

2.3 Flora and Vegetation

2.3.1 Desktop Information

Perth is located within the Swan Coastal Plan Bioregion. The Swan Coastal Plain region is a low lying coastal plain, mainly covered with woodlands. It is dominated by Banksia or Tuart on sandy soils, *Casuarina obesa* on outwash plains, and paperbark in swampy areas. In the east, the plain rises to duricrusted Mesozoic sediments dominated by Jarrah woodland. The climate is Warm Mediterranean. Three phases of marine sand dune development provide relief. The outwash plains, once dominated by *C. obesa*-Marri woodlands and Melaleuca shrublands, are extensive only in the south.

The proposed action itself is located in the Perth subregion, which is composed of colluvial and aeolian sands, alluvial river flats, coastal limestone. Heath and/or Tuart woodlands on limestone, Banksia and Jarrah-Banksia woodlands on Quaternary marine dunes of various ages, Marri on colluvial and alluvial. Includes a complex series of seasonal wetlands and also includes Rottnest, Carnac and Garden Islands. Rainfall ranges between 600 and 1000 mm annually and the climate is Mediterranean.

Vegetation Complexes are a broad level of vegetation description which is based on the underlying geomorphology and rainfall. The areas of remnant native vegetation on the site are part of the Cottesloe Complex– Central and South vegetation complex (Att. F, Figure 6) which is described as:

- Mosaic of woodland of (Tuart) and open *Eucalyptus gomphocephala* forest of– *E. gomphocephala*, *E. marginata* (Jarrah) – *Corymbia calophylla* (Marri), closed heath on the limestone outcrops.

2.3.2 Vegetation Units

A flora and vegetation survey was undertaken by PGV (2021). One native vegetation unit was described within the area to be impacted by the proposed action as shown on Figure 4:

- BsXp: *Banksia sessilis* / *Xanthorrhoea preissii* Tall Open Scrub over *Melaleuca systena* / *Hakea lissocarpha* Open Shrubland over *Jacksonia sericea* / *Hibbertia hypericoides* Low Open Shrubland.

An area of highly disturbed vegetation was also recorded within the site, referred to as 'Rehabilitation'.

Two TECs occur in the area of vegetation to the north and east of the site, as shown on Figure 4:

- Banksia Woodlands of the Swan Coastal Plain TEC (Endangered).
- Tuart Woodlands and Forests of the Swan Coastal Plain TEC (Critically Endangered).

2.3.3 Vegetation Condition

Vegetation within the site was assessed to be in 'Degraded' to 'Good' condition. Vegetation condition within the site is poorer than in the areas surrounding, as all vegetation was previously cleared in the year 2000 and

has since regenerated. Weed cover within the site is therefore higher than in surrounding areas which range from Good to Excellent condition.

2.4 Fauna

A fauna habitat assessment was undertaken by Bamford Consulting Ecologists (2022).

The site provides 3.63 ha of suitable foraging habitat for Carnaby's black cockatoo (*Zanda latirostris*) which is listed as Endangered under the BC Act and EPBC Act. All of the mapped foraging habitat was assessed as high quality, given the density of *Banksia sessilis* which is a mainstay of the species' diet. Carnaby's black cockatoo habitat within and adjacent to the site is shown on Figure 5.

Figure 4. Vegetation Types, Condition and Threatened Ecological Communities

Figure 5. Black Cockatoo Habitat

3. Roles, Responsibilities, and Reporting

3.1 Environmental Management Roles and Responsibilities

The roles and responsibilities for delivering this EMP are outlined in Table 3-1.

Table 3-1. Roles and Responsibilities

Role	Responsibilities
Quarry Manager	Responsible for ensuring adequate resources are available to implement the requirements of this EMP. They are also responsible for assisting with the development and implementation of training, inspections monitoring and reporting, and internal and external reporting of environmental performance, incident response and notifications.
Site Supervisor	The Site Supervisor is responsible for environmental performance and compliance for the proposed action. Specific responsibilities include management of site works, ensuring employees and contractors are competent on the basis of training, education, and experience; ensure processes and resourcing are in place to implement this EMP; and report any incidents or non-compliances to the Quarry Manager. The Site Supervisor is responsible for the implementation of the EMP. They are also responsible for ensuring all personnel are suitably trained, conducting site inspections of environmental controls and reporting of environmental performance.
Environmental Advisor	The Environmental Advisor is to assist with the implementation of the EMP. They are also responsible for assisting with community complaints/ inquiries, developing and reviewing environmental induction/training materials and conducting site inspections and audits.
Employees and Contractors	Employees and contractors would be required to complete project and site inductions and must attend all environmental training and toolbox meetings. Contractors are required to report any activity which has resulted, or has the potential to result, in an environmental incident.
Contractor Ecologist	Undertake pre-clearance ecological surveys and supervise vegetation clearing in accordance with the requirements of this EMP.

3.2 Reporting

The proposed action has been referred under the EPBC Act as Not a Controlled Action and will require the approval of a native vegetation clearing permit under Part V Division 2 of the EP Act. It is anticipated that approval under the EP Act (and under the EPBC Act in the event that the proposed action is determined to be a Controlled Action) will include conditions relating to the implementation of and adherence to this EMP. As such, ongoing monitoring and reporting against this EMP will be undertaken in accordance with those conditions.

3.3 Environmental Training

All employees, contractors and utility staff working on site must undergo site induction training relating to the management of environmental risks. The induction training will address the following:

- The requirements of this EMP.
- Applicable legislation, approvals, and decisions under the EP Act and EPBC Act.
- Specific Threatened and Priority fauna species likely to occur within and surrounding the proposed action.
- Specific Threatened and Priority ecological communities adjacent to the proposed action.
- Approved clearing boundaries (including areas designated for stockpiles and laydown).
- General flora and fauna management measures for clearance activities, including fauna rescue and egress requirements.
- Responsibilities for weed and disease control.
- Groundwater monitoring requirements.
- Erosion and sediment control measures and locations.
- Presentation of mapping and data to illustrate areas of environmental significance.

Records of training will be maintained and include the following:

- Name of person receiving the training.
- Name of the trainer.
- Date of training.
- Summary of training provided.

3.4 Emergency Contacts and Procedures

In the event of an environmental emergency (e.g. injury to a listed Threatened or Priority species) all works that have the potential to cause further harm must cease and the Site Supervisor must be contacted immediately.

Any environmental incidents with the potential to cause material harm will be reported in accordance with WA Limestone's Heath, Safety, Environment and Quality (HSEQ) Management System Reporting requirements.

Internal site telephone lists will be kept up to date for the reporting of emergencies to the appropriate site personnel. Personnel will have the power to stop and direct works. The site emergency management plan

will cover more detailed information regarding emergency contacts outside of WA Limestone, should the need arise. Emergency contacts are specified in Table 3-2.

Table 3-2. Emergency Contacts for Carabooda Quarry

Role	Name	Contact Information
Quarry Manager	Joe Concei	0405 365 643 Joe.c@walimestone.com
Alternate Manager	Peter Della Bona	0414 335 620 Peter.db@walimestone.com

4. Potential Environmental Impacts and Risks

4.1 Preliminary Risk Assessment

A preliminary (pre-mitigation) risk assessment was undertaken to determine the potential impacts of the proposed action in accordance with AS ISO 31000:2018 Risk management - Guidelines and DCCEEW (2024) *Environmental Management Plan Guidelines* and DWER (2017) *Guideline: Risk Assessments*.

The risk assessment was undertaken in terms of the likelihood and consequence using the criteria in Table 4-1 and Table 4-2.

Table 4-1. Measure and Description of Likelihood

Qualitative Measure of Likelihood	Description of Likelihood
Highly likely (5)	Is expected to occur in most circumstances.
Likely (4)	Will probably occur during the life of the project.
Possible (3)	Might occur during the life of the project.
Unlikely (2)	Could occur but considered unlikely or doubtful.
Rare (1)	May occur in exceptional circumstances.

Table 4-2. Measure and Description of Consequence

Qualitative Measure of Consequences	Description of Consequence
Minor (1)	Minor incident of environmental damage that can be reversed.
Moderate (2)	Isolated but substantial instances of environmental damage that could be reversed with intensive efforts.
High (3)	Substantial instances of environmental damage that could be reversed with intensive efforts.
Major (4)	Major loss of environmental amenity and real danger of continuing.
Critical (5)	Severe widespread loss of environmental amenity and irrecoverable environmental damage.

The risk assessment matrix (Table 4-3) was then used to determine the environmental risk rating for the proposed action. In each case, a score of 1 to 5 was applied for the likelihood and consequence of impact, with the sum of the scores used to determine the environmental risk. The resulting risk ratings are described in Table 4-4.

Table 4-3. Risk Assessment Matrix

Likelihood	Consequence				
	Minor (1)	Moderate (2)	High (3)	Major (4)	Critical (5)
Highly Likely (5)	Medium (6)	High (7)	High (8)	Extreme (9)	Extreme (10)
Likely (4)	Low (5)	Medium (6)	High (7)	High (8)	Extreme (9)
Possible (3)	Low (4)	Medium (5)	Medium (6)	High (7)	Extreme (8)
Unlikely (2)	Low (3)	Low (4)	Medium (5)	High (6)	High (7)
Rare (1)	Low (2)	Low (3)	Low (4)	Medium (5)	High (6)

Table 4-4. Risk Rating

Risk Rating	Description
Low	Risks that are below the risk acceptance threshold and do not require active management. Certain risks could require additional monitoring.
Moderate	Risks that lie on the risk acceptance threshold and require active monitoring. The implementation of additional measures could be used to reduce the risk further.
High	Risks that exceed the risk acceptance threshold and require proactive management. Includes risk for which proactive actions have been taken, but further risk reduction is impractical.
Extreme	Risks that will are not acceptable.

Table 4-5 provides the preliminary risk rating for each potential impact, prior to the application of management measures.

Table 4-5. Preliminary Risk Rating (Without Mitigation)

Potential Impact	Likelihood	Consequence	Risk Rating
Direct impacts to flora, vegetation and fauna during clearing activities.	4	3	7 (High)
Indirect impacts to retained ecological communities during mining operations.	4	3	7 (High)
Adverse impact to surface water quality and risk of erosion and sedimentation.	3	3	6 (High)
Uncontrolled dust emissions from clearing, excavation, processing and transport	4	3	7 (High)
Off-site impacts from unmanaged noise, vibration and light emissions	3	2	5 (Medium)

4.2 Environmental Management Measures

4.2.1 Pre-Clearance Procedure

Prior to the clearing of vegetation for the proposed action, the following measures will be implemented to prevent clearing or damage to vegetation outside of the disturbance footprint, and minimise the risk of direct impacts to fauna:

- Quarry Manager to review electronic mapping of the disturbance footprint and the flora, vegetation and fauna habitat features in the surrounding area to be retained.
- Ensure all personnel (Employees and Contractors) have been trained in environmental risks prior to clearing activities commencing (as detailed in section 3.3).
- Ensure that areas approved for clearing and ground disturbance are communicated to all personnel (GPS coordinates and hard copy) prior to clearing commencing.
- Clearing boundaries marked on site using either temporary fencing or flagging tape at no greater than 30 m intervals.
- Ensure that significant vegetation (Banksia TEC and Tuart TEC) adjacent to the disturbance footprint are clearly demarcated using red and yellow tape or temporary fencing, signposted, and are avoided during all ground disturbance activities. This demarcation must persist for the duration of construction and operation.
- Clearly demarcate tracks suitable for vehicles to ensure there is no unauthorised off-road vehicle movement. Vehicles and machinery must only use designated tracks and roads within the area to be cleared.
- Weed risk areas will be highlighted on plans so that weed-infested topsoil can be stockpiled separately.

The following measures will be implemented prior to and during vegetation clearing to minimise the risk of direct impacts to fauna by clearing activities:

- Pre-clearance surveys (via trapping) for Quenda will be undertaken for the purpose of avoiding direct impacts to the species. Trapping will be undertaken for one night immediately prior to vegetation clearing with a potential of four traps per hectare, evenly distributed.
- Pre-clearance walk throughs shall be undertaken to identify and displace any fauna present prior to clearing. The walk throughs shall be undertaken in the morning prior to clearing commencing, to displace individuals. Refugia sites shall be checked to minimise the presence of any fauna species within the clearing boundary.

4.2.2 Vegetation Clearance Procedure

The Quarry Manager or authorised delegate shall ensure that the following clearing procedure is complied with:

- An approved Environmental Supervisor must be present on site during all clearing activities.
- Monitor clearing activities daily to ensure proper management and compliance.
- Clearing will be undertaken progressively from the existing quarry moving towards the retained vegetation to allow maximum opportunity for any fauna present to move into adjacent vegetation.
- Clearing should not be undertaken where adverse weather conditions would result in significant topsoil losses to wind or water erosion.
- Dust management activities as required throughout clearing, with sufficient water carts on site to manage dust emissions.
- Cleared vegetation will be stockpiled in rows adjacent to topsoil stockpiles in a manner that allows for easy re-distribution during rehabilitation. Weed and/or pathogen-impacted topsoil will be stockpiled separately for disposal.
- Ensure all machinery and vehicles that arrive on site have been thoroughly cleaned down and are free of all soil, debris, and vegetative material. Vehicles or equipment that arrives on site not in clean condition shall be turned away from site.
- If a sick or injured animal is found, the Environmental Supervisor shall be contacted who will attend to the scene. Sick or injured wildlife shall be taken to an approved wildlife rehabilitation centre.
- Maintain a fauna interaction register to capture observations, interactions with, and injury to fauna.

4.2.3 Post-Clearance Procedure

Following the completion of clearing for the proposed action, ongoing measures will be undertaken to avoid and minimise the risk of impacts to Banksia TEC, Tuart TEC, and conservation significant fauna during ongoing quarry operations. These measures include:

- Update mapping to reflect on-site conditions post-clearing and identify flora, vegetation and fauna habitat features requiring ongoing protection and preservation. Mapping must then be made available to the Site Supervisor for provision to personnel as required.
- Fencing established as part of the pre-clearance procedure is to remain in place for the duration of mining operations to ensure adequate protection from overburden and stockpile creation.

- Ongoing monitoring of retained vegetation, recording any change in vegetation condition and any weed or pathogen infestations.
- Undertake periodic weed spraying if required, using qualified bush regeneration contractors. The risk of weed introduction or spread will be minimised through the measures identified in section 4.2.4.
- Minimise the risk of *Phythophthora* dieback introduction or spread through the measures identified in section 4.2.4.
- If a sick or injured animal is found, the Environmental Supervisor shall be contacted who will attend to the scene. Sick or injured wildlife shall be taken to an approved wildlife rehabilitation centre.
- Maintain a fauna interaction register to capture observations, interactions with, and injury to fauna.
- In the event that fauna relocation is required (e.g. removing from trenches/excavations to avoid harm to the animal), the action shall be undertaken by a trained and licenced person under the BC Act.
- Install fauna egress no steeper than 2:1 on any open excavation/trench to minimise the risk of entrapment. If a trench is more than 100 m long, egress (e.g. ramps or nets) must be installed every 100 m.
- Undertake twice daily trench/excavation inspections for entrapped fauna within 3 hours of sunrise and between 3-6 pm. Open lengths of trenches must not exceed the length that can be inspected and cleared within the required timeframes.
- Install fauna egress in any open water storage areas, and any water in open trenches shall be pumped out in the event of significant rainfall.
- Ensure open excavations are covered, fenced, or bunded to prevent injury to fauna.
- Ensure that no poison baiting of feral animals such as rodents is undertaken without the express permission of the Environmental Supervisor and in accordance with specified conditions.

4.2.4 Weed and Pathogen Management

The risk of weed and/or pathogen introduction or spread to areas of adjacent vegetation (including Banksia TEC and Tuart TEC) will be minimised by implementing the following procedure:

- Identify any weed and/or pathogens during annual vegetation monitoring.
- Implement erosion and sediment controls identified in section 4.2.5.
- Provide boot and vehicle wash down facilities in areas where the transport of weeds and/or pathogens is identified as a risk.

- Ensure vehicles and footwear are free of soil and vegetative material before entering or exiting the site (i.e. direct to wash down area before entering or exiting the site).
- Ensure plants, soil, or fill brought into the site are from certified weed-free sources.
- Quarantine any infected material for disposal to an approved landfill facility.

4.2.5 Erosion, Sediment, and Surface Water Management

Erosion and sedimentation will be managed through the construction of sediment dams. Given the permeability of limestone, the local area is not prone to flooding and the pit is internally draining. Bunding will be installed alongside retained vegetation to ensure sediment runoff is contained and does not impact the surrounding Banksia TEC and Tuart TEC. Routine inspections will be undertaken to ensure the sedimentation basins and bunding are providing effective treatment during overflow conditions.

The following measures will be implemented for the duration of construction and operation of the proposed action:

- Design, install, and manage surface water diversion structures to enable non-contaminated water to be directed around disturbance and construction areas.
- Ensure all bunds have sufficient capacity so that contaminated water is not released to the environment during a rainfall event.
- Ensure that potentially contaminated storm water (e.g. runoff that contains hydrocarbons) is not discharged to the environment, and that any contaminated water is captured in sediment basins or bunds and is settled out or treated prior to discharge to the environment.
- Ensure that no works or structures cause obstructions to the free flow of drainage lines in rainfall events.
- Stockpiles will incorporate stormwater diversion and sediment controls.
- Ensure that equipment servicing is undertaken in designated areas that have been confirmed as being acceptable by the Environmental Supervisor.
- Access road runoff will pass through site-specific sediment controls, using a combination of bunding and sediment fencing. Dity water drains will include sediment controls and will be either:
    - Lined with geofabric or jute mesh.
    - Seeded and stabilised.
    - Controlled via the use of rock checks or sandbags.

- All truck loads will be covered to minimise dust generation and road spillages.

4.2.6 Dust Management

Ambient dust levels will be monitored across the proposed action area as part of environmental monitoring requirements. To ensure dust does not have an adverse impact on retained vegetation or create safety/occupational health hazards, the following measures will be implemented:

- Implement dust suppression activities (water trucks) on unsealed roads and access tracks, cleared areas, locations of high dust risk (e.g. cutting machines), and where dust generation is visible.
- The licensed bore on site will be used to source water for dust suppression.
- All dust suppressants must be approved by the Site Supervisor prior to use.
- Stockpiles will be hydromulched to avoid dust emissions.
- Comply with site Traffic Management Plan, including vehicle speed limits on haul roads and at work sites. Speed limits will be reduced where necessary to minimise dust emissions.
- Ensure vehicles remain within designated roads and formed tracks, and park only in allocated areas.

4.2.7 Groundwater Management

Groundwater is situated between 20 m and 22 m beneath the site and is confined to the underlying sand and limestone with high vertical and lateral transmissivity. Mining will be undertaken to a depth of 10 m and, as such, will remain at least 10 m above the water table. Approximately 10% of rainfall is expected to recharge to groundwater, as detailed in Table 2-1.

Limestone and sand excavation does not affect the quality of water in the shallow groundwater system, because the only chemicals used are regular fuels and lubricants. This is recognised by the WA Department of Water and Environmental Regulation (DWER) who, under Water Quality Protection Note No. 15, permit extractive industries in Priority 1 Groundwater Areas (DWER, 2019).

Given that excavation will remain at least 10 m above the water table, and that limestone extraction does not affect groundwater quality, there is a low risk of groundwater impacts resulting from the proposed action (Table 4-5). As such, a groundwater monitoring plan is not proposed.

To ensure there are no indirect impacts to groundwater as a result of the proposed action, the following measures will be implemented:

- Drainage infrastructure is to be designed so rainfall runoff is directed towards sumps where it can be adequately contained.

- Containment sumps shall be of sufficient capacity and design to withstand significant rainfall, as determined during the design process.

- Vegetation monitoring of areas adjacent to dust suppression activities will be carried out by the Environmental Supervisor and any evidence of impact will be reported as an environmental incident.

4.2.8 Noise and Vibration Management

Indirect impacts from noise and vibration are expected to be minor, given the proposed action is an expansion of the existing quarry rather than a change in land use. The following will be implemented to ensure potential noise and vibration impacts are managed appropriately:

- Conduct all operations in accordance with the *Environmental Protection (Noise) Regulations 1997*, Australian Standard 2436-1981: Guide to noise control on construction, maintenance and demolition sites, and all relevant occupational health and safety standards.

- Ensure that equipment is fitted with appropriate noise reduction devices (where necessary) to comply with regulatory requirements.

4.2.9 Light Emissions Management

Indirect impacts from light emissions are expected to be minor, given that the proposed action is an expansion of the existing quarry rather than a change in land use. The following will be implemented to ensure potential impacts from light emissions are managed appropriately:

- Operating hours will be between 6am to 5pm, requiring minimal use of artificial lighting.

- Position lights to directly focus on the intended target.

- Minimise light spill without impacting on the legal requirement to provide a safe working environment.

- Use lighting with beam characteristics applicable to the specific task at hand.

- Switch off lighting that is deemed not essential to personnel safety, when not in use.

- Ensure that lighting is not directed outwards into surrounding vegetation to minimise indirect impacts to fauna therein.

4.3 Post-Mitigation Risk Assessment

Following the implementation of the measures described in section 4.2, a post-mitigation risk assessment was undertaken. A summary of the post-mitigation risk assessment and management actions for each key

environmental factor is provided in Table 4-6. Then, Table 4-7 summarises the residual risk rating for each potential impact following the application of management measures.

The management objectives for all actions are to:

- Avoid direct impacts to retained vegetation adjacent to the proposed action which contains Banksia TEC, Tuart TEC, and habitat for conservation significant fauna.
- Minimise the risk of direct impacts to conservation significant fauna during construction and operation from, for example, collision with machinery or vehicles, becoming trapped in excavations.
- Minimise the risk of indirect impacts to Banksia TEC and Tuart TEC via changes by avoiding changes to abiotic conditions such as surface water and groundwater quality and quantity.

Table 4-6. Risk Assessment and Management

Management Action(s)	Timeframe	Residual Risk			Trigger Value and Detection	Corrective Action(s)
		L	C	R		
Direct and indirect impacts to flora, vegetation, fauna and ecological communities						
Quarry Manager to review electronic mapping of the disturbance footprint and the flora, vegetation and fauna habitat features in the surrounding area to be retained.	Pre-clearing	1	3	4	Environmental values and clearing extent not adequately communicated to site personnel prior to clearing.	Review of mapping to be undertaken immediately.
Ensure all personnel (Employees and Contractors) have been trained in environmental risks prior to clearing activities commencing (as detailed in section 3.3).	Pre-clearing	1	3	4	Personnel present on site who have not undertaken training in environmental risks. Register of staff/contractor training to be kept at site office and reviewed regularly.	Any non-compliances are recorded and kept at the site office. Personnel to undertake training as soon as possible.
Ensure that areas approved for clearing and ground disturbance are communicated to all personnel (GPS coordinates and hard copy) prior to clearing commencing.	Pre-clearing	1	3	4	Environmental values and clearing extent not adequately communicated to site personnel prior to clearing.	Extent of clearing boundary to be communicated immediately.
Clearing boundaries marked on site using either temporary fencing or flagging tape at no greater than 30 m intervals.	Pre-clearing	2	3	5	Insufficient fencing/flagging of clearing boundary identified during pre-clearing inspection.	Implement correct fencing/flagging prior to clearing commencing.
Ensure that significant vegetation (Banksia TEC and Tuart TEC) adjacent to the disturbance footprint are clearly demarcated using red and yellow tape, signposted, and are avoided during all ground disturbance activities. This demarcation must persist for the duration of construction and operation.	Pre-clearing	2	3	5	Insufficient demarcation of Banksia TEC and Tuart TEC adjacent to the disturbance footprint identified during pre-clearing inspection.	Implement correct taping prior to clearing commencing.
Clearly demarcate tracks suitable for vehicles to ensure there is no unauthorised off-road vehicle movement. Vehicles and machinery must only use designated tracks and roads within the area to be cleared.	Pre-clearing	2	3	5	Tracks suitable for vehicles not clearly demarcated, identified through observation of vehicles using inappropriate tracks.	Additional signage to direct vehicles to appropriate tracks.
Weed risk areas will be highlighted on plans so that weed-infested topsoil can be stockpiled separately.	Pre-clearing	2	3	5	Weed risk areas not highlighted and communicated to personnel.	Weed-infested areas marked on plans immediately and communicated to clearing personnel prior to clearing.
Pre-clearance surveys (via trapping) for Quenda will be undertaken for the purpose of avoiding direct impacts to the species. Trapping will be undertaken for one night immediately prior to vegetation clearing with a potential of four traps per hectare, evenly distributed.	Pre-clearing	2	3	5	Pre-clearance survey not undertaken with sufficient effort and/or improper evidence provided.	Pre-clearance survey to be undertaken prior to clearing commencing, with adequate records provided.
Pre-clearance walk throughs shall be undertaken to identify and displace any fauna present prior to clearing. The walk throughs shall be undertaken in the morning prior to clearing commencing, to displace individuals. Refugia sites shall be checked to minimise the presence of any fauna species within the clearing boundary.	Pre-clearing	2	3	5	Pre-clearance site walkover not completed and/or improper evidence provided.	Pre-clearance walkover to be undertaken prior to clearing commencing, with adequate records provided.
An approved Environmental Supervisor must be present on site during all clearing activities to monitor clearing activities and ensure proper management and compliance.	During clearing	1	3	4	Environmental Supervisor is absent during clearing.	Appointment of an approved Environmental Supervisor to be on site throughout clearing activities.
Clearing will be undertaken progressively from the existing quarry moving towards the retained vegetation to allow maximum opportunity for any fauna present to move into adjacent vegetation.	During clearing	2	3	5	Inappropriate clearing activities that do not provide adequate opportunity for fauna to move away from machinery and vegetation. To be raised by the Environmental Supervisor during clearing.	• Site meeting to remind clearing personnel of appropriate clearing activities. • Clearing to recommence at the existing quarry and moving towards retained vegetation.

Management Action(s)	Timeframe	Residual Risk			Trigger Value and Detection	Corrective Action(s)
		L	C	R		
Clearing should not be undertaken where adverse weather conditions would result in significant topsoil losses to wind or water erosion.	During clearing	1	3	4	Bureau of Meteorology indicates excessive winds or rainfall.	Clearing activities to hold until forecast wind and/or rainfall are below identified thresholds.
Ensure vehicles remain within designated roads and formed tracks, and park only in allocated areas.	Construction and operation	1	3	4	Vehicles parked in unauthorised locations.	Refresher training for relevant personnel. If retained vegetation is damaged by vehicles, vegetation is to be reinstated immediately. Any damage to vegetation will be reported through compliance reporting.
Cleared vegetation will be stockpiled in rows adjacent to topsoil stockpiles in a manner that allows for easy re-distribution during rehabilitation. Weed and/or pathogen-impacted topsoil will be stockpiled separately for disposal.	During clearing	2	3	5	Observation of non-contaminated stockpiles stored without adequate separation or bunding to protect from those designated for disposal.	In the event that topsoil stockpiles may have been contaminated, a precautionary approach shall be taken and the affected topsoil disposed of.
Ensure all machinery and vehicles that arrive on site have been thoroughly cleaned down and are free of all soil, debris, and vegetative material. Vehicles or equipment that arrives on site not in clean condition shall be turned away from site.	During clearing	2	3	5	Vehicles entering/leaving site without adequate cleaning.	Vehicles to be re-directed to clean down bays. Machinery or equipment may be turned away from site if heavily contaminated.
If a sick or injured animal is found, the Environmental Supervisor shall be contacted who will attend to the scene. Sick or injured wildlife shall be taken to an approved wildlife rehabilitation centre.	During clearing	2	3	5	Improper recording of fauna observations, injury or mortality. Improper adherence to site management protocols and environmental training.	Wildlife Rehabilitation Centre contacted in the event of injury or mortality. Review cause of injury or mortality, and revise site management protocols accordingly. Any non-compliances to be recorded and kept at the site office.
Maintain a fauna interaction register to capture observations, interactions with, and injury to fauna.	During clearing	2	3	5		
Update mapping to reflect on-site conditions post-clearing and identify flora, vegetation and fauna habitat features requiring ongoing protection and preservation. Mapping must then be made available to the Site Supervisor for provision to personnel as required.	Post-clearing	2	3	5	Identify and confirm any damage to vegetation outside of approved clearing boundary during post-clearing inspection.	If works have encroached on any fenced/flagged areas it is to be reinstated. Report as part of compliance reporting in accordance with approval conditions.
Maintain fencing established during pre-clearance procedure to provide a physical barrier between mining operations and adjacent Banksia TEC and Tuart TEC.	Construction and operation	2	3	5	Identify any areas where fencing has been damaged or is ineffective	Re-instate or repair damaged or ineffective portion of fence.
Ongoing monitoring of retained vegetation, recording any change in vegetation condition and any weed or pathogen infestations.	Construction and operation	2	3	5	Any reduction in vegetation condition to be recorded.	Review efficacy of mitigation measures, and increase physical controls as required (e.g. height of bunding, fencing). Report as part of compliance reporting in accordance with approval conditions.
If a sick or injured animal is found, the Environmental Supervisor shall be contacted who will attend to the scene. Sick or injured wildlife shall be taken to an approved wildlife rehabilitation centre.	Construction and operation	2	3	5	Improper recording of fauna observations, injury or mortality. Improper adherence to site management protocols and environmental training. Handling by personnel not trained and licenced under the BC Act.	Wildlife Rehabilitation Centre contacted in the event of injury or mortality. Review cause of injury or mortality, and revise site management protocols accordingly. Any non-compliances to be recorded and kept at the site office.
Maintain a fauna interaction register to capture observations, interactions with, and injury to fauna.	Construction and operation	2	3	5		
In the event that fauna relocation is required (e.g. removing from trenches/excavations to avoid harm to the animal), the action shall be undertaken by a trained and licenced person under the BC Act.	Construction and operation	2	3	5		

Management Action(s)	Timeframe	Residual Risk			Trigger Value and Detection	Corrective Action(s)
		L	C	R		
Install fauna egress no steeper than 2:1 on any open excavation/trench to minimise the risk of fauna becoming trapped. If a trench is more than 100 m long, egress (e.g. ramps or nets) must be installed every 100 m.	Construction and operation	2	3	5	Regular (daily) inspections of any excavations to identify any insufficient fauna egress, trapped fauna, waterlogging, or improper covering or bunding.	Any trapped fauna to be observed, but not handled, by untrained personnel. Licenced fauna handler to remove trapped fauna, record the incident in fauna interaction register, and refer to Wildlife Rehabilitation Centre/personnel in the event the animal is injured, displaced, or orphaned.
Undertake twice daily trench/excavation inspections for entrapped fauna within 3 hours of sunrise and between 3-6 pm. Open lengths of trenches must not exceed the length that can be inspected and cleared within the required timeframes.	Construction and operation	2	3	5		
Install fauna egress in any open water storage areas, and any water in open trenches shall be pumped out in the event of significant rainfall.	Construction and operation	2	3	5		
Ensure open excavations are covered, fenced, or bunded to prevent injury to fauna.	Construction and operation	2	3	5		
Ensure that no poison baiting of feral animals such as rodents is undertaken without the express permission of the Environmental Supervisor and in accordance with specified conditions.	Construction and operation	1	3	4	Any approved baiting or poisoning of feral animals is to occur, records must be maintained.	Unapproved baiting or positioning must be ceased upon discovery and recorded as an environmental incident.
Identify any weed and/or pathogens during annual vegetation monitoring, and undertake weed control (spot spraying, hand removal) as required.	Construction and operation	2	3	5	Weed invasion into retained vegetation adjacent to the proposed action detected through monitoring.	Weed control (hand weeding or spot spraying) to be undertaken through experienced bush regeneration contractors.
Provide boot and vehicle wash down facilities in areas where the transport of weeds and/or pathogens is identified as a risk.	Construction and operation	2	3	5	Wash down facilities absent from areas identified to carry risk of weed/pathogen spread. Vehicles, machinery or personnel bypassing washdown facilities.	Vehicles to be turned away from site unless clean or directed to wash down facilities. Non-compliance records to be kept at site office.
Ensure vehicles and footwear are free of soil and vegetative material before entering or exiting the site (i.e. direct to wash down area before entering or exiting the site).	Construction and operation	2	3	5		
Ensure plants, soil, or fill brought into the site are from certified weed-free sources.	Construction and operation	2	3	5	Evidence of weed-free sources not provided.	Review of supplier to ensure weed-free certification. Non-compliance records to be kept at site office.
Adverse impacts to surface water quality and risk of erosion and sedimentation						
Design, install, and manage surface water diversion structures to enable non-contaminated water to be directed around disturbed and construction areas.	Construction	1	3	4	Stormwater and/or sediment observed to be tracking off-site.	Maintain/install controls to sufficient capacity. Investigate water quality exceedance to determine cause and install additional controls if required. Vegetation monitoring of areas adjacent to dust suppression activities will be carried out by the Environmental Supervisor and any evidence of impact will be reported as an environmental incident.
Ensure all bunds have sufficient capacity so that contaminated water is not released to the environment during a rainfall event.	Construction	1	3	4		
Ensure that potentially contaminated storm water (e.g. runoff that contains hydrocarbons) is not discharged to the environment, and that any contaminated water is captured in sediment basins or bunds and is settled out or treated prior to discharge to the environment.	Construction and operation	1	3	4		
Ensure that no works or structures cause obstructions to the free flow of drainage lines in rainfall events.	Construction and operation	1	3	4		
Stockpiles will incorporate stormwater diversion and sediment controls.	Construction and operation	1	3	4		
Access road runoff will pass through site-specific sediment controls, using a combination of bunding and sediment fencing. Dity water drains will include sediment controls and will be either:	Construction and operation	1	3			

Management Action(s)	Timeframe	Residual Risk			Trigger Value and Detection	Corrective Action(s)
		L	C	R		
○ Lined with geofabric or jute mesh. ○ Seeded and stabilised. ○ Controlled via the use of rock checks or sandbags.						
Ensure that equipment servicing is undertaken in designated areas that have been confirmed as being acceptable by the Environmental Supervisor.	Construction and operation	1	3	4	Equipment servicing or refuelling observed outside of approved areas.	Raise at toolbox meetings to ensure all staff and contractors are aware of environmental risks. Relevant personnel to be directed to take refresher training if required. Report non-compliance in records held at site office.
Uncontrolled dust emissions from clearing, excavation, processing and transport						
All truck loads will be covered to minimise dust generation and road spillages.	Construction and operation	1	3	4	Sediment discharges observed from uncovered trucks or road spillages.	Raise at toolbox meetings to ensure all staff and contractors are aware of environmental risks. Relevant personnel to be directed to take refresher training if required. Report non-compliance in records held at site office.
Implement dust suppression activities (water trucks) on unsealed roads and access tracks, cleared areas, locations of high dust risk (e.g. cutting machines), and where dust generation is visible.	Construction and operation	1	3	4	Uncontrolled dust emissions observed.	Implement dust suppression as detailed in this EMP across high-risk areas using water trucks. Review the location/source of inappropriate dust emissions and revise site procedures accordingly to incorporate dust suppression at those locations.
Apply hydromulch to stockpiles.	Construction and operation	1	3	4		Re-instate hydromulch over any areas that have become damaged and allowing dust emissions. Introduce regular spraying of stockpiles as required.
Comply with site Traffic Management Plan, including vehicle speed limits on haul roads and at work sites. Speed limits will be reduced where necessary to minimise dust emissions.	Construction and operation	1	3	4	Vehicles exceeding speed limits.	Refresher training for relevant personnel. Non-compliance records to be held at site office.
Off-site impacts from unmanaged noise, vibration and light emissions						
Conduct all operations in accordance with the *Environmental Protection (Noise) Regulations 1997*, Australian Standard 2436-1981: Guide to noise control on construction, maintenance and demolition sites, and all relevant occupational health and safety standards.	Construction and operation	1	2	3	Exceedance of noise regulations recorded on site or by adjacent land users.	Complaints register to be maintained. Corrective actions shall be dependent on equipment/machinery causing the exceedance.
Operating hours will be between 6am to 5pm**.**	Construction and operation	1	2	3		
Ensure that equipment is fitted with appropriate noise reduction devices (where necessary) to comply with regulatory requirements.	Construction and operation	1	2	3		
Position lights to directly focus on the intended target.	Construction and operation	1	2	3	Inappropriate light emissions observed off-site.	Complaints register to be maintained. Corrective actions shall be dependent on the equipment/machinery causing the inappropriate light emissions.
Minimise light spill without impacting on the legal requirement to provide a safe working environment.	Construction and operation	1	2	3		
Use lighting with beam characteristics applicable to the specific task at hand.	Construction and operation	1	2	3		
Switch off lighting that is deemed not essential to personnel safety, when not in use.	Construction and operation	1	2	3		
Ensure that lighting is not directed outwards into surrounding vegetation to minimise indirect impacts to fauna therein.	Construction and operation	1	2	3		

Table 4-7. Residual Risk Rating

Potential Impact	Likelihood	Consequence	Risk Rating
Direct impacts to flora, vegetation and fauna during clearing activities.	2	3	5 (Medium)
Indirect impacts to retained ecological communities during mining operations.	1	3	4 (Low)
Adverse impact to surface water quality and risk of erosion and sedimentation.	1	3	4 (Low)
Uncontrolled dust emissions from clearing, excavation, processing and transport	1	3	4 (Low)
Off-site impacts from unmanaged noise, vibration and light emissions	1	2	3 (Low)

5. Monitoring and Review

Weekly inspections shall be undertaken prior to, during, and immediately after clearing to ensure compliance with the measures detailed in section 4.2.1 to 4.2.3. The inspections will be undertaken by the appointed Environmental Supervisor.

General environmental inspections (including for erosion and sediment control) will be undertaken on a weekly basis during construction and following heavy rainfall events. The general environmental inspections will cover:

- Vegetation management, fencing, and weed incursion.
- Erosion and sediment controls.
- Fencing and access.
- Soil and stockpile management.

Monitoring will consider the performance indicators and trigger values that apply to each environmental risk, as summarised in Table 5-1.

Table 5-1. Key Performance Indicators and Trigger Values

Risk	Performance Indicator	Trigger Value
Adverse impacts to flora, vegetation and fauna.	• Confirm nil impact to vegetation outside of approved clearing boundary. • Confirm minimal impact to fauna during clearing activities. • Confirm minimal impact to fauna during operation.	• Limit of clearing not fenced appropriately. • Environmental Supervisor not present during clearing. • Clearing activities not undertaken progressively from existing quarry towards adjacent retained vegetation. • Injured fauna not reported, handled by trained and licenced person, and referred to Wildlife Rehabilitation.
Adverse impacts to ecological communities.	• Confirm weed control and disposal • Confirm appropriate segregation, inspection and removal of vegetation within the approved clearing boundary. • Confirm pathogen control.	• Weed invasion into retained vegetation adjacent to the proposed action. • Weed-contaminated stockpiles not disposed of at approved landfill facility. • Avoidable damage to retained Banksia TEC and Tuart TEC through improper vehicle management. • Introduction of *Phytophthora* dieback into the area.

Risk	Performance Indicator	Trigger Value
Adverse impact to surface water quality and risk of erosion and sedimentation.	• Confirm minimal impact to surface water flow as a result of the proposed action. • Confirm minimal erosion and mobilisation of sediment off-site.	• Identification of sediment having tracked off-site towards retained vegetation.
Uncontrolled dust emissions from clearing, excavation, processing and transport.	• Dust suppression implemented across all high-risk operations during clearing and quarrying resulting in no excessive, visible dust emissions.	• Excessive dust emissions observed within the site.
Off-site impacts from unmanaged noise, vibration and light emissions.	• Minimal impact to fauna and other sensitive adjacent land uses through unmanaged light emissions.	• Excessive light emissions observed within the site.

As detailed in Table 4-6, where corrective actions are required, the relevant mitigation measures will be reviewed for their efficacy. Should these measures be found to provide inadequate environmental protection, they shall be revised and this EMP shall be updated.

6. References

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