



mainroads
WESTERN AUSTRALIA

EPBC 2016/7656 Annual Compliance Report

Great Northern Highway Upgrade Stage 2:
Muceha to Wubin – Muceha North

21 September 2019 – 21 September 2020

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Revision Number	Revision Date	Description of Key Changes	Section / Page No.
1	24/08/2020	Draft for internal review	N/A
2	25/08/2020	Final for publication	N/A

1 INTRODUCTION

Great Northern Highway forms part of the National Highway Network and provides a strategic freight link between Perth and the State's north, as well as Darwin and the Northern Territory. Between 2000 and 2009, Stage One of the Great Northern Highway Muchea to Wubin Upgrade project was completed, which saw 76 km of the highway upgraded to National Highway standard.

In 2014 a comprehensive planning review was undertaken of the full Muchea to Wubin link along the highway. A series of construction packages were prioritised following the review, which included town bypasses, wider roads, more passing lanes, flattening crests and easing curves, safer roadsides, more rest stops and additional facilities for heavy vehicles.

Jointly funded by the Australian and Western Australian Governments, the \$384.8 million project will improve road safety, increase freight efficiency and reduce traffic delays, improve travel times and access, improve roadside amenities, and enhance the environmental value of roadsides.

The key objectives for the project include:

- Improved safety
- Increased freight efficiency and reduced traffic delays
- Improved network reliability - improving travel times and enhancing network access
- Enhanced travel wellbeing - improvements in roadside amenities for rest and driver information
- Contribution to sustainable and viable communities - by balancing community concerns, economic, community safety and network access issues
- Enhancement of the environment - by undertaking practices to retain and improve the environmental value of roadsides.

1.1 Approval under the Environment Protection and Biodiversity Conservation Act 1999

Proposed construction of the Muchea North (Old Gingin Road to Chittering Roadhouse) package was referred to the then Department of the Environment and Energy (DoEE; 'the Department') now termed the Department of Agriculture, Water and the Environment (DAWE) for assessment under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The referral was determined to be a Controlled Action with the controlling provision being "listed threatened species and communities"—namely, Carnaby's Cockatoo (*Calyptorhynchus latirostris*) and the Star Sun-orchid (*Thelymitra stellata*). The referred works were assessed through Preliminary Documentation. The Department issued conditional approval for these works to proceed on 10 August 2018 (EPBC 2016/7656).

1.1.1 Purpose of this Report

Construction of the Action commenced on 21 September 2018. This compliance report has been produced as required by Condition 12 of EPBC approval 2016/7656. Table 1 of this report outlines the compliance with each condition of approval over the 12-month period between 21 September 2019 and 21 September 2020.

Implementation of the Action has not yet been completed, hence reporting will continue annually under Condition 12 of EPBC 2016/7656.

2 COMPLIANCE

Condition No.	Condition	Status
1	The approval holder must not clear more than 52.5 hectares of Carnaby's Black Cockatoo habitat within the project area and can only clear up to six of the hollows identified as 'hollow with evidence of use' and up to eight of the hollows identified as 'suitable hollows', in Attachment 1.	Compliant. 3.11 ha of Carnaby's Cockatoo habitat; 0 hollows identified as 'hollow with evidence of use'; and 0 hollows identified as 'suitable hollows' have been cleared between 21 September 2019 and 21 September 2020 (Attachment 1).
2	To mitigate impacts to the Carnaby's Black Cockatoo, the approval holder must undertake all efforts to avoid clearing the known nesting hollow and suitable nesting hollow identified in Attachment 2. Within one month of the completion of clearing, the approval holder must provide the Department with evidence that these hollows have not been cleared or a detailed assessment of why clearing of these hollows could not be avoided.	Compliant. The suitable nesting hollows and known nesting hollows identified in Attachment 2 have not been cleared, as confirmed to the Department in an email on 11 April 2019 (Attachment 2).
3	Within 7 days prior to clearing of any area of Carnaby's Black Cockatoo habitat, the approval holder must investigate and document all potential nesting trees within the area to be cleared to determine if there are any hollows that are being utilised, or are capable of being utilised, by the Carnaby's Black Cockatoos for nesting. The investigation must be undertaken by a suitably qualified person.	Compliant. All potential nesting trees within the approved area to be cleared were investigated no more than 7 days prior to each clearing event (Attachment 3). Survey and clearing commencement dates are summarised as follows: <ul style="list-style-type: none"> • Inspection on 19 September 2018 • Clearing on 21 September 2018 • Inspection on 1 March 2019 • Clearing on 8 March 2019

Condition No.	Condition	Status
	<p>a. If any Carnaby's Black Cockatoo(s) is detected utilising any hollow in any tree, the approval holder must:</p> <ul style="list-style-type: none"> i. clearly identify and mark the identified nesting tree ii. maintain a register of nesting trees iii. only clear the identified nesting tree and vegetation within a 10 metre radius of the tree, if a suitably qualified person has verified that the hollow in the tree are no longer being used by the Carnaby's Black Cockatoo iv. record the location of any known nesting hollow or suitable nesting hollow, identified during the investigations, that are additional to the nesting hollows identified in Attachment 1. 	<p>Fauna specialists (Evan Webb and Colleen McDonald of 360 Environmental Pty Ltd) were commissioned by the Contractor (WBHO) to undertake a pre-clearing assessment. A report was provided which is included as Attachment 3 which addresses all the requirements of this Condition. Appendix A of that report provides the information required to demonstrate the appropriate qualifications of the fauna specialists engaged and confirmation that they meet the definition of 'suitably qualified person'.</p> <p>The report provided as evidence in Attachment 3 demonstrates that no clearing of any black cockatoo nesting tree identified as being utilised by a black cockatoo was cleared until it was confirmed that any chick(s) had fledged the hollow. A summary register of how these trees have been managed has been provided as part of Attachment 3 for ease of reference.</p>
4	<p>To mitigate and offset the loss of known nesting hollows and suitable nesting hollow the approval holder must:</p> <ul style="list-style-type: none"> a. install at least three artificial nesting hollows for each known nesting hollow and suitable nesting hollow cleared b. install at least ten of the artificial nesting hollows required by Condition 4.a prior to the clearing of any known nesting hollow or suitable nesting hollow with all remaining hollows to be installed prior to the beginning of the next breeding 	<p>Compliant.</p> <ul style="list-style-type: none"> a. A total of 13 trees with either known or suitable nesting hollows were cleared. Thirty-nine (39) artificial nest boxes (Cockatubes®, fabricated by Landcare Serpentine Jarrahdale) have been installed at locations as provided in the Evidence of Installation Record attached as part of Attachment 4. An artificial nest box register has been maintained, which is also provided in Attachment 4. b. As above c. Main Roads WA commissioned Phoenix Environmental to undertake baseline monitoring of confirmed and suitable nesting hollows recorded within the Muceha North EPBC Act Approval Boundary and wider baseline survey study area. The initial baseline monitoring program was conducted in the 2017-

Condition No.	Condition	Status
	<p>season following the commencement of the action.</p> <ul style="list-style-type: none"> c. maintain the pre-impact breeding density of the Carnaby's Black Cockatoo within the project area by undertaking adaptive management of the artificial nesting hollows to maximise the likelihood that the installed artificial nesting hollows are used by the Carnaby's Black Cockatoo d. adaptive management may cease when at least one artificial nesting hollow for each known nesting hollow cleared has shown evidence of use by the Carnaby's Black Cockatoo, as verified by the suitable qualified person, for three consecutive years; the artificial nesting hollow in use for three consecutive years need not be the same artificial nesting hollow each year e. if after nine years from commencement of the action the outcome identified in Condition 4.d is not met, the approval holder must <ul style="list-style-type: none"> i. submit to the Minister for approval the details of an offset that meets the requirements of the EPBC Environmental Offsets Policy and will compensate for the permanent loss of known Carnaby's Black Cockatoo breeding hollows 	<p>2018 breeding season (August 2017 – February 2018) and assessed hollow usage of suitable nesting hollows and hollows with evidence of use within the study area. Phoenix was subsequently commissioned to undertake a second and third year of monitoring for hollow usage within the study area in the 2018-2019 and 2019-2020 breeding seasons respectively. The 2019-2020 report (Attachment 4) incorporates the results of the third monitoring season into the nesting hollow usage dataset for Muchea North.</p> <ul style="list-style-type: none"> d. The required period of three consecutive years has not yet been achieved. e. Not applicable for the 2019-2020 reporting period. f. Main Roads commissioned Phoenix Environmental Sciences to undertake the required monitoring as provided in Attachment 4.

Condition No.	Condition	Status
	<ul style="list-style-type: none"> ii. submit to the Department a detailed assessment of the factors that cause the failure to achieve the outcome identified in Condition 4.d f. Each artificial nesting hollow installed must: <ul style="list-style-type: none"> i. be inspected at least twice a year by a suitably qualified person during the peak breeding season to record any evidence of use by the Carnaby's Black Cockatoo and to identify any maintenance requirements ii. be monitored and maintained in accordance with relevant artificial hollow guidance for the life of the approval, with maintenance actions, if required, undertaken outside of the breeding season and before the commencement of the next breeding season iii. not be installed in a manner that requires additional clearing of Carnaby's Black Cockatoo habitat or within 10 metres of the edge of the road seal to reduce the risk of vehicle strike. 	

Condition No.	Condition	Status
5	For the purposes of Condition 4, the maximum number of hollows to be cleared that are additional to the hollows identified in Attachment 1 must not exceed four and at least half of all artificial nesting hollows installed must be installed within 500 m of the project area.	<p>Compliant.</p> <p>A total of thirteen trees were felled as part of the clearing activities, therefore not exceeding the number of trees identified in Attachment 1. Evidence of this is provided in Attachment 3.</p> <p>Thirty four (34) of the thirty nine (39) artificial nesting hollows have been installed within 500 m of the project area (Attachment 5).</p>
6	All data, enquiries and findings of the monitoring required by Condition 4 must be provided to the Department, DBCA and published on the approval holder's website to contribute to broader research into the use of artificial nesting hollows by the Carnaby's Black Cockatoo. Publication must occur within one year of the environmental outcome identified in Condition 4.d being achieved or after nine years from the commencement of the action if the environment outcome is not met by that time.	<p>Not applicable.</p> <p>A time period of one year from the outcome identified in Condition 4.d has not yet been reached.</p>
7	To mitigate impacts to the Carnaby's Black Cockatoo, the approval holder must revegetate at least 19.69 hectares of land with species that are known to provide foraging and breeding habitat for the Carbaby's Black Cockatoo, in the area identified in Attachment 3. The objective of revegetation works is to re-establish a self-sustaining vegetation cover, integrate with the surrounding ecosystem, which provides Carnaby's Black Cockatoo habitat.	<p>Compliant.</p> <ul style="list-style-type: none"> a. Initial revegetation activities commenced on 20 August 2019, approximately 11 months after commencement of the action. Revegetation activities occurred again between 1 June 2020 and 1 July 2020. See Attachment 6 for details of these revegetation activities. b. No flora species identified as Carnaby's Black Cockatoo habitat have or will be planted within 10 metres of the edge of the road seal. Attachment 6 contains a list of all species planted (page 5). c. The most recent revegetation event ceased on 1 July 2020. The success of these activities has yet to be assessed and verified as to whether the completion criteria have been achieved. Revegetation monitoring will occur

Condition No.	Condition	Status
	<p>The approval holder must adhere to the following during all revegetation works:</p> <ul style="list-style-type: none"> a. revegetation must begin within one year of commencement of the action and must have commenced within all the areas identified for revegetation in Attachment 3, within one year of the completion of construction b. flora species identified as Carnaby's Black Cockatoo habitat must not be planted within 10 metres of the edge of the road seal to reduce the risk of vehicle strike c. revegetation works may cease once a suitably qualified person has verified that the revegetated areas meet the completion criteria d. once the completion criteria have been achieved, all areas of revegetation must be inspected once every 2 years, during Spring, for at least a further 20 years to ensure the completion criteria are being maintained e. undertaken corrective actions to improve vegetation quality within the revegetated areas, within 3 months of becoming aware that an area of revegetation no longer meets the completion criteria; corrective actions may cease once the completion criteria have again been achieved. 	<p>annually to assess the status of the revegetation against the required completion criteria.</p> <ul style="list-style-type: none"> d. As above for 7c. e. Completion criteria have yet to be assessed.

Condition No.	Condition	Status
8	<p>To mitigate impacts to the Carnaby's Black Cockatoo, the approval holder must prepare and submit a <i>Construction Environmental Management Plan</i> (CEMP) for the approval of the Minister. The approval holder must not commence the action unless the Minister has approved the CEMP. The approved CEMP must be implemented.</p> <p>The CEMP must be prepared in accordance with the Department's Environmental Management Plan Guidelines and include, but not be limited to:</p> <ul style="list-style-type: none"> a. design principles and practices to minimise clearing of Carnaby's Black Cockatoo habitat – for example, road micro-alignment, traffic management alternatives to side roads b. measures to prevent impacts to Carnaby's Black Cockatoo habitat during construction, including to: <ul style="list-style-type: none"> i. prevent and/or control site access, weeds, <i>Phytophthora</i> dieback, erosion, dust and fire ii. delineate vegetation to be retained through, for example, the erection of temporary fencing or signage to avoid accidental clearing or disturbance outside of the impact area 	<p>Compliant.</p> <p>The Minister approved the CEMP on 5 September 2018 (Attachment 7) and the action commenced on 21 September 2019. Main Roads has implemented the approved CEMP.</p>

Condition No.	Condition	Status
	<ul style="list-style-type: none"> c. management measures, including in relation to fencing and access controls, to permanently restrict access to adjacent road reserves d. objectives, targets and completion criteria for post construction rehabilitation measures such as site clean-up and weed management, including information on the mapping, monitoring and removal of noxious weeds e. objectives and targets for landscaping and revegetation works required by Condition 7, including details on site preparation works, seeding planting programs, success rates, ongoing management post establishment and details of replanting requirements if success rates are not achieved f. clear objectives and performance indicators for all management actions, mitigation measures and practices prescribed by the CEMP including details of the monitoring to be undertaken to demonstrate the effectiveness of the measures g. corrective actions for circumstances where an action, mitigation measure or practice prescribed by the CEMP fails to meet, or is unlikely to meet, its prescribed objectives, and trigger action points at which these corrective actions will be implemented 	

Condition No.	Condition	Status
	h. timeframes for implementing the above measures.	
9	To compensate for the loss of up to 52.5 hectares of foraging habitat, and 744 potential breeding trees for the Carnaby's Black Cockatoo the approval holder must, within one year after the commencement of the action, provide the Department with the offset attributes, shapefiles and textual descriptions and maps to clearing define the location and boundaries of the Ippolo Road Offset and Banovich Road Offset, that the approval holder has transferred to the DBCA.	<p>Compliant.</p> <p>Main Roads provided a letter and information to the Department on 12 November 2018 to satisfy the requirements of this Condition. Please see Attachment 8 for a copy of the letter and associated information as follows:</p> <ul style="list-style-type: none"> • Offset attributes table, Shapefile and map defining the location and boundary of the offset area • A textual description of the offset property including relevant figure and biological surveys.
10	Within 30 days after the commencement of the action, the approval holder must advise the Department in writing of the actual date of commencement.	<p>Compliant.</p> <p>The action commenced on 21 September 2018, with written notification provided to the Department by email on 27 September 2018 (Attachment 9).</p>
11	The approval holder must maintain accurate records substantiating all activities associated with or relevant to the conditions of approval, including measures taken to implement the plan required by this approval (Condition 8), and make them available upon request to the Department. Such records may be subject to audit by the Department or an independent auditor in accordance with section 458 of the EPBC Act or used to verify compliance with the conditions of this approval. Summaries of audits will be posted on the Department's website. The results of audits may also be publicised through the general media.	<p>Compliant.</p> <p>Main Roads has maintained records in accordance with this condition and their legal obligations under the <i>WA State Records Act 2000</i>.</p>

Condition No.	Condition	Status
12	<p>Within three months of every 12 month anniversary of the commencement of the action, the approval holder must publish a report on their website addressing compliance with each of the conditions of this approval, including implementation of any management plans as specified in the conditions.</p> <p>Documentary evidence providing proof of the date of publication and non-compliance with any of the conditions of this approval must be provided to the Department at the same time as the compliance report is published. Reports must remain on the website for the life of this approval. The approval holder must continue to comply with this condition until such time as agreed to in writing by the Minister.</p>	<p>Compliant.</p> <p>This 2018/2019 Compliance Assessment Report will be published on the Main Roads website at the same time as the provision of this report to the Department.</p> <p>This is the first Compliance Assessment Report for this approval.</p>
13	<p>Upon the direction of the Minister, the approval holder must ensure that an independent audit of compliance with the conditions of approval is conducted and a report submitted to the Minister. The independent auditor must be approved by the Minister prior to the commencement of the audit. Audit criteria must be agreed to by the Minister and the audit report must address the criteria to the satisfaction of the Minister.</p>	<p>Not applicable.</p> <p>The Minister has not yet directed Main Roads to conduct an independent audit of compliance with EPBC 2016/7761's conditions of approval.</p>
14	<p>The approval holder may choose to revise a management plan approved by the Minister under Condition 8 without submitting it for approval under section 143A of the EPBC Act, if the taking of the action in accordance with the revised plan would not be likely to have a new</p>	<p>Compliant.</p> <p>The approved CEMP was revised on 25 October 2018. An email was sent to the Department including a letter outlining the differences between the approved and revised plan, the reasons for the revision and an electronic copy of the revised plan. Please see Attachment 10 for a copy of this letter.</p>

Condition No.	Condition	Status
	<p>or increased impact. If the approval holder makes this choice they must notify the Department in writing that the approved plan has been revised and provide the Department, at least four weeks before implementing the revised plan, with:</p> <ul style="list-style-type: none"> a. an electronic copy of the revised plan; b. an explanation of the differences between the revised plan and the approved plan; and c. the reasons the approval holder considers that taking the action in accordance with the revised plan would not be likely to have a new or increased impact. 	
15	<p>The approval holder may revoke their choice under Condition 14 at any time by notice to the Department. If the approval holder revokes the choice to implement a revised plan, without approval under section 143A of the Act, the plan approved by the Minister must be implemented.</p>	<p>Not applicable.</p> <p>Main Roads has not elected to revoke their choice under Condition 14.</p>
16	<p>If the Minister gives a notice to the approval holder that the Minister is satisfied that the taking of the action in accordance with the revised plan would be likely to have a new or increased impact, then:</p> <ul style="list-style-type: none"> a. Condition 14 does not apply, or ceases to apply, in relation to the revised plan; and 	<p>Not applicable.</p> <p>No notice from the Minister was received in relation the CEMP amended in accordance with Condition 14.</p>

Condition No.	Condition	Status
	<p>b. The approval holder must implement the plan approved by the Minister.</p> <p>To avoid any doubt, this condition does not affect any operation of Conditions 14 and 15 in the period before the day the notice is given.</p>	
17	<p>Conditions 14, 15 and 16 are not intended to limit the operation of section 143A of the EPBC Act which allows the approval holder to submit a revised plan to the Minister for approval.</p>	<p>Compliant.</p> <p>A revised CEMP was provided to the Department as per Condition 14 above.</p>
18	<p>Unless otherwise agreed to in writing by the Minister, the approval holder must publish all management plans referred to in these conditions of approval on their website for the duration of this approval. Each management plan must be published on the website within 1 month of being approved by the Minister or being submitted under Condition 12 and must remain on the website for the life of this approval.</p>	<p>Compliant.</p> <p>The approved CEMP was first published on Main Roads' website on 2 October 2018. The plan is available here: https://project.mainroads.wa.gov.au/home/gnhmucheatowubin/Pages/enviro.aspx</p>

3 ATTACHMENTS

Attachment	Title
Attachment 1	Carnaby's Black Cockatoo habitat and hollows clearing
Attachment 2	Memo and Cover email closing out Condition 2
Attachment 3	Reports for inspection of potential Carnaby's Black Cockatoo nesting trees before clearing & Summary Register
Attachment 4	Artificial nest box installation evidence (including artificial nest box register and results of nest box baseline monitoring)
Attachment 5	Artificial nest box installation locations
Attachment 6	Revegetation plans and species lists
Attachment 7	Ministerial approval of the CEMP
Attachment 8	Notification to the Department of offset properties
Attachment 9	Notification of commencement of action
Attachment 10	Notification to the Department of CEMP revision

Attachment 1: Carnaby's Black Cockatoo habitat and Trees with suitable hollows clearing



Legend

- Cleared Carnaby's Black Cockatoo Habitat
- EPBC Approval Boundary
- Locality
- Freeway / Highway
- Major Road
- Minor Road
- GNH Road Centreline (H006)
- GNH Design Alignment

Data Source: Main Roads WA, Landgate

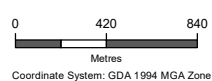


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Great Northern Highway
Muecha to Wubin Upgrade Stage 2

Location of Carnaby's Black Cockatoo Habitat cleared between 21 September 2019 and 21 September 2020

Drawing No: GNH-CN03-EN01-GIS-0111 Issue: A

Task No: GNH-XXX Drawing Status / Other: Final

Date	By	Chkd	Appd
24/08/2020	JR	GJ	GJ

Attachment 2: Memo and Cover email closing out Condition 2

Jones, Grace

From: BAETGE Marni (EO) <marni.baetge@mainroads.wa.gov.au>
Sent: Thursday, 11 April 2019 10:25 AM
To: 'Post Approval'
Cc: 'epbcmonitoring@environment.gov.au'; BRAID John (PEO); Davies, Jonathan; Jones, Grace
Subject: [EXTERNAL] EPBC 2016/7656 Condition 2 Close-out
Attachments: EPBC 2016-7656 Condition 2 Closure.pdf

Hello Post Approvals,

Please find attached memo summarising closure of EPBC 2016/7656 Condition 2.

Thanks, Marni

Marni Baetge

ENVIRONMENT OFFICER

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Western Australia.*



	Great Northern Highway - Muchea to Wubin Upgrade - Stage 2			
	Memorandum (MEM)			
	Doc No.	GNH-CN0X-PM01-MEM-000X	Rev	1

Contract No. & Work Identifier:	CN01-EN01	Client Contract No.:	187/15	Date:	11/04/2019
Contract Title:	Muchea North - SLK 38.6 - 51.4 Environment				
To:	Marni Baetge (MRWA); John Braid (MRWA).				
Copies:					
From:	Grace Jones				
Subject:	EPBC 2016/7656 Condition 2 Closure				

1. Purpose

The purpose of this memorandum is to demonstrate how the requirements of EPBC 2016/7656 Condition 2 have been met within the required timeframe.

2. Background

Condition 2 of EPBC Approval 2016/7656 as granted on 10th August 2018 makes the following requirement:

'To mitigate impacts to the Carnaby's Black Cockatoo, the approval holder must undertake all efforts to avoid clearing the known nesting hollow and suitable nesting hollow identified in Attachment 2. Within one month of the completion of clearing, the approval holder must provide the Department with evidence that these hollows have not been cleared or a detailed assessment of why clearing of these hollows could not be avoided'.

Clearing activities for the Muchea North section of the alignment (proposed action) have been completed, as of April 2019. The trees identified in Attachment 2 and their status are outlined in Table 1-1 below.

Table 2-1: Details of Trees identified in Attachment 2

Tree ID	Reason for protection	Co-ordinates		Status
		Easting	Northing	
HT13533	Suitable hollow	409048.15	6516513	Tree and hollow remain in situ
HT14749	Hollow with evidence of use	405084.58	6509180	Tree and hollow remain in situ

3. Evidence

Photographic evidence of the above referenced trees are shown below in Plate 1 and Plate 2 demonstrating that the hollows identified in Attachment 2 have not been cleared as part of the proposed action.

Memorandum (MEM)

Doc No.

GNH-CN0X-PM01-MEM-000X

Rev

1



Plate 1 - HT13533


	Great Northern Highway - Muchea to Wubin Upgrade - Stage 2		
	Memorandum (MEM)		
	Doc No.	GNH-CN0X-PM01-MEM-000X	Rev 1



Plate 2 - HT14749

4. Conclusion

The above provided evidence demonstrates that the requirements of EPBC 2016/7656 Condition 2 have been met within the required time. This Condition has now been closed-out.

Attachment 3: Reports for inspection of potential Carnaby's Black Cockatoo nesting trees before and after clearing (including Summary Register)



Great Northern Highway,
Muceha

Tree Hollow Assessment

Prepared for:

WBHO Infrastructure Pty Ltd

March 2019

● people ● planet ● professional

Document Reference	Revision	Prepared by	Reviewed by	Admin Review	Submitted to Client	
					Copies	Date
2911AB	INTERNAL DRAFT	E. Webb	S. Walker A. Hide	NL	-	11/10/18
2911AB	A CLIENT DRAFT	360 ENV	WBHO	NL	1 Electronic (email)	12/10/18
2911AB	0 CLIENT FINAL	360 ENV	WBHO	NL	1 Electronic (email)	08/11/18
2911AB	1 CLIENT FINAL	360 ENV	WBHO	NL	1 Electronic (email)	04/12/18
2911AB	2 CLIENT FINAL	360 ENV	WBHO	NL	1 Electronic (email)	08/02/19
2911AB	3 CLIENT FINAL	360 ENV	WBHO	NL	1 Electronic (email)	21/02/19
2911AB	4 CLIENT FINAL	360 ENV	WBHO	NL	1 Electronic (email)	08/03/19

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Executive Summary

360 Environmental Pty Ltd was commissioned by WBHO Infrastructure Pty Ltd to undertake a pre-clearing and post-clearing assessment of potential Black Cockatoo breeding trees that were to be removed as part of upgrades to the Great Northern Highway near the Muchea townsite, approximately 50 km northeast of Perth. A follow-up assessment of five trees was undertaken on 29 November 2018 and an additional follow-up assessment of three trees was undertaken on 31 January 2019 and two trees on 1 March 2019. The main findings from the onsite assessments are summarised below.

ASSESSMENT	OUTCOMES
Pre-clearing (19 Sep 2019)	<ul style="list-style-type: none"> • Six trees (HT05923, HT06020, HT06046, HT06655, HT13534, HT13535) were not in use; • Three trees were unconfirmed (HT08753, HT08753, HT08754) and require further inspection; and • Four trees (HT06261, HT06278, HT1479, HT06295) were currently in use by Carnaby's Black Cockatoos.
Post-clearing (27 Sep 2019)	<ul style="list-style-type: none"> • Of the six trees confirmed to not be in current use by Carnaby's Black Cockatoos during the post-clearing assessment had been felled; • Seven trees (HT06261, HT06278, HT08752, HT08753, HT08754, HT14749, HT06295) were not felled and require further inspection; and • All hollows contained within felled trees were confirmed to have not been in use by Carnaby's Black Cockatoos.
Follow-up (29 Nov 2018)	<ul style="list-style-type: none"> • Four trees (HT06261, HT06278, HT08752, HT06295) that had been recorded as currently in use by Carnaby's Black Cockatoos during the pre-clearing assessment were not in current use; and • Three trees (HT08753, HT08754, HT14749) that had been recorded as having evidence of recent use but were unconfirmed to be in current use by Carnaby's Black Cockatoos during the pre-clearing assessment were not in current use.
Follow-up (Jan 2019)	<ul style="list-style-type: none"> • Tree HT08753 which was originally recorded as currently not in use the pre-clearing assessment but had been retained due to its proximity to another tree, was not in current use; and • Tree HT08754, originally recorded as having evidence of recent use but was unconfirmed to be in current use during the pre-clearing assessment, was in current use. A Carnaby's Black Cockatoo chick was confirmed to be occupying a hollow.
Follow-up (1 Mar 2019)	<ul style="list-style-type: none"> • Tree HT08754 was inspected and confirmed that no hollows were being occupied by Black Cockatoos or any other fauna; and • An adjacent tree to HT08754 that contains bees was also inspected and confirmed to not have any occupied hollows.

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Appendix B Tree Hollow Assessments

1 Introduction

1.1 Background

360 Environmental Pty Ltd (360 Environmental) was commissioned by WBHO Infrastructure Pty Ltd (WBHO) to undertake a pre-clearing and post-clearing assessment of potential Black Cockatoo breeding trees that were to be removed as part of upgrades to the Great Northern Highway near the Muchea townsite, approximately 50 km northeast of Perth (Figure 1).

A survey undertaken by Phoenix Environmental (2015) identified a total of 1,441 potential Black Cockatoo breeding trees within the study area comprising of *Corymbia calophylla*, *Eucalyptus wandoo*, *E. marginata* and *E. gomphocephala*. Of these, 25 were recorded that contained hollows suitable for breeding and nine of these showed signs of use at the time of the survey.

The removal of 13 trees with suitable hollows for Carnaby's Black Cockatoo breeding was approved with conditions under the *Environment Protection and Biodiversity Act 1999* (EPBC Act) approval 2016/7656, 12 of which were located within the proposed disturbance footprint. All 13 trees approved for clearing are listed in Table 1.

Table 1: Trees Approved for Clearing Under EPBC 2016/7656 Subject to Conditions

TREE IDENTIFICATION NUMBER	IN FOOTPRINT?	EASTING (MGA 50)	NORTHING (MGA 50)
HT05923	Yes	405117	6509299
HT06020	Yes	407878	6511816
HT06046	Yes	407899	6511833
HT06261	Yes	404995	6509205
HT06278	Yes	405096	6509297
HT06655	Yes	409264	6517057
HT08752	Yes	405050	6509280
HT08753	Yes	409124	6516490
HT08754	Yes	407820	6511703
HT13534	Yes	409065	6516361
HT13535	Yes	409066	6516315
HT14749	Yes	405081	6509174
HT13533	No	409049	6516516

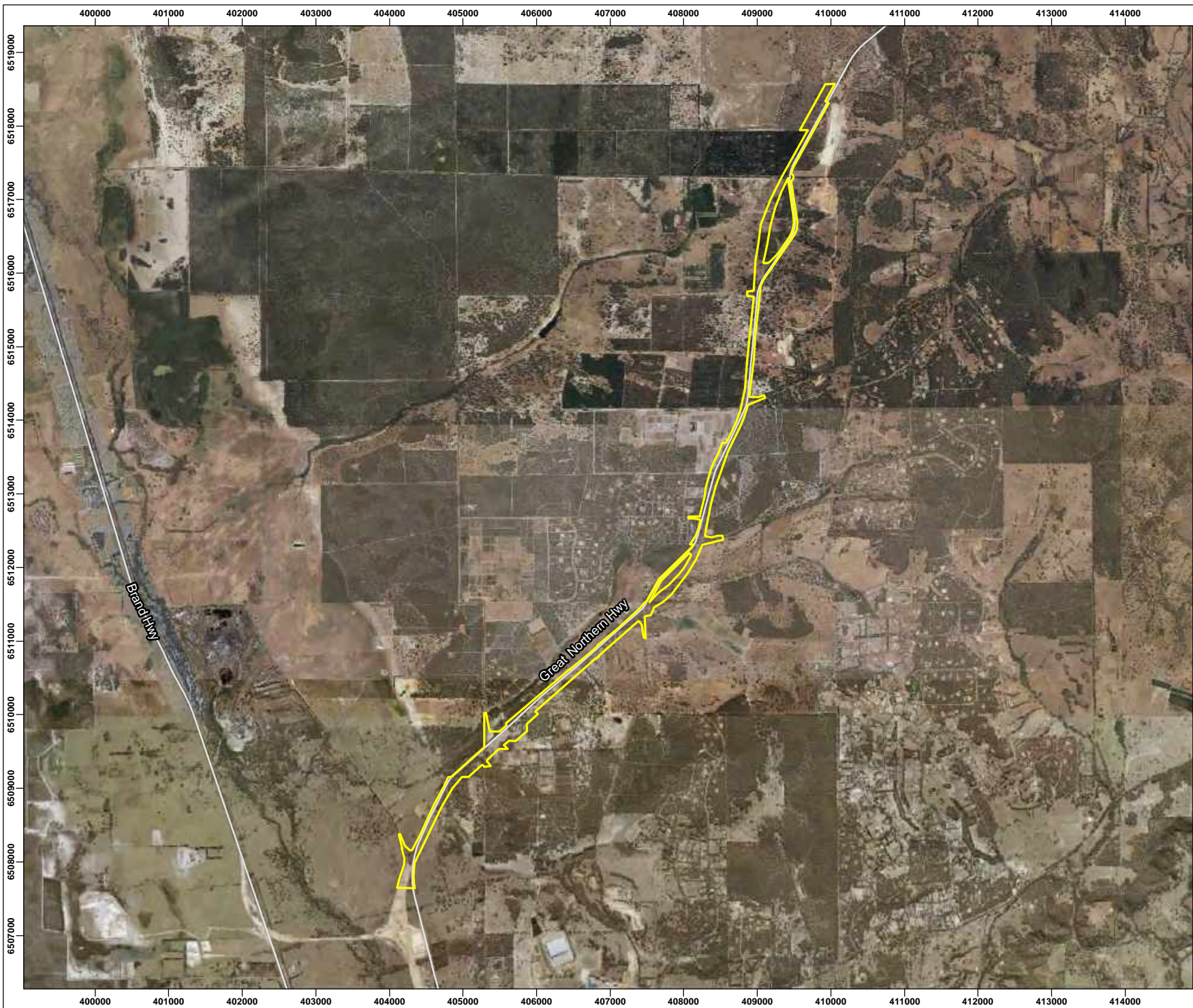
The assessment undertaken by 360 Environmental addressed the following condition of the approval:

- Condition 3: *Within 7 days prior to clearing of any area of Carnaby's Black Cockatoo habitat, the approval holder must investigate and document all potential nesting trees within the area to be cleared to determine if there are any hollows that are being utilised, or are capable of being utilised, by the Carnaby's Black Cockatoos for nesting. The investigation must be undertaken by a suitably qualified person. If any Carnaby's Black Cockatoo(s) is detected utilising any hollow in any tree, the approval holder must:*
 - *clearly identify and mark the identified nesting tree;*
 - *maintain a register of nesting trees;*
 - *only clear the identified nesting tree and vegetation within a 10-metre radius of the tree, if a suitably qualified person has verified that the hollow in the tree is no longer being used by the Carnaby's Black Cockatoo; and*
 - *record the location of any known nesting hollow or suitable nesting hollow, identified during the investigations, that are additional to the nesting hollows identified in Attachment 1 (refer to EPBC 2016/7656 approval with conditions).*

1.2 Scope of Works

The following scope of works was undertaken:

- Ecologist(s) visually inspected the 12 predetermined breeding trees containing suitable hollows for Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) within the proposed construction disturbance footprint from the ground;
- Ecologist(s) visually inspected any breeding trees containing suitable hollows for Carnaby's Black Cockatoo that were identified during the assessment in addition to the 12 predetermined trees;
- Qualified arborist(s) climbed trees identified by ecologists and inspected hollows;
- Any tree found to contain a hollow in use by fauna was immediately flagged and communicated to WBHO; and
- A follow-up inspection of five predetermined breeding trees containing suitable hollows for Carnaby's Black Cockatoo (*C. latirostris*) and remaining (that is, not cleared within 7 days) after the first inspection were climbed by arborists and assessed by a qualified zoologist; and
- An additional follow-up inspection of three predetermined breeding trees containing suitable hollows for Carnaby's Black Cockatoo (*C. latirostris*) and remaining (that is, not cleared within 7 days) after the second inspection were climbed by arborists and assessed by a qualified zoologist.

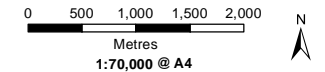


Legend
 — Disturbance Footprint

NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
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PROJECT ID 2911	DATE 10/10/2018
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HORIZONTAL DATUM AND PROJECTION
 GDA 1994 MGA Zone 50

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WBHO Infrastructure
Great Northern Highway

Tree Hollow Inspection

Figure 1
Disturbance Footprint

2 Methods

An onsite field pre-clearing assessment was undertaken by suitably qualified 360 Environmental ecologists Evan Webb and Colleen McDonald (refer to Appendix A for CVs) and qualified arborists from CPD Tree Services Pty Ltd. This assessment was undertaken on consecutive days on 19 and 20 of September 2018. A post-clearing assessment (not required under the conditions of EPBC 2016/7656) was undertaken on the 27 of September 2018. Additional follow-up assessments were undertaken on 29 November 2018 and 31 January 2019. Note that the inspection included additional nearby trees to evaluate the potential impacts of their felling on Carnaby's Black Cockatoos that may have been using hollows in the trees identified in Table 1. These additional trees have not been discussed in this report and are mentioned for context only.

2.1 Pre-clearing Assessment

During the first day of the pre-clearing assessment (19 September 2018), an ecologist assessed the 12 predetermined trees within the proposed construction footprint (Table 1) that occurred within or near the disturbance footprint. The assessment consisted of:

- Inspection of hollow entrances using binoculars and a telephoto zoom lens for signs of use such as scratch marks;
- Tapping and scratching the base of the tree to observe the response of fauna, if any, that may occupy the hollow;
- Measuring the diameter at breast height (DBH) of the tree;
- Recording GPS coordinates using mobile app Fulcrum;
- Opportunistic observations of fauna such as of fauna entering or exiting tree hollows; and
- Opportunistic observations of evidence of fauna, such as scat at the base of a tree.

The second day (20 September 2018) used qualified arborists to climb and inspect all trees assessed on the previous day to confirm the presence/absence of fauna. The arborists visually inspected each hollow and reported observations to an ecologist, who was present on site. Each hollow was inspected for signs of use by Carnaby's Black Cockatoos including:

- Signs of use such as scratch marks around the hollow entrance;
- Evidence of nesting within the hollow such as eggs, woodchips or feathers; and
- Fauna occupying hollows.

Pink flagging tape was then wrapped around the inspected tree trunk to delineate the tree as confirmed to be in use by a Carnaby's Black Cockatoo. Green flagging tape was used to flag trees confirmed not to be currently in use. Trees flagged in green were reported to

WBHO as acceptable for felling within 7 days, and trees flagged in pink were reported for further protection in accordance with EPBC 2016/7656.

2.2 Post-clearing Assessment

The post-clearing assessment on 27 September 2018—not required by EPBC 2016/7656—consisted of an ecologist inspecting and, where possible, photographing hollows contained within felled trees to verify the date of felling and the results of the pre-clearing assessment.

2.3 Follow-up Assessment 29 November 2018

The follow-up assessment involved the reinspection by qualified arborists and a suitably qualified zoologist of trees previously assessed during the initial pre-clearing assessment as currently in use, or unconfirmed to be currently in use, by Carnaby's Black Cockatoos. The arborists lowered an inspection camera into each potential Black Cockatoo nesting hollow contained within each tree. The footage from the inspection camera was examined in real time by an ecologist who was present on site. Each hollow was inspected for signs of current use by Carnaby's Black Cockatoos including:

- Viable eggs or live chicks; and
- Fauna occupying hollows.

2.4 Follow-up Assessment 31 January 2019

The second follow-up assessment involved the reinspection by qualified arborists and a suitably qualified zoologist of trees previously assessed during the prior assessments as currently in use, or unconfirmed to be currently in use, by Carnaby's Black Cockatoos. One of the trees inspected had been assessed as not currently in use by Carnaby's Black Cockatoos during the pre-clearing assessment; however, the tree had been retained due to its proximity to one of the trees that was unconfirmed to be currently in use. The arborists lowered an inspection camera into each potential Black Cockatoo nesting hollow contained within the trees. The footage from the inspection camera was examined in real time by an ecologist who was present on site. Each hollow was inspected for signs of current use by Carnaby's Black Cockatoos including:

- Viable eggs or live chicks; and
- Fauna occupying hollows.

2.5 Follow-up Assessment 1 March 2019

Tree hollow HT08754 was reinspected by a qualified arborist and Principal Ecologist in Scott Walker on the 1st March 2019. The arborist climbed the tree and took photographic evidence of the tree hollows in question. A neighbouring tree that contained bees was also inspected whilst onsite.

3 Results

3.1 Pre-clearing Assessment

All 12 trees identified in Table 1 were inspected. The assessment determined that:

- Six trees were not currently in use;
- Three trees were currently in use by Carnaby's Black Cockatoos (Plates 1 – 4); and
- Three trees had evidence of recent use, but the assessment did not confirm whether the hollow was in current use by Carnaby's Black Cockatoos.

The inspection also identified a previously-unsuitable hollow (HT06295) being used by Carnaby's Black Cockatoos for breeding. This hollow and tree was added to the inspection scope, including follow-up assessments.

Results of each tree inspection are summarised in Table 2 and Figure 2 and presented in full in Appendix B.

Table 2: Pre-clearing Assessment Results

TREE	CARNABY'S USE	EASTING (MGA 50)	NORTHING (MGA 50)
HT05923	No	405117	6509299
HT06020	No	407878	6511816
HT06046	No	407899	6511833
HT06261	Yes	404995	6509205
HT06278	Yes	405096	6509297
HT06655	No	409264	6517057
HT08752	Unconfirmed	405050	6509280
HT08753	Unconfirmed	409124	6516490
HT08754	Unconfirmed	407820	6511703
HT13534	No	409065	6516361
HT13535	No	409066	6516315
HT14749	Yes	405081	6509174
HT06295 (additional)	Yes	405015	6509235



Plate 1: Female Carnaby's Black Cockatoo entering hollow in tree HT06261 with male perched nearby

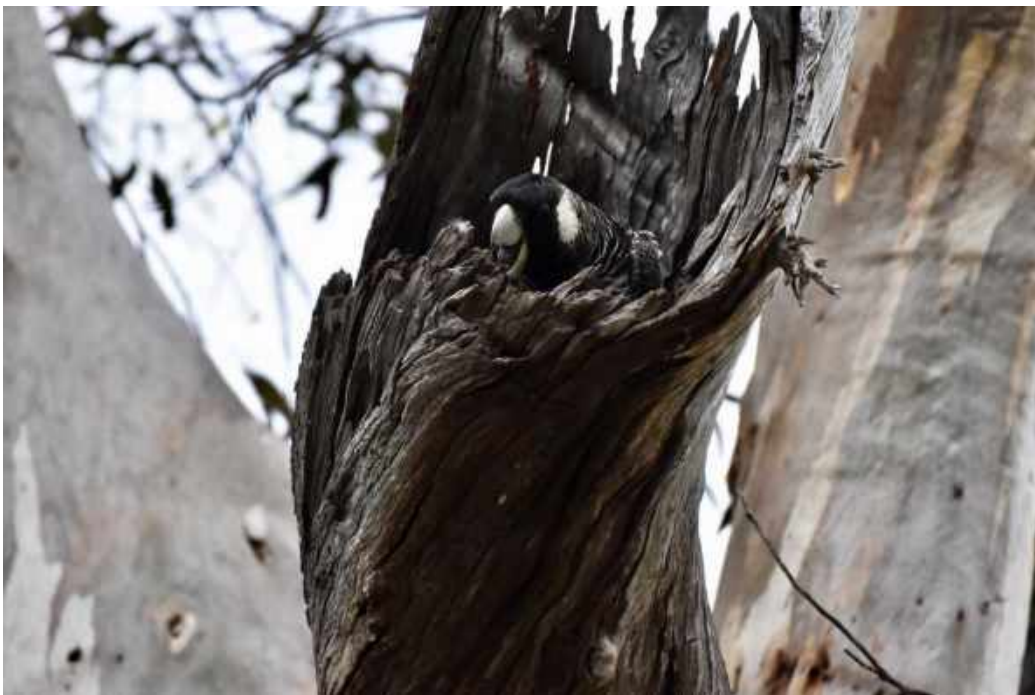


Plate 2: Female Carnaby's Black Cockatoo chewing hollow in tree HT06278



Plate 3: Female Carnaby's Black Cockatoo chewing hollow in tree HT14749



Plate 4: Male and female Carnaby's Black Cockatoo in entrance of hollow in additional tree (HT06295)

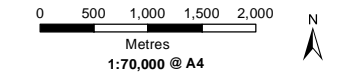


- Legend**
- Disturbance Footprint
 - Trees containing potential nesting hollows**
 - In use by Carnaby's Black Cockatoos
 - Yes
 - Unconfirmed
 - No

NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
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WBHO Infrastructure
Great Northern Highway

Tree Hollow Inspection

Figure 2
Pre-clearing Assessment

3.3 Post-clearing Assessment

The post-clearing assessment determined that:

- All of the six trees confirmed to not be in current use by Carnaby's Black Cockatoos had been felled;
- All trees identified or unconfirmed as being in use by Carnaby's Black Cockatoos, including the additional tree HT06295, remained in situ and had been demarcated in accordance with EPBC 2016/7656;
- All hollows contained within felled trees were confirmed to have not been in current use by Carnaby's Black Cockatoos; and
- All tree-felling occurred within 7 days of the pre-clearing assessment.

The results of the post-clearing assessment are summarised in Table 3 and presented in full in Appendix B.

Table 3: Post-clearing Assessment Results

TREE	STATUS	CURRENT USE	DEMARCATED
HT05923	Felled	No	N/A
HT06020	Felled	No	N/A
HT06046	Felled	No	N/A
HT06261	Not felled	Yes	Yes
HT06278	Not felled	Yes	Yes
HT06655	Felled	No	N/A
HT08752	Not felled	Unconfirmed	Yes
HT08753	Not felled	Unconfirmed	Yes
HT08754	Not felled	Unconfirmed	Yes
HT13534	Felled	No	N/A
HT13535	Felled	No	N/A
HT14749	Not felled	Yes	Yes
HT06295 (additional)	Not felled	Yes	Yes

3.4 Follow-up Assessment 29 November 2018

The follow-up assessment undertaken on 29 November 2018 included reinspection of HT06261, HT06278, HT08752 and the additional HT06295. It excluded HT08753, HT08754 and HT14749 as no works were planned in the vicinity at the time of the inspection. The assessment determined that:

- All four inspected trees were no longer in use by Carnaby's Black Cockatoos.

The results of the follow-up assessment 29 November 2018 are summarised in Table 4 and Figure 3 and presented in full in Appendix B. WBHO confirmed that all four trees

(HT06261, HT06278, HT08752 and HT06295) were felled on 04 December 2018, which is within the 7-day post-inspection period.

Table 4: Follow-up Assessment Results 29 November 2018

TREE	CURRENT USE	EASTING (MGA 50)	NORTHING (MGA 50)
HT06261	No	404995	6509205
HT06278	No	405096	6509297
HT08752	No	405050	6509280
HT06295 (additional)	No	405015	6509235

3.5 Second Follow-up Assessment 31 January 2019

The second follow-up assessment undertaken on 31 January 2019 included reinspection of HT08753 and HT08754 and excluded HT14749 which was no longer required to be cleared. The assessment determined that:

- HT08753, originally recorded as currently not in use by Carnaby's Black Cockatoos during the pre-clearing assessment but had been retained due to its proximity to another tree, was not in current use; and
- HT08754, originally recorded as having evidence of recent use but was unconfirmed to be in current use by Carnaby's Black Cockatoos during the pre-clearing assessment, was in current use. A Carnaby's Black Cockatoo chick was confirmed to be occupying a hollow (Plate 5).

The results of the follow-up assessment 31 January 2019 are summarised in Table 5 presented in full in Appendix B. WBHO confirmed that HT08753 was felled on 01 February 2019, which is within the 7-day post-inspection period. HT08754 was not felled and the demarcation left in situ.

Table 5: Follow-up Assessment Results 31 January 2019

TREE	CURRENT USE	EASTING (MGA 50)	NORTHING (MGA 50)
HT08753	No	409125	6516490
HT08754	Yes	407821	6511703

3.6 Follow-up Assessment 1 March 2019

The reinspection confirmed that the previously occupied tree hollow (HT08754) was vacated and no longer in use by Black Cockatoos (Plate 6). The adjacent tree to HT08754 that still contains bees and was also confirmed not to have tree hollows occupied by Black Cockatoos.



Plate 5: Carnaby's Black Cockatoo chick in hollow in tree HT08754 when assessed in January 2019



Plate 6: Reinspection of tree hollow HT08754 in March 2019

4 Conclusion and Recommendations

It could be concluded at the time of the pre-clearing assessment that of the 12 inspected trees approved for clearing under EPBC 2016/7656:

- Six were not currently in use;
- Three trees were currently in use by Carnaby's Black Cockatoos;
- Three trees had evidence of recent use, but the assessment did not confirm whether the hollow was in current use by Carnaby's Black Cockatoos; and
- An additional tree previously recorded as having an unsuitable breeding hollow was in current use by Carnaby's Black Cockatoos.

The post-clearing assessment of breeding trees containing suitable hollows for Carnaby's Black Cockatoo determined that:

- All six trees not in current use by Carnaby's Black Cockatoos had been felled within 7 days of the inspection; and
- All trees with hollows in current use by Carnaby's Black Cockatoos, or unconfirmed as being in use, were retained and demarcated in accordance with EPBC 2016/7656.

The follow-up assessment of four of the remaining trees undertaken on 29 November 2018 determined that:

- All four inspected trees were no longer in use by Carnaby's Black Cockatoos and were felled on 04 December 2018; and
- All remaining previously-inspected trees were retained and demarcated in accordance with EPBC 2016/7656.

The second follow-up assessment undertaken on 31 January 2019 determined that:

- HT08754, originally recorded as currently not in use by Carnaby's Black Cockatoos during the pre-clearing assessment but had been retained due to its proximity to another tree, was not in current use and was felled on 01 February 2019; and
- HT08753, originally recorded as having evidence of recent use but was unconfirmed to be in current use by Carnaby's Black Cockatoos during the pre-clearing assessment, was in current use and was retained and demarcated. A Carnaby's Black Cockatoo chick was confirmed to be occupying a hollow.

At completion of the second follow-up assessment, two of the original 12 trees approved for clearing under EPBC 2016/7656 (HT14749 and HT08754) remain in situ and demarcated. Ten of the original 12 trees approved for clearing under EPBC 2016/7656, with the addition of HT06295, have been determined to not be in use by Carnaby's Black Cockatoos and felled within the 7-day post-inspection period.

The third follow-up assessment undertaken on 1 March 2019 determined that:

- HT08754 is no longer occupied with Black Cockatoos and is now cleared to be felled. The tree must be felled within seven business days otherwise further onsite inspections will be required.

5 Limitations

This report is produced strictly in accordance with the scope of services set out in the contract or otherwise agreed in accordance with the contract. 360 Environmental makes no representations or warranties in relation to the nature and quality of soil and water other than the visual observation and analytical data in this report.

In the preparation of this report, 360 Environmental has relied upon documents, information, data and analyses ("client's information") provided by the client and other individuals and entities. In most cases where client's information has been relied upon, such reliance has been indicated in this report. Unless expressly set out in this report, 360 Environmental has not verified that the client's information is accurate, exhaustive or current and the validity and accuracy of any aspect of the report including, or based upon, any part of the client's information is contingent upon the accuracy, exhaustiveness and currency of the client's information. 360 Environmental shall not be liable to the client or any other person in connection with any invalid or inaccurate aspect of this report where that invalidity or inaccuracy arose because the client's information was not accurate, exhaustive and current or arose because of any information or condition that was concealed, withheld, misrepresented, or otherwise not fully disclosed or available to 360 Environmental.

Aspects of this report, including the opinions, conclusions and recommendations it contains, are based on the results of the investigation, sampling and testing set out in the contract and otherwise in accordance with normal practices and standards. The investigation, sampling and testing are designed to produce results that represent a reasonable interpretation of the general conditions of the site that is the subject of this report. However, due to the characteristics of the site, including natural variations in site conditions, the results of the investigation, sampling and testing may not accurately represent the actual state of the whole site at all points.

It is important to recognise that site conditions, including the extent and concentration of contaminants, can change with time. This is particularly relevant if this report, including the data, opinions, conclusions and recommendations it contains, are to be used a considerable time after it was prepared. In these circumstances, further investigation of the site may be necessary.

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6 References

Department of Environment and Energy (2018) Great Northern Highway Muchea to Wubin Upgrade Stage 2 – Muchea North, WA (EPBC 2016/7656). Available at http://epbcnotices.environment.gov.au/_entity/annotation/e7fb4f8f-2ab2-e811-b817-005056ba00a7/a71d58ad-4cba-48b6-8dab-f3091fc31cd5?t=1539149164955

Phoenix Environmental Sciences (2015) Flora and fauna assessment for Muchea North and Chittering study area. Prepared for Muchea to Wubin Integrated Project Team (Main Roads WA, Jacobs and Arup).

APPENDIX A

Ecologist CVs

Curriculum Vitae of Evan Webb

Education	Bachelor of Science (Environmental Management), Edith Cowan University.
Organisations and Affiliations	Environment Institute of Australia and New Zealand Inc. (EIANZ) as part of 360 Environmental
Professional Profile	Evan has developed a diverse range of skills in several areas of environmental science, having gained experience as both an Ecologist and GIS Specialist at 360 Environmental. Evan has worked on a range of biological assessments that include undertaking flora and fauna surveys both Level 1 and Level 2, targeted fauna investigation (i.e. Black Cockatoo), vegetation, weed and rehabilitation assessments, environmental management plans and fauna relocation programs. Evan's recent project experience has seen him undertake ecological investigations on the Swan Coastal Plain, South West, Pilbara, Carnarvon, Yalgoo, Dampierland and Central Kimberley bioregions of Western Australia.
Project Experience	<p>Evan's relevant experience investigating Black Cockatoos whilst employed at 360 Environmental includes the following recent project list:</p> <p>Allanooka to Geraldton 600S Pipeline Clearing Fauna and Black Cockatoo Survey, Water Corporation (2019)</p> <p>Currently delivering the data analysis and reporting for an 83 hectare proposed pipeline corridor that spans from Allanooka to Geraldton.</p> <p>Level 2 Fauna and Black Cockatoo Assessment, Various Reserves, City of Rockingham (2018)</p> <p>Completed a fauna, Black Cockatoo and habitat assessment of 8 reserves throughout the City of Rockingham totalling approximately 127 hectares, which contained over 900 potential Black Cockatoo breeding trees, then delivered the data analysis and reporting.</p> <p>Great Northern Hwy Upgrade - Black Cockatoo Assessment, Muchea, WBHO (2018 - 2019)</p> <p>Lead zoologist that completed an on-ground assessment of 17 potential Black Cockatoo breeding trees for the Great Northern Hwy upgrade between Muchea and Wubin. Additional inspections confirmed the presence or absence of Carnaby's Black Cockatoos via visual inspection and/or photography. Was also responsible for organising arborists that assisted in visually inspecting all hollows.</p> <p>Fauna and Black Cockatoo Assessment, Gidgegannup, Private Client (2018)</p> <p>Completed a fauna and Black Cockatoo and habitat assessment of a 120 hectare site, which contained almost 2,000 potential Black Cockatoo breeding trees, then delivered the data analysis, reporting and GIS requirements for the project as part of the EIA process.</p> <p>Fauna and Black Cockatoo Assessment, Casuarina, PRM Property (2018)</p> <p>Completed a Black Cockatoo and habitat assessment of a 71 hectare site, then delivered the data analysis, reporting and GIS requirements for the project as part of the EIA process.</p> <p>Thomsons Reservoir Level 1 Fauna Survey and Black Cockatoo Habitat Assessment, Cockburn, Water Corp (2018)</p> <p>Completed a fauna and Black Cockatoo and habitat assessment then delivered the data analysis, reporting and GIS requirements for the project.</p> <p>Fauna and Black Cockatoo Survey, Chadwick Grain Receiving Site, CBH (2018)</p>

Delivered the data analysis and reporting and GIS requirements for the project.

Fauna and Black Cockatoo Survey, Dale Development, CBH (2018)

Delivered the data analysis and reporting and GIS requirements for the project.

Bottle Creek Tank Fauna and Black Cockatoo Survey, Water Corporation (2018)

Provided support in delivering the data analysis and reporting requirements for the project.

Nilgen Level 1 Flora Survey and Black Cockatoo Habitat Assessment, Water Corporation (2017)

Completed a fauna and Black Cockatoo and habitat assessment then delivered the data analysis, reporting and GIS requirements for the project.

Black Cockatoo Habitat Assessment, Treeby (2017)

Delivered the data analysis, reporting and GIS requirements for the project.

Targeted Declared Rare Flora Survey and Black Cockatoo Habitat Assessment, Toodyay, Boral (2017)

Undertook a Black Cockatoo survey and habitat assessment then delivered the data analysis and GIS requirements for the project.

Roe 8 Offset Independent Review for Black Cockatoo Habitat, Main Roads WA (2017)

Analysed spatial data to provide an independent review of the offset sites proposed for the Roe 8 site clearing.

Relevant Experience

Research Intern, Federal Senator (2015)

Prior to his employment at 360 Environmental, Evan spent one year as a research intern for a Federal Senator. His role was specifically providing environmental advice relating to Carnaby's Black Cockatoos as part of an environmental appeals process. Evan reviewed extensive literature regarding the ecology of Carnaby's Black Cockatoos and relevant survey techniques and undertook site visits to gain context for the potential impacts to the species. He used this information to scrutinise technical fauna reports that were part of a Public Environmental Review and authored ministerial correspondence and appeal submissions on behalf of the Federal Senator and relevant community groups. This role provided Evan with a detailed understanding of survey techniques for Carnaby's Black Cockatoos, as well as an understanding of the level of detail required when undertaking environmental surveys for highly scrutinised and controversial projects.

Volunteering

Edith Cowan University (2018)

Evan assisted in monitoring Carnaby's Black Cockatoo chicks in artificial nesting boxes and natural hollows at Edith Cowan University using an extendable pole with a camera mounted on the end. The presence of six Carnaby's Black Cockatoo chicks was confirmed.

This monitoring had previously been undertaken as part of a fellow student's postgraduate studies and since then Evan has been considering undertaking Black Cockatoo research for his own postgraduate studies.

Curriculum Vitae of Colleen McDonald

Education

Bachelor of Science (Environmental Biology), Curtin University, 2017
Bachelor of Commerce (Economics), Curtin University, 2017

Organisations and Affiliations

Environment Institute of Australia and New Zealand Inc. (EIANZ) as part of 360 Environmental

Professional Profile

Colleen has a range of flora and fauna baseline survey experience in undertaking field works, conducting desktop assessments, report writing and data analysis of flora and vegetation data. Colleen has recently completed various Level 1 and 2 Flora, Fauna and Black Cockatoo Assessments. Her experience covers a variety of projects throughout the Swan Coastal Plain bioregion.

Colleen also supports a range of projects for the Approvals, Compliance and Strategy team. With project experience including EIA, licence and permit applications, referrals under Commonwealth and State legislation and management plans.

Colleen completed a six week secondment to the Department of Water and Environmental Regulation where she processed the extensive back log of clearing permit entries to the publicly available Environmental Offsets register.

Project Experience

A selection of recent project experience specific to Black Cockatoos is provided below:

Bushland Assessment Level 2 Fauna and Black Cockatoo Survey, City of Rockingham (2018)

Field survey and data management for Management Plan

Halls Head Central Black Cockatoo Tree Assessment, Insight Project Service (2018)

Data analysis and management to support EPBC compliance

Thomsons Reservoir Level 1 Fauna Survey and Black Cockatoo Habitat Assessment, Cockburn, Water Corp (2018)

Data management and analysis to support an EPBC referral

Nilgen Level 1 Flora Survey and Black Cockatoo Habitat Assessment, Water Corporation (2017)



Field survey and data management to support an EPBC referral

Biological Survey Karnup Station, Water Corporation (2017)

Data management and analysis to support EPBC referral

APPENDIX B

Tree Hollow Assessments

TREE ID: HT04059			
Current Carnaby Use:	No	DBH:	477 mm
Easting:	409570	Northing:	6517602
Pre-clearing assessment photos:			
			
Arborist inspecting artificial hollow		Artificial hollow	
<p>Pre-clearing assessment: This tree was not provided in predetermined list, however was listed in Phoenix Environmental (2015) and occurs within the disturbance footprint. It contains an artificial hollow but no natural hollows. The arborist observed evidence of past use within the artificial hollow consisting of scratching's and woodchips. No evidence of current use was observed.</p>			
<p>Post-clearing assessment photo: N/A</p>			
<p>Post-clearing assessment: Not felled.</p>			

TREE ID: HT05923

Current Carnaby Use:	No	DBH:	840 mm
Easting:	405117	Northing:	6509299

Pre-clearing assessment photo:



Arborist inspecting hollow

Pre-clearing assessment: Potential hollows occurred in dead branch and main trunk. The hollow in dead branch was unsuitable for Black Cockatoos due to splitting which exposed the inside of the hollow. The arborist confirmed the hollow in the main trunk was not in current use.

Post-clearing assessment photos:



Hollow in main trunk



Remains of dead branch

Post-clearing assessment: Felled, hollows confirmed not in current use by Carnaby's Black Cockatoos.

TREE ID: HT06020

Current Carnaby Use:	No	DBH:	914 mm
Easting:	407879	Northing:	6511816

Pre-clearing assessment photo:



Arborist inspecting hollow

Pre-clearing assessment: The arborist confirmed two broken branches were not hollow. A large, extremely deep hollow near top of tree extended down into the trunk, however it contained cobwebs and no evidence of current or recent use.

Post-clearing assessment photo:



Large hollow entrance

Post-clearing assessment: Felled, hollows confirmed not in current use by Carnaby's Black Cockatoos.

TREE ID: HT06046

Current Carnaby Use:	No	DBH:	837 mm
Easting:	407900	Northing:	6511833

Pre-clearing assessment photo:



Arborist inspecting hollows

Pre-clearing assessment: Two potential hollows were observed. Scat at the base of the tree indicated that the tree was used for roosting, however the bird species was unconfirmed. The arborist confirmed both hollows were too shallow to be suitable for Black Cockatoos.

Post-clearing assessment photos:



Hollow facing downwards



Hollow with pile of debris

Post-clearing assessment: Felled, hollows confirmed not in current use by Carnaby's Black Cockatoos.

TREE ID: HT06261

Current Carnaby Use:	Yes	DBH:	821 mm
Easting:	404996	Northing:	6509205

Pre-clearing assessment photo:



Arborist inspecting large hollow

Pre-clearing assessment: A pair of Carnaby's Black Cockatoos was observed perching at the hollow entrance with the female entering and exiting the hollow. The arborist observed nesting materials such as downy feathers on the base of the hollow. No eggs or chicks were observed, however the view of the base of the hollow was partially obscured.

Post-clearing assessment photo: N/A

Post-clearing assessment: Not felled.

Follow-up assessment 29 November 2018 photo:



Old, unviable eggs in hollow

Follow-up assessment 29 November 2018: The hollow was found to contain six old eggs with visible cracks, obviously not viable, no evidence of current use was recorded.

TREE ID: HT06278

Current Carnaby Use:	Yes	DBH:	805 mm
Easting:	405096	Northing:	6509297

Pre-clearing assessment photo:



Arborist climbing tree, dead branch containing hollow visible near centre of photo

Pre-clearing assessment: One large, deep hollow occurred within a dead, broken branch. A pair of Carnaby's Black Cockatoos was observed at the hollow entrance, with the female entering hollow and chewing around hollow entrance. Three Forest Red-tailed Black Cockatoos were observed perching on higher branches. The arborist found that the base of the hollow was not visible from the entrance, therefore the presence of eggs or chicks is unconfirmed.

Post-clearing assessment photo: N/A

Post-clearing assessment: Not felled.

Follow-up assessment 29 November 2018 photo:



Base of hollow

Follow-up assessment 29 November 2018: Woodchips at base of hollow provides evidence of chewing by Carnaby's Black Cockatoos, however no evidence of current use was recorded.

TREE ID: HT06655

Current Carnaby Use:	No	DBH:	971 mm
Easting:	409265	Northing:	6517057

Pre-clearing assessment photo:



Arborist inspecting a hollow

Pre-clearing assessment: Two large hollows were observed. One was occupied by bees, the other showed evidence of past use such as scratching but no evidence of recent or current use and the arborist confirmed it to be unoccupied.

Post-clearing assessment photos:



Hollow



Hollow occupied by bees

Post-clearing assessment: Felled, hollows confirmed not in current use by Carnaby's Black Cockatoos.

TREE ID: HT08752

Current Carnaby Use:	Unconfirmed	DBH:	1111 mm
Easting:	405050	Northing:	6509280

Pre-clearing assessment photos:



Arborist inspecting large hollow

Broken branch containing large hollow
(partially obscured by epicormic growth)

Pre-clearing assessment: A small hollow in upper canopy was occupied by Australian Ringnecks. A large hollow extends down to the trunk, within which the arborist observed eggs that that of a Carnaby's Black Cockatoo, however species is unconfirmed and no birds were observed entering or exiting hollow.

Post-clearing assessment photo: N/A





Post-clearing assessment: Not felled.

Follow-up assessment 29 November 2018 photo:



Old, unviable egg in hollow

Follow-up assessment 29 November 2018: The hollow was found to contain one old egg with visible cracks, obviously not viable, no evidence of current use was recorded.

TREE ID: HT08753			
Current Carnaby Use:	Unconfirmed	DBH:	602 mm
Easting:	409125	Northing:	6516490
Pre-clearing assessment photo:			
			
Arborist inspecting large hollow		Large top-opening hollow shown on limb (left of trunk)	
<p>Pre-clearing assessment: Two small hollows were observed to be in use by Tree Martins. Australian Ringnecks were observed perching in the tree. A large, top-opening hollow had recent chew marks around entrance. The arborist observed that the base of the hollow was not visible from the entrance, therefore whether the hollow was in use by Carnaby's Black Cockatoos was unable to be confirmed. The depth of the hollow was estimated to be greater than 2 metres.</p>			
Post-clearing assessment photo: N/A			
Post-clearing assessment: Not felled.			
Follow-up assessment 31 January 2019 photos:			
			
Base of large deep hollow, termites present (left)		and base of a hollow previously used by Tree Martins, no longer occupied (right)	

Follow-up assessment 31 January 2019: Termites were present in the large hollow. Nesting material left by Tree Martins was observed in a small hollow. All hollows were confirmed to be not currently in use.

TREE ID: HT08754

Current Carnaby Use:	Unconfirmed	DBH:	799 mm
Easting:	407821	Northing:	6511703

Pre-clearing assessment photos:



Arborist inspecting hollow



Extremely large, deep hollow

Pre-clearing assessment: One hollow was confirmed to be in use by Galahs, one hollow was confirmed to be in use by Little Corellas. The arborist observed a nest built within the hollow occupied by Little Corellas. An extremely large, deep hollow was also inspected; however the base of the hollow was not visible from the entrance, therefore whether the hollow was in use by Carnaby's Black Cockatoos could not be confirmed.

Post-clearing assessment photo: N/A

Post-clearing assessment: Not felled.

Follow-up assessment 31 January 2019 photo:



Hollow containing Carnaby's Black Cockatoo chick (left) and hollow containing abandoned eggs (right)

Follow-up assessment 31 January 2019: The hollow previously occupied by Galahs contained a Carnaby's Black Cockatoo chick. The hollow previously occupied by Little Corellas contained an abandoned clutch of eggs.

TREE ID: HT13534

Current Carnaby Use:	No	DBH:	780 mm
Easting:	409065	Northing:	6516361

Pre-clearing assessment photo:



Arborist inspecting hollow

Pre-clearing assessment: Two hollows were observed. The tree also contained an old stick nest that lacked evidence of current use. The arborist confirmed the hollow was too shallow for Black Cockatoos. The second hollow was located in a dead limb and had evidence of past use such as chew marks, but no evidence of current use was observed and the arborist confirmed hollow was unoccupied.

Post-clearing assessment photos:



Large hollow, too shallow for Black Cockatoos



Hollow in dead limb

Post-clearing assessment: Felled, hollows confirmed not in current use by Carnaby's Black Cockatoos.

TREE ID: HT13535

Current Carnaby Use:	No	DBH:	732 mm
Easting:	409067	Northing:	6516315

Pre-clearing assessment photo:



Dead section containing hollow extends from top to near base of tree

Pre-clearing assessment: One extremely large, deep hollow. The arborist did not observe evidence of use and observed that the hollow almost extended down to base of the tree, therefore the hollow would not be suitable for Carnaby's Black Cockatoos as they would have difficulty entering and exiting.

Post-clearing assessment photo:



Remains of large hollow entrance

Post-clearing assessment: Felled, hollows confirmed not in current use by Carnaby's Black Cockatoos.

TREE ID: HT14749

Current Carnaby Use:	Yes	DBH:	758 mm
Easting:	405082	Northing:	6509174

Pre-clearing assessment photo:



Arborist inspecting hollow

Pre-clearing assessment: A large amount of scat at the base of the tree indicated it was in frequent use as a roost or nesting tree. A pair of Carnaby's Black Cockatoos were observed returning to the hollow at nightfall, with the female entering a hollow. Two hollows were inspected by the arborist, both were confirmed to contain evidence of use such as nesting materials but no eggs or chicks were observed.

Post-clearing assessment photo: N/A

Post-clearing assessment: Not felled.

TREE ID: ADDITIONAL, ADJACENT HT06261

Current Carnaby Use:	Unconfirmed	DBH:	885 mm
Easting:	404991	Northing:	6509220

Pre-clearing assessment photos:



Arborist inspecting hollow



Large, deep hollow occurs in broken branch

Pre-clearing assessment: The arborist identified one hollow as extremely large and deep, however the base of the hollow was not visible from the entrance, therefore it was unable to be confirmed whether the hollow was in use by Carnaby's Black Cockatoos. Given its proximity to four other trees currently in use by Carnaby's Black Cockatoos, further investigation is required.

Post-clearing assessment photo: N/A

Post-clearing assessment: Not felled.

Follow-up assessment 29 November 2018 photo:



Inside of hollow

Follow-up assessment 29 November 2018: Undisturbed cobwebs visible in hollow indicate no current or recent use.

TREE ID: ADDITIONAL, ADJACENT HT08754

Current Carnaby Use:	No	DBH:	767 mm
Easting:	407819	Northing:	6511693

Pre-clearing assessment photos:



Arborist inspecting hollow



Three broken branches containing hollows

Pre-clearing assessment: Three hollows occurring within broken branches were inspected. Evidence of past use was observed in scratching one hollow however the arborist confirmed that none were currently occupied. One hollow contains feral bees. This tree was flagged as not in current use.

Post-clearing assessment photo: N/A

Post-clearing assessment: Not felled.

Follow-up assessment 31 January 2019 photo:



Insides of empty hollows

Follow-up assessment 31 January 2019: Two hollows confirmed unoccupied, one hollow still contains feral bees.

TREE ID: ADDITIONAL, ADJACENT HT13535

Current Carnaby Use:	No	DBH:	589 mm
Easting:	409075	Northing:	6516308

Pre-clearing assessment photo:



Arborist inspecting hollow

Pre-clearing assessment: One suitable hollow was observed in a broken branch. The arborist confirmed the hollow was unoccupied.

Post-clearing assessment photo:



Hollow after clearing (entrance facing downwards)

Post-clearing assessment: Felled, hollows confirmed not in current use by Carnaby's Black Cockatoos.

TREE ID: ADDITIONAL, HT06295

Current Carnaby Use:	Not cleared	DBH:	793 mm
Easting:	405015	Northing:	6509235

Pre-clearing assessment photos:



Two large hollows formed by broken branches



Arborist inspecting hollows

Pre-clearing assessment: Two large hollows in broken branches off the main trunk of the tree. A pair of Carnaby's Black Cockatoos seen with both male and female entering one of the large hollows. The arborist observed the higher of the two large hollows to contain a Boobook Owl. As Boobook Owls will occupy hollows as a daytime roost, it is still possible for the hollow to be an active nest if the pair of Carnaby's Black Cockatoos are foraging.

Post-clearing assessment photo: N/A

Post-clearing assessment: Not felled.

Follow-up assessment 29 November 2018 photo:



Base of hollow

Follow-up assessment 29 November 2018: No evidence of current use or nesting at base of hollow.

The logo for 360 environmental features the number '360' in a large, bold, sans-serif font. Below the number, the word 'environmental' is written in a smaller, lowercase, sans-serif font. Underneath the text are three white circles arranged horizontally.

360

environmental



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● people ● planet ● professional

Great Northern Highway M2W Upgrade Stage 2
Muceha North



EPBC 2016/7656 Compliance Record | Condition 3 | Carnaby's Black Cockatoo breeding tree clearing

Tree_ID	Easting	Northing	Grouping	Inspection Status				Date of Felling
				20/09/2018	29/11/2018	31/01/2019	1/03/2019	
HT06261	404997.108	6509204.757	Hollow with Evidence of Use	Occupied: CBC (pair)	Clear	N/A	N/A	4/12/2018
HT08752	405057.204	6509283.6	Hollow with Evidence of Use	Occupied: PGC	Clear	N/A	N/A	4/12/2018
HT05923	405116.388	6509297.042	Suitable Hollow	Clear	N/A	N/A	N/A	21/09/2018
HT08754	407825.359	6511700.615	Hollow with Evidence of Use	Occupied: PGC	Not inspected	Occupied: CBC (chick)	Clear	8/03/2019
HT06020	407881.393	6511823.895	Suitable Hollow	Clear	N/A	N/A	N/A	21/09/2018
HT06046	407899.497	6511839.173	Suitable Hollow	Clear	N/A	N/A	N/A	21/09/2018
HT08753	409121.308	6516490.977	Hollow with Evidence of Use	Occupied: PGC	Not inspected	Clear	N/A	1/02/2019
HT06655	409262.425	6517052.222	Suitable Hollow	Clear	N/A	N/A	N/A	21/09/2018
HT06278	405097.278	6509294.938	Hollow with Evidence of Use	Occupied: CBC (pair)	Clear	N/A	N/A	4/12/2018
HT13534	409066.073	6516361.711	Suitable Hollow	Clear	N/A	N/A	N/A	21/09/2018
HT13535	409070.63	6516320.138	Suitable Hollow	Clear	N/A	N/A	N/A	21/09/2018
HT14749	405084.531	6509180.22	Hollow with Evidence of Use	Occupied: CBC (egg)	Not inspected	Not inspected	Not inspected	Not felled
HT06295	405015	6509235	Not Suitable Hollow	Occupied: CBC (pair)	Clear	N/A	N/A	4/12/2018

Acronyms:

CBC Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*)
PGC Pink and Grey Cockatoo (*Eolophus roseicapilla*)

Evidence File Pathways:

[Evidence of Compliance](#)

Attachment 4: Attachment 4: Artificial nest box installation evidence (including artificial nest box register and results of nest box baseline monitoring)

Seq.	Tree ID*	Nest Box	Easting	Northing	Property	Date of Installation
1	NB01	157	405259.5	6509220.8	Road reserve	21/09/2018
2	NB02	322	405266.3	6509205.7	Road reserve	20/09/2018
3	NB03	329	405236.7	6509161.9	Road reserve	21/09/2018
4	NB04	301	405112.7	6509159	Road reserve	21/09/2018
5	NB05	323	405151.2	6509157.5	Road reserve	18/09/2018
6	NB06	320	405206.6	6509171.9	Road reserve	20/09/2018
7	NB08	321	404869.2	6509207.2	Road reserve	20/09/2018
8	NB09	317	404911.7	6509242.7	Road reserve	20/09/2018
9	NB10	337	409444.4	6517083.4	Road reserve	17/09/2018
10	NB11	151	409458.4	6517017.9	Road reserve	17/09/2018
11	NB12	338	409466.6	6516970.4	Road reserve	5/10/2018
12	NB13	324	404871.4	6509186.2	Road reserve	19/09/2018
13	NB14	312	404867.7	6509191.5	Road reserve	19/09/2018
14	NB32	335	408816.8	6511229	Nesci Estate	17/09/2018
15	NB33	334	408917.1	6511364	Nesci Estate	17/09/2018
16	NB34	309	409433.5	6511416	Nesci Estate	5/10/2018
17	NB41	228	408712	6511304	Nesci Estate	21/09/2018
18	NB42	328	408593.5	6511352.9	Nesci Estate	11/03/2019
19	NB46	313	407493.2	6510681.7	Road reserve	17/09/2018
20	NB55	315	406265.3	6510434.4	Road reserve	19/09/2018
21	NB57	145	408882.4	6512561.4	Road reserve	18/09/2018
22	NB58	319	408668.8	6512460.5	Road reserve	19/09/2018
23	NB59	325	408616.7	6512443.4	Road reserve	19/09/2018
24	NB60	139	408602.1	6512436.1	Road reserve	19/09/2018
25	NB61	161	407968.7	6512684.9	Road reserve	18/09/2018
26	NB62	327	409464.5	6517209.6	Road reserve	21/09/2018
27	NB63	330	409460.8	6517205.9	Road reserve	21/09/2018
28	NB64	152	409530	6516756.2	Road reserve	21/09/2018
29	NB65	311	409523.4	6516738.3	Road reserve	21/09/2018
30	NB66	319	409426.3	6516458.2	Road reserve	18/09/2018
31	NB67	333	409450.1	6516453.1	Road reserve	21/09/2018
32	NB68	326	409498.7	6516712.5	Road reserve	18/09/2018
33	NB69	336	409500.9	6516729.4	Road reserve	21/09/2018
34	NB71	331	409519	6516796.1	Road reserve	18/09/2018
35	NB76	163	407544.5	6512297.9	Road reserve	19/09/2018
36	NB77	316	407573	6512307.9	Road reserve	19/09/2018
37	NB78	314	407495.7	6512310.2	Road reserve	19/09/2018
38	NB79	164	407461.5	6512308.5	Road reserve	19/09/2018
39	NB99	318	405289.7	6509164.3	Road reserve	20/09/2018
N/A	NB75	328	405439.3	6509336	Lullfitz Nursery	21/09/2018
N/A	NB70	N/A	409494.6	6516787.4	Relocated to NB41: tree too tall	N/A

* see Phoenix Environmental Sciences Pty Ltd report, 1169-GNH-JA-FAU-CBC nest box survey

Evidence File Pathways:

[Evidence of Compliance](#)

Davies, Jonathan

From: Francis Smit <francis@landcaresj.com.au>
Sent: Tuesday, 25 September 2018 9:21 AM
To: Bentley, Joe
Cc: Davies, Jonathan; Peter Dodd; Mark Thompson
Subject: [EXTERNAL] Muchea to Wubin Cockatube installation

Hi Joe,

On Friday 21st September Alan Elliott and I monitored 16 Cockatubes installed across six locations on the Muchea to Wubin Main Roads project. All nestboxes monitored were installed professionally and as per guidelines provided. Nestboxes appeared to be secure and upright, with sacrificial posts well placed and also easily accessible for future monitoring of Black Cockatoo breeding activity. Landcare SJ is highly satisfied with the quality of the installations and locations for the nesting hollows.

Kind regards,
Francis Smit

Executive Officer
Landcare SJ Inc.
P.O. Box 41, Mundijong WA 6123
tel: 08 9526 0012
e: francis@landcaresj.com.au
web: www.landcaresj.com
Fb: www.facebook.com/landcaresj



**LENDLEASE – RNC WHEATBELT
COCKATUBE INSTALLATION
PHOTO RECORDS**

DATE	05 October 2018	TREE NO.	12 box 338
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NOTES

PHOTO # 1	PHOTO # 2
	

**LENDLEASE – RNC WHEATBELT
COCKATUBE INSTALLATION
PHOTO RECORDS**

DATE	05 October 2018	TREE NO.	34 box 309 relocated from tree 72
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NOTES

PHOTO # 1	PHOTO # 2
	

**LENDLEASE – RNC WHEATBELT
COCKATUBE INSTALLATION
PHOTO RECORDS**

DATE	21 September 2018	TREE NO.	1 - Box 157
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NOTES
Box 157

PHOTO # 1	PHOTO # 2
	

**LENDLEASE – RNC WHEATBELT
COCKATUBE INSTALLATION
PHOTO RECORDS**

DATE	20 September 2018	TREE NO.	2 - Box 322
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NOTES

PHOTO # 1	PHOTO # 2
	

**LENDLEASE – RNC WHEATBELT
COCKATUBE INSTALLATION
PHOTO RECORDS**

DATE	21 September 2018	TREE NO.	3 - Box 329
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NOTES
Box 329

PHOTO # 1	PHOTO # 2
	

**LENDLEASE – RNC WHEATBELT
COCKATUBE INSTALLATION
PHOTO RECORDS**

DATE	21 September 2018	TREE NO.	4 Box 301
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NOTES
Box 301

PHOTO # 1	PHOTO # 2
	

**LENDLEASE – RNC WHEATBELT
COCKATUBE INSTALLATION
PHOTO RECORDS**

DATE	18 September 2018	TREE NO.	5 - Box 323
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NOTES
Box 323

PHOTO # 1	PHOTO # 2
	

**LENDLEASE – RNC WHEATBELT
COCKATUBE INSTALLATION
PHOTO RECORDS**

DATE	20 September 2018	TREE NO.	6 - Box 320
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NOTES

PHOTO # 1	PHOTO # 2
	

**LENDLEASE – RNC WHEATBELT
COCKATUBE INSTALLATION
PHOTO RECORDS**

DATE	20 September 2018	TREE NO.	8 box 321
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NOTES

PHOTO # 1	PHOTO # 2
	

**LENDLEASE – RNC WHEATBELT
COCKATUBE INSTALLATION
PHOTO RECORDS**

DATE	20 September 2018	TREE NO.	9 - Box 317
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NOTES

PHOTO # 1	PHOTO # 2
	

**LENDLEASE – RNC WHEATBELT
COCKATUBE INSTALLATION
PHOTO RECORDS**

DATE	17 September 2018	TREE NO.	10 - Box 337
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NOTES
Box 337 sorry no before photo

PHOTO # 1	PHOTO # 2
	

**LENDLEASE – RNC WHEATBELT
COCKATUBE INSTALLATION
PHOTO RECORDS**

DATE	17 September 2018	TREE NO.	11 - Box 151
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NOTES
Box 151 sorry no before photo

PHOTO # 1	PHOTO # 2
	

**LENDLEASE – RNC WHEATBELT
COCKATUBE INSTALLATION
PHOTO RECORDS**

DATE	19 September 2018	TREE NO.	13 box 324
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NOTES

PHOTO # 1	PHOTO # 2
	

**LENDLEASE – RNC WHEATBELT
COCKATUBE INSTALLATION
PHOTO RECORDS**

DATE	19 September 2018	TREE NO.	14 box 312
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NOTES

PHOTO # 1	PHOTO # 2
	

**LENDLEASE – RNC WHEATBELT
COCKATUBE INSTALLATION
PHOTO RECORDS**

DATE	17 September 2018	TREE NO.	32 box 335
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NOTES

PHOTO # 1	PHOTO # 2
	

**LENDLEASE – RNC WHEATBELT
COCKATUBE INSTALLATION
PHOTO RECORDS**

DATE	17 September 2018	TREE NO.	33 box 334
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NOTES

PHOTO # 1	PHOTO # 2
	

**LENDLEASE – RNC WHEATBELT
COCKATUBE INSTALLATION
PHOTO RECORDS**

DATE	21 September 2018	TREE NO.	41 box 228 replaces tree 70
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NOTES

PHOTO # 1	PHOTO # 2
	

**LENDLEASE – RNC WHEATBELT
COCKATUBE INSTALLATION
PHOTO RECORDS**

DATE	17 September 2018	TREE NO.	46 box 313
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NOTES

PHOTO # 1	PHOTO # 2
	

**LENDLEASE – RNC WHEATBELT
COCKATUBE INSTALLATION
PHOTO RECORDS**

DATE	19 September 2018	TREE NO.	55 - Box 315
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NOTES

PHOTO # 1	PHOTO # 2
	

**LENDLEASE – RNC WHEATBELT
COCKATUBE INSTALLATION
PHOTO RECORDS**

DATE	18 September 2018	TREE NO.	57 - Box 145
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NOTES
Box 145

PHOTO # 1	PHOTO # 2
	

**LENDLEASE – RNC WHEATBELT
COCKATUBE INSTALLATION
PHOTO RECORDS**

DATE	19 September 2018	TREE NO.	58 - Box 319
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NOTES
Box 319

PHOTO # 1	PHOTO # 2
	

**LENDLEASE – RNC WHEATBELT
COCKATUBE INSTALLATION
PHOTO RECORDS**

DATE	19 September 2018	TREE NO.	59 - Box 325
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NOTES
Box 325

PHOTO # 1	PHOTO # 2
	

**LENDLEASE – RNC WHEATBELT
COCKATUBE INSTALLATION
PHOTO RECORDS**

DATE	19 September 2018	TREE NO.	60 - Box 139
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NOTES
Box 139

PHOTO # 1	PHOTO # 2
	

SAVED

**LENDLEASE – RNC WHEATBELT
COCKATUBE INSTALLATION
PHOTO RECORDS**

DATE	18 September 2018	TREE NO.	61 - Box 161
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NOTES
Box 161

PHOTO # 1	PHOTO # 2
	

**LENDLEASE – RNC WHEATBELT
COCKATUBE INSTALLATION
PHOTO RECORDS**

DATE	21 September 2018	TREE NO.	62 box 327
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NOTES

PHOTO # 1	PHOTO # 2
	

**LENDLEASE – RNC WHEATBELT
COCKATUBE INSTALLATION
PHOTO RECORDS**

DATE	21 September 2018	TREE NO.	63 box 330
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NOTES

PHOTO # 1	PHOTO # 2
	

**LENDLEASE – RNC WHEATBELT
COCKATUBE INSTALLATION
PHOTO RECORDS**

DATE	21 September 2018	TREE NO.	64 box 152
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NOTES

PHOTO # 1	PHOTO # 2
	

**LENDLEASE – RNC WHEATBELT
COCKATUBE INSTALLATION
PHOTO RECORDS**

DATE	21 September 2018	TREE NO.	65 box 311
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NOTES

PHOTO # 1	PHOTO # 2
	

**LENDLEASE – RNC WHEATBELT
COCKATUBE INSTALLATION
PHOTO RECORDS**

DATE	18 September 2018	TREE NO.	66 - Box 319
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NOTES
319

PHOTO # 1	PHOTO # 2
	

**LENDLEASE – RNC WHEATBELT
COCKATUBE INSTALLATION
PHOTO RECORDS**

DATE	21 September 2018	TREE NO.	67 box 333
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NOTES

PHOTO # 1	PHOTO # 2
	

**LENDLEASE – RNC WHEATBELT
COCKATUBE INSTALLATION
PHOTO RECORDS**

DATE	18 September 2018	TREE NO.	68 - Box 326
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NOTES
Box 326

PHOTO # 1	PHOTO # 2
	

**LENDLEASE – RNC WHEATBELT
COCKATUBE INSTALLATION
PHOTO RECORDS**

DATE	21 September 2018	TREE NO.	69 box 336
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NOTES

PHOTO # 1	PHOTO # 2
	

**LENDLEASE – RNC WHEATBELT
COCKATUBE INSTALLATION
PHOTO RECORDS**

DATE	18 September 2018	TREE NO.	71 box 331
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NOTES

PHOTO # 1	PHOTO # 2
	

**LENDLEASE – RNC WHEATBELT
COCKATUBE INSTALLATION
PHOTO RECORDS**

DATE	21 September 2018	TREE NO.	72 - Box 309
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NOTES
Box 309

PHOTO # 1	PHOTO # 2
	

**LENDLEASE – RNC WHEATBELT
COCKATUBE INSTALLATION
PHOTO RECORDS**

DATE	21 September 2018	TREE NO.	75 - Box 328
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NOTES
Box 328

PHOTO # 1	PHOTO # 2
	

**LENDLEASE – RNC WHEATBELT
COCKATUBE INSTALLATION
PHOTO RECORDS**

DATE	19 September 2018	TREE NO.	76 - Box 163
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NOTES
Box 163

PHOTO # 1	PHOTO # 2
	

**LENDLEASE – RNC WHEATBELT
COCKATUBE INSTALLATION
PHOTO RECORDS**

DATE	19 September 2018	TREE NO.	77 - Box 316
-------------	-------------------	-----------------	--------------

NOTES
Box 316

PHOTO # 1	PHOTO # 2
	

**LENDLEASE – RNC WHEATBELT
COCKATUBE INSTALLATION
PHOTO RECORDS**

DATE	19 September 2018	TREE NO.	78 - Box 314
-------------	-------------------	-----------------	--------------

NOTES
Box 314

PHOTO # 1	PHOTO # 2
	

**LENDLEASE – RNC WHEATBELT
COCKATUBE INSTALLATION
PHOTO RECORDS**

DATE	19 September 2018	TREE NO.	79 - Box 164
-------------	-------------------	-----------------	--------------

NOTES
164

PHOTO # 1	PHOTO # 2
	

**LENDLEASE – RNC WHEATBELT
COCKATUBE INSTALLATION
PHOTO RECORDS**

DATE	20 September 2018	TREE NO.	99 - Box 318
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NOTES
318

PHOTO # 1	PHOTO # 2
	



PHOENIX

ENVIRONMENTAL SCIENCES

Black cockatoo breeding activity census 2019-20 for Muchea North
Great Northern Highway, Muchea to Wubin Upgrade Stage 2 Project

Prepared for Main Roads WA

April 2020

Final



Black cockatoo breeding activity census 2019-20 for Muchea North.
Great Northern Highway, Muchea to Wubin Upgrade Stage 2 Project.
Prepared for Main Roads WA

Version history				
Author	Version	Version number	Date	Submitted to
A. Jacks	Draft issued for client review	0.1	27-Mar-2020	M. Baetge
A. Jacks	Final, client comments addressed	1.0	01-Apr-2020	M. Baetge

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Appendix 2	Results for all hollows in 2017-18 and 2018-19 breeding season

1 INTRODUCTION

Phoenix Environmental Sciences Pty Ltd (Phoenix) was commissioned by Main Roads WA, to undertake a Carnaby's Cockatoo breeding activity census over the 2019-20 breeding season within and surrounding the disturbance footprint for the Muchea North project area (Figure 1). This report presents the results of the census.

1.1 BACKGROUND

Main Roads is currently upgrading the Great Northern Highway (GNH) between Straight Line Kilometre (SLK) 38.60 and 51.40 (referred to as Muchea North Upgrade). The Muchea North Upgrade proposal was referred under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) on 1 March 2016 (EPBC 2016/7656), assessed as a controlled action and granted conditional approval in August 2018.

Muchea North Upgrade resulted in the loss of 13 Carnaby's Black Cockatoo nesting hollows. To mitigate and offset the loss of these, Main Roads was required to install 39 artificial nest boxes (Figure 1). In accordance with EPBC 2016/7656 Conditions 4f(i) and (ii) each artificial nesting hollow installed must:

- EPBC 2016/7656 condition f(i): be inspected at least twice a year by a suitably qualified person during the peak breeding season to record any evidence of use by the Carnaby's Black Cockatoo and to identify any maintenance requirements
- EPBC 2016/7656 condition f(ii): be monitored and maintained in accordance with relevant artificial hollow guidance for the life of the approval, with maintenance actions, if required, undertaken outside of the breeding season and before the commencement of the next breeding season.

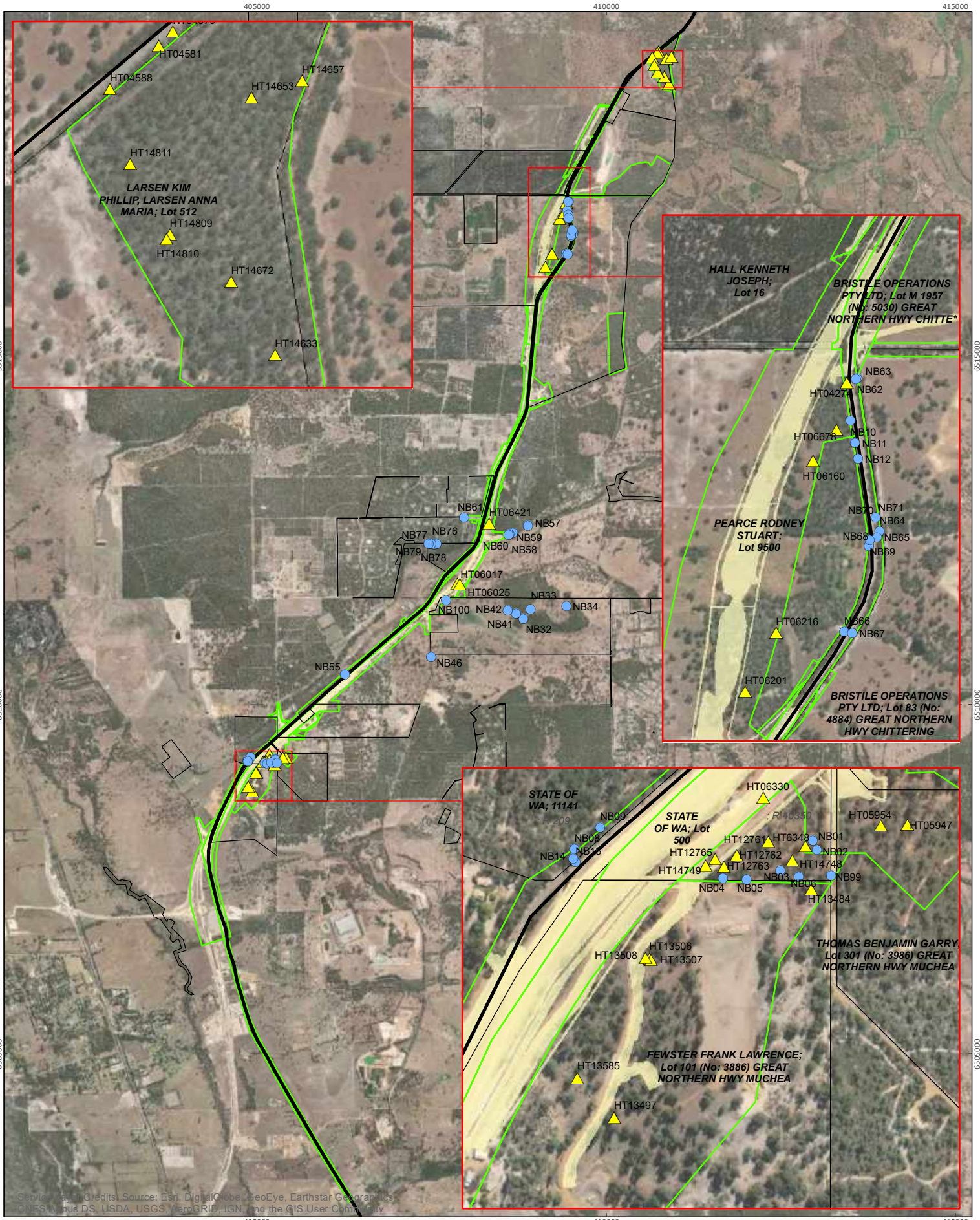
The monitoring campaign will also require monitoring of previously recorded natural hollows suitable for Carnaby's Cockatoo (Figure 1). Monitoring of artificial and natural hollows shall be monitored in accordance with How to Monitor and Maintain Artificial Hollows for Carnaby's Cockatoo (DPaW 2015).

Detailed black cockatoo habitat assessments conducted as part of the baseline assessments for the Muchea North project (Phoenix 2015, 2017a) recorded all potential breeding trees of species known to support black cockatoo breeding and identified suitable nesting hollows and hollows with evidence of use.

A native vegetation clearing permit (NVCP) for Muchea North (Permit no. 7563/2) has been approved by the WA Department of Water and Environmental Regulation (DWER) under the *Environmental Protection Act 1986* (EP Act).



To support Condition 4c of EPBC 2016/7656, Main Roads commissioned Phoenix to undertake monitoring of confirmed and suitable nesting hollows recorded within the Muchea North EPBC Act Approval Boundary and wider baseline survey area (Phoenix 2015, 2017a) (the study area; Figure 1). The initial baseline monitoring program was conducted in the 2017-18 breeding season (August 2017 – February 2018) and assessed hollow usage of suitable nesting hollows and hollows with evidence of use within the study area (Phoenix 2018). A second year of monitoring for hollow usage within the study area in the 2018-19 breeding season was undertaken by Phoenix from August 2018 to February 2019 (Phoenix 2019). The artificial nesting hollows were installed during the 2018-2019 breeding season, therefore the results of these first two surveys collectively represent the pre-impact breeding density.

Phoenix was subsequently commissioned to undertake a third year of monitoring for hollow usage within the study area in the 2019-2020 breeding season. This report incorporates the results of the third monitoring season into the nesting hollow usage dataset for Muchea North.



Service: Mapbox Credits; Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Main Roads WA Great Northern Highway, M2W Upgrade Project	
Project No	1272
Date	26-Mar-20
Drawn by	AJ
Map author	AJ
	
	
1:70,000 (at A4) GDA 1994 MGA Zone 50	

- Study area
- Disturbance footprint
- Road
- Monitored hollows**
- Artificial nesting hollow
- ▲ Natural nesting hollow

Figure 1
Study area and sampling sites



All information within this map is current as of 26-Mar-20. This product is subject to COPYRIGHT and is property of Phoenix Environmental Sciences (Phoenix). While Phoenix has taken care to ensure the accuracy of this product, Phoenix make no representations or warranties about its accuracy, completeness or suitability for any particular purpose.

1.2 SCOPE OF WORK

The scope of work was as follows:

Six rounds of monitoring of artificial and natural nest hollows to be undertaken between August 2019 and January 2020.

During inspections of artificial and natural hollows, record evidence of use by Carnaby's Cockatoos at each artificial and natural hollow in accordance with (DPaW 2015).

During inspections, identify any artificial nest box maintenance needs in accordance with (DPaW 2015) and whether natural hollows remain suitable for use by Carnaby's Black Cockatoo.

Provide a report that summarises all records required by Conditions 4f(i) and (ii) of EPBC 2016/7656 for all artificial and natural hollows inspected. The draft report shall be provided to Main Roads in electronic PDF and Word version copy format.

2 CENSUS METHODOLOGY

Methods were consistent with the approach undertaken in previous monitoring events for Muchea North (Phoenix 2018, 2019).

Prior to the surveys, site locations (artificial and natural nest hollows) were loaded onto field tablets. Data was collected electronically using a customised data collection template and included:

- site code
- signs of use – birds prospecting hollows, fresh chewings, birds perching, birds entering/existing hollows, birds flushed from hollows, gender of observed birds, chick calls, eggs observed (inc. status if possible – incubated or abandoned), chick/s observed, chick/s fledged
- other indicators, e.g. gender mix of flocks, evidence of nesting at base of trees
- condition of hollow, current suitability for use (natural hollows), maintenance requirements (artificial hollows).

The knocking and scraping method was conducted at the base of trees for all monitored hollows. Other observational methods were also employed, i.e. pole camera inspections of hollows where possible, listening for nest activity, flock and individual bird behaviour.

Consistent with previous methodology the following activities were undertaken:

- evidence of nesting activity was noted where fresh chewing is around the hollow entrance and/or birds are seen prospecting hollows.
- a confirmed breeding event was noted where eggs are seen in hollow and/or other clear evidence observed that a chick is present (i.e. female seen at hollow entrance when during brooding eggs, and/or parents seen preparing to feed chick in the hollow).

Maintenance checks of artificial hollows will assess the following as a minimum:

- condition of chewing posts
- condition of attachment points
- condition of hollow bases
- stability of tree or pole used to mount the artificial hollow.

As per previous surveys, site visits were undertaken every 4-5 weeks between August 2019 and January 2020: 15 August, 17 September, 22 October, 22 November, 21 December and 20 January.

The baseline surveys for Muchea North identified a total of 57 trees in the study area containing suitable nesting hollows for black cockatoos, of which 25 had evidence of nesting activity. In the initial survey 37 of these were monitored as the remaining 20 were unable to be assessed due to access constraints.

In the 2018-19 season, 47 natural nesting hollows and 36 artificial nesting hollows were monitored. This included two new natural hollows added to the census in the current season and 14 trees that were not accessible in the 2017-18 season. Twelve further natural nesting hollows were not monitored; five of these were not able to be accessed, three were not relocated and four hollows were removed from monitoring in the 2017-18 season due to collapse, cracks forming or tree death.

In the current survey a total of 73 hollows were monitored, of which 33 were natural nesting hollows and 40 were artificial nesting hollows (Table 1). Prior to the survey, 13 trees which contained suitable nesting hollows were removed as part of the GNH road upgrades (HT05911, HT05923, HT06020, HT06046, HT06261, HT06278, HT06655, HT08752, HT08753, HT08754, HT13533, HT13534 and HT13535), 12 of these were monitored in the previous two monitoring programs and one was not accessible. These 13 trees were offset by the installation of the 39 artificial nesting hollows of which all were able to be monitored this season. An additional artificial nesting hollow (NB100) was included in the survey which was erected to replace HT04059. Four natural nesting hollows from the baseline dataset that had not been monitored in the previous two years were this year able to be surveyed because landowner access had been granted. Four trees with natural nesting hollows were not surveyed this year because the tree or hollow was no longer considered suitable.

In this report:

- *confirmed breeding event* – means eggs were seen in hollow and/or other clear evidence observed that chick was present (i.e. female seen at hollow entrance when brooding eggs and/or parents seen preparing to feed chick in the hollow)
- *evidence of nesting activity* – means chewing around the hollow entrance and/or bird seen prospecting hollows. It does not necessarily mean that a breeding event took place that year; however, it is evidence that the hollow is suitable and was considered and may have been used in previous years.

Table 1 Monitored hollows

HT ID*	Baseline records (pre-2017)	Species	2017-18	2018-19	2019-20
HT04059	Evidence of nesting activity, artificial hollow	<i>Eucalyptus wandoo</i>	Yes	Yes	No (tree cleared)
HT04274	Suitable, no evidence of breeding	<i>Eucalyptus wandoo</i>	Yes	Yes	Yes
HT04579	Suitable, artificial hollow, no evidence of breeding	<i>Eucalyptus wandoo</i>	Yes	Yes	Yes
HT04581	Suitable, artificial hollow, no evidence of breeding	<i>Eucalyptus wandoo</i>	Yes	Yes	Yes
HT04588	Suitable, artificial hollow, no evidence of breeding	<i>Eucalyptus accedens</i>	Yes	Yes	Yes
HT05911	Suitable, artificial hollow, no evidence of breeding	<i>Eucalyptus accedens</i>	No access	No access	No (tree cleared)
HT05923	Suitable, no evidence of breeding	<i>Eucalyptus wandoo</i>	Yes	Yes	No (tree cleared)
HT05938	Suitable, no evidence of breeding	<i>Eucalyptus wandoo</i>	Yes	No	No (not suitable – hollow has cracked or degraded)
HT05947	Suitable, no evidence of breeding	<i>Eucalyptus wandoo</i>	Yes	No	Yes
HT05954	Evidence of nesting activity	<i>Eucalyptus wandoo</i>	Yes	Yes	Yes
HT06017	Evidence of nesting activity	<i>Eucalyptus wandoo</i>	No access	Yes	Yes
HT06020	Suitable, no evidence of breeding	<i>Corymbia calophylla</i>	No access	Yes	No (tree cleared)
HT06025	Suitable, no evidence of breeding	<i>Eucalyptus wandoo</i>	No access	Yes	Yes
HT06046	Suitable, no evidence of breeding	<i>Eucalyptus wandoo</i>	No access	Yes	No (tree cleared)
HT06148	Suitable, no evidence of breeding	<i>Corymbia calophylla</i>	Yes	No	No (not suitable – hollow has cracked or degraded)
HT06160	Suitable, no evidence of breeding	<i>Eucalyptus wandoo</i>	Yes	Yes	Yes
HT06201	Suitable, no evidence of breeding	<i>Eucalyptus wandoo</i>	Yes	Yes	Yes
HT06216	Suitable, no evidence of breeding	<i>Eucalyptus marginata</i>	Yes	Yes	Yes
HT06261	Suitable, no evidence of breeding	<i>Eucalyptus wandoo</i>	Yes	Yes	No (tree cleared)
HT06278	Evidence of nesting activity	<i>Eucalyptus wandoo</i>	Yes	Yes	No (tree cleared)
HT06330	Not suitable	<i>Eucalyptus wandoo</i>	No	Yes	Yes
HT06348	Evidence of nesting activity	<i>Eucalyptus wandoo</i>	Yes	Yes	Yes
HT06421	Evidence of nesting activity	<i>Corymbia calophylla</i>	No access	No access	No (no access)

HT ID*	Baseline records (pre-2017)	Species	2017-18	2018-19	2019-20
HT06655	Suitable, no evidence of breeding	<i>Corymbia calophylla</i>	Yes	No	No (tree cleared)
HT06678	Suitable, no evidence of breeding	<i>Eucalyptus wandoo</i>	Yes	Yes	Yes
HT08752	Evidence of nesting activity	<i>Eucalyptus wandoo</i>	Yes	Yes	No (tree cleared)
HT08753	Evidence of nesting activity	<i>Eucalyptus wandoo</i>	Yes	Yes	No (tree cleared)
HT08754	Evidence of nesting activity	<i>Eucalyptus wandoo</i>	No access	Yes	No (tree cleared)
HT12761	Evidence of nesting activity	<i>Eucalyptus wandoo</i>	No	No	Yes
HT12762	Evidence of nesting activity	<i>Eucalyptus wandoo</i>	Yes	Yes	Yes
HT12763	Evidence of nesting activity (FRTBC)	<i>Eucalyptus wandoo</i>	Yes	Yes	Yes
HT12765	Evidence of nesting activity	<i>Eucalyptus wandoo</i>	Yes	Yes	Yes
HT13484	Suitable, no evidence of breeding	<i>Eucalyptus wandoo</i>	No access	Yes	Yes
HT13497	Suitable, no evidence of breeding	<i>Eucalyptus marginata</i>	No access	Yes	Yes
HT13503	Suitable, no evidence of breeding	<i>Eucalyptus marginata</i>	No access	Yes	No (not suitable – hollow has cracked or degraded)
HT13505	Suitable, no evidence of breeding	<i>Eucalyptus sp.</i>	No access	Yes	No (not suitable – hollow has cracked or degraded)
HT13506	Suitable, no evidence of breeding	<i>Eucalyptus wandoo</i>	No access	Yes	Yes
HT13507	Suitable, no evidence of breeding	<i>Eucalyptus wandoo</i>	No access	Yes	Yes
HT13508	Suitable, no evidence of breeding	<i>Eucalyptus wandoo</i>	No access	Yes	Yes
HT13511	Suitable, no evidence of breeding	<i>Corymbia calophylla</i>	No access	Yes	No (not suitable – hollow has cracked or degraded)
HT13523	Suitable, no evidence of breeding	<i>Eucalyptus wandoo</i>	No access	Yes	No (not suitable – hollow has cracked or degraded)
HT13533	Suitable, no evidence of breeding	<i>Eucalyptus wandoo</i>	Yes	Yes	No (tree cleared)
HT13534	Suitable, no evidence of breeding	<i>Eucalyptus wandoo</i>	Yes	Yes	No (tree cleared)

HT ID*	Baseline records (pre-2017)	Species	2017-18	2018-19	2019-20
HT13535	Suitable, no evidence of breeding	<i>Eucalyptus wandoo</i>	Yes	Yes	No (tree cleared)
HT13585	Not suitable	<i>Corymbia calophylla</i>	No	Yes	Yes
HT14633	Suitable, no evidence of breeding	<i>Eucalyptus wandoo</i>	Yes	Yes	Yes
HT14653	Evidence of nesting activity	<i>Eucalyptus wandoo</i>	Yes	Yes	Yes
HT14657	Evidence of nesting activity	<i>Eucalyptus wandoo</i>	Yes	Yes	Yes
HT14670	Evidence of nesting activity	<i>Eucalyptus wandoo</i>	Yes	No	No (not suitable – hollow collapsed)
HT14672	Evidence of nesting activity	<i>Eucalyptus wandoo</i>	Yes	Yes	Yes
HT14748	Evidence of nesting activity	<i>Eucalyptus wandoo</i>	Yes	Yes	Yes
HT14749	Evidence of nesting activity	<i>Eucalyptus wandoo</i>	Yes	Yes	Yes
HT14805	Evidence of nesting activity	<i>Eucalyptus wandoo</i>	No access	No access	No (not suitable – hollow has cracked or degraded)
HT14806	Evidence of nesting activity	<i>Eucalyptus wandoo</i>	No access	No access	No (not suitable – hollow has cracked or degraded)
HT14807	Suitable, no evidence of breeding	<i>Eucalyptus wandoo</i>	No access	No access	No (not suitable – hollow has cracked or degraded)
HT14808	Suitable, no evidence of breeding	<i>Eucalyptus wandoo</i>	No access	No access	No (not suitable – hollow has cracked or degraded)
HT14809	Evidence of nesting activity	<i>Eucalyptus wandoo</i>	Yes	Yes	Yes
HT14810	Evidence of nesting activity	<i>Eucalyptus wandoo</i>	Yes	Yes	Yes
HT14811	Evidence of nesting activity	<i>Eucalyptus wandoo</i>	Yes	Yes	Yes
NB01	n/a	n/a	n/a	Yes	Yes
NB02	n/a	n/a	n/a	Yes	Yes
NB03	n/a	n/a	n/a	Yes	Yes
NB04	n/a	n/a	n/a	Yes	Yes
NB05	n/a	n/a	n/a	Yes	Yes
NB06	n/a	n/a	n/a	Yes	Yes
NB08	n/a	n/a	n/a	Yes	Yes
NB09	n/a	n/a	n/a	Yes	Yes
NB10	n/a	n/a	n/a	Yes	Yes

HT ID*	Baseline records (pre-2017)	Species	2017-18	2018-19	2019-20
NB11	n/a	n/a	n/a	Yes	Yes
NB12	n/a	n/a	n/a	Yes	Yes
NB13	n/a	n/a	n/a	Yes	Yes
NB14	n/a	n/a	n/a	Yes	Yes
NB32	n/a	n/a	n/a	Yes	Yes
NB33	n/a	n/a	n/a	Yes	Yes
NB34	n/a	n/a	n/a	n/a	Yes
NB41	n/a	n/a	n/a	n/a	Yes
NB42	n/a	n/a	n/a	n/a	Yes
NB46	n/a	n/a	n/a	Yes	Yes
NB55	n/a	n/a	n/a	Yes	Yes
NB57	n/a	n/a	n/a	Yes	Yes
NB58	n/a	n/a	n/a	Yes	Yes
NB59	n/a	n/a	n/a	Yes	Yes
NB60	n/a	n/a	n/a	Yes	Yes
NB61	n/a	n/a	n/a	Yes	Yes
NB62	n/a	n/a	n/a	Yes	Yes
NB63	n/a	n/a	n/a	Yes	Yes
NB64	n/a	n/a	n/a	Yes	Yes
NB65	n/a	n/a	n/a	Yes	Yes
NB66	n/a	n/a	n/a	Yes	Yes
NB67	n/a	n/a	n/a	Yes	Yes
NB68	n/a	n/a	n/a	Yes	Yes
NB69	n/a	n/a	n/a	Yes	Yes
NB71	n/a	n/a	n/a	Yes	Yes
NB76	n/a	n/a	n/a	Yes	Yes
NB77	n/a	n/a	n/a	Yes	Yes
NB78	n/a	n/a	n/a	Yes	Yes
NB79	n/a	n/a	n/a	Yes	Yes
NB99	n/a	n/a	n/a	Yes	Yes
NB100	HT04059 was cleared and this nestbox was installed to replace it in 2019	n/a	n/a	n/a	Yes

* HT = habitat tree (natural); NB = nest box (artificial)

3 RESULTS

3.1 CENSUS RESULTS 2019-20 BREEDING SEASON

Confirmed breeding events were recorded in three artificial nesting hollows and three natural nesting hollows by Phoenix, (Table 2; Figure 2). Evidence of nesting activity was observed in a further ten artificial nesting hollows and four natural nesting hollows (Table 2; Figure 2).

Of the confirmed breeding events:

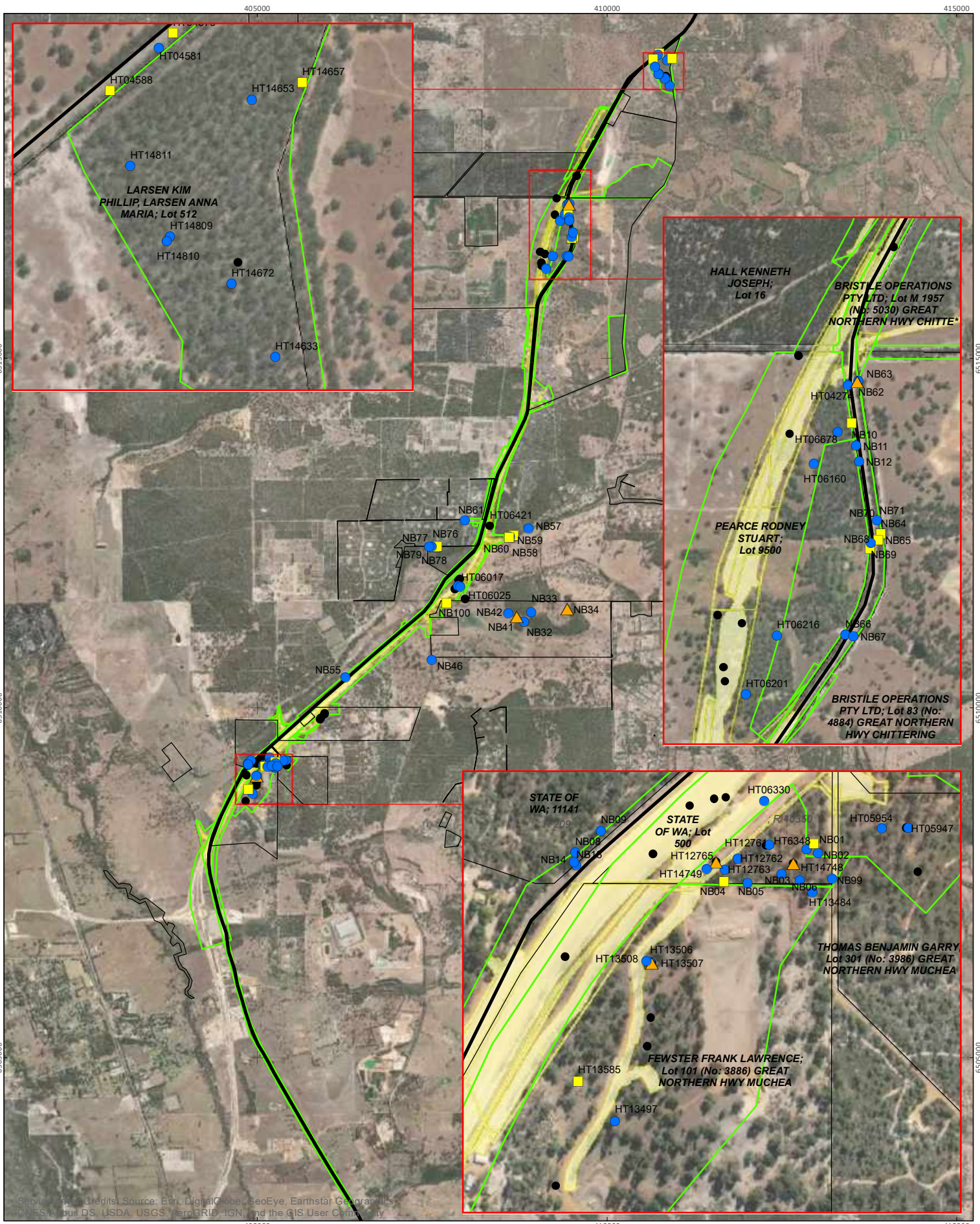
- NB34, NB41 and NB63 – are presumed to have resulted in successful fledging of a chick. Images of large chicks were seen with a camera in all three artificial nest hollows in December 2019 (Figure 3).
- HT12765 and HT13507 – female was flushed from hollow, presumed to be sitting on eggs.
- HT06348 – two eggs were observed with a camera in the hollow in October 2019, however these had been predated by November 2019.

There were several instances where females were flushed from a hollow but a later inspection saw no chicks or eggs and the bird was likely to be prospecting. No evidence of nesting activities were observed in the remaining 27 natural nesting hollows or 26 artificial nesting hollows (Appendix 1).

Table 2 Evidence of breeding records by Phoenix during the 2019-20 census

HT ID	Inspection date						Result
	15/08/2019	17/09/2019	22/10/2019	22/11/2019	21/12/2019	20/01/2020	
NB01	Fresh chewing at post	No flush	No flush	No flush	No flush	No flush	Evidence of nesting activity
NB04	No flush	No flush	No flush	Flushed female CBC, likely to be prospecting hollow	No flush, no eggs in hollow	No flush	Evidence of nesting activity
NB10	No flush	Prospecting pair in tree: female flushed from hollow, likely to be prospecting hollow	No flush, no eggs in hollow	No flush	No flush	No flush	Evidence of nesting activity
NB34	No flush	No flush	No flush	No access	Camera check: Large chick in nest	Chick fledged	Confirmed breeding event: assumed successful
NB41	No flush	No flush	No flush	No access	Camera check: Large chick in nest	Chick fledged	Confirmed breeding event: assumed successful
NB58	No flush	No flush	No flush	Flushed female CBC, possibly prospecting hollow	No flush, no eggs in hollow	No flush	Evidence of nesting activity
NB60	No flush	Chewing at post	No flush	No flush	No flush	No flush	Evidence of nesting activity
NB63	No flush	Flushed female CBC, likely to be incubating eggs	Flushed female CBC, likely to be incubating eggs	Camera check: small chick in nest	Camera check: Large chick in nest	Chick fledged	Confirmed breeding event: assumed successful
NB64	No flush	Chewing at post	No flush	No flush	No flush	No flush	Evidence of nesting activity

HT ID	Inspection date						Result
	15/08/2019	17/09/2019	22/10/2019	22/11/2019	21/12/2019	20/01/2020	
NB65	No flush	Chewing at post	No flush	No flush	No flush	No flush	Evidence of nesting activity
NB68	No flush	No flush	No flush	Flushed female CBC, likely to be prospecting hollow	No flush, no eggs in hollow	No flush	Evidence of nesting activity
NB76	No flush	No flush	No flush	Chewing at post	No flush	No flush	Evidence of nesting activity
NB77	No flush	No flush		Chewing at post	No flush	No flush	Evidence of nesting activity
HT04579	No flush	No flush	Chewing at hollow entrance	No flush	No flush	No flush	Evidence of nesting activity
HT04588	No flush	No flush	Chewing at hollow entrance	No flush	No flush	No flush	Evidence of nesting activity
HT06348	No flush	No flush	Flushed female CBC, camera check: 2 eggs in nest	Camera check: eggs predated	No flush	No flush	Confirmed breeding event: unsuccessful
HT12765	No flush	No flush	No flush	Flushed female CBC, likely to be incubating eggs	No flush, tree too close to powerlines to inspect with pole camera	No flush	Confirmed breeding event
HT13507	No flush	Flushed female CBC, likely to be incubating eggs	No flush, hollow too high to inspect with pole camera	No flush	No flush	No flush	Confirmed breeding event
HT13585	No flush	No flush	Chewing at hollow entrance	No flush	No flush	No flush	Evidence of nesting activity
HT14657	No flush	Flushed female CBC, likely to be prospecting hollow	No flush	No flush, no eggs or chicks seen in hollow	Prospecting pair in tree hollows	No flush	Evidence of nesting activity



Service: Mapbox Credits; Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Main Roads WA Great Northern Highway, M2W Upgrade Project	
Project No	1272
Date	26-Mar-20
Drawn by	AJ
Map author	AJ

1:70,000 (at A4) GDA 1994 MGA Zone 50

- Study area
 - Disturbance footprint
 - Road
- Results**
- ▲ Confirmed breeding event
 - Evidence of nesting activity
 - No evidence of breeding
 - Not surveyed (no access/no longer suitable, cleared)

Figure 2
Monitoring results for 2018-19 breeding season



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Figure 3 Female flushed from a nest box (September 2019)



Figure 4 Chick in nest box (December 2019)

3.2 COMPARISON BETWEEN MONITORING SEASONS

The number of confirmed Carnaby's Cockatoo breeding events in the 2019-20 breeding season is about consistent with the pre-impact average, however the nesting activity was significantly higher than the pre-impact average, particularly the 2018-2019 breeding season which surveyed a comparable number of artificial and natural nesting hollows (Table 3).

Breeding events and evidence of nesting activity in the 2019-20 season were identified in the same general areas as in the previous seasons, including the two areas that were identified as having a higher rate of breeding activity, Reserve 40350 and Lot 512 (Figure 3). An additional cluster where there was evidence of nesting or breeding activity was on a property where several artificial nesting hollows were installed after it was observed that Carnaby's Cockatoos were present in higher numbers, indicating the area could be a favourable breeding area (Nesci Estate and surrounding road reserve) (Phoenix 2017b).

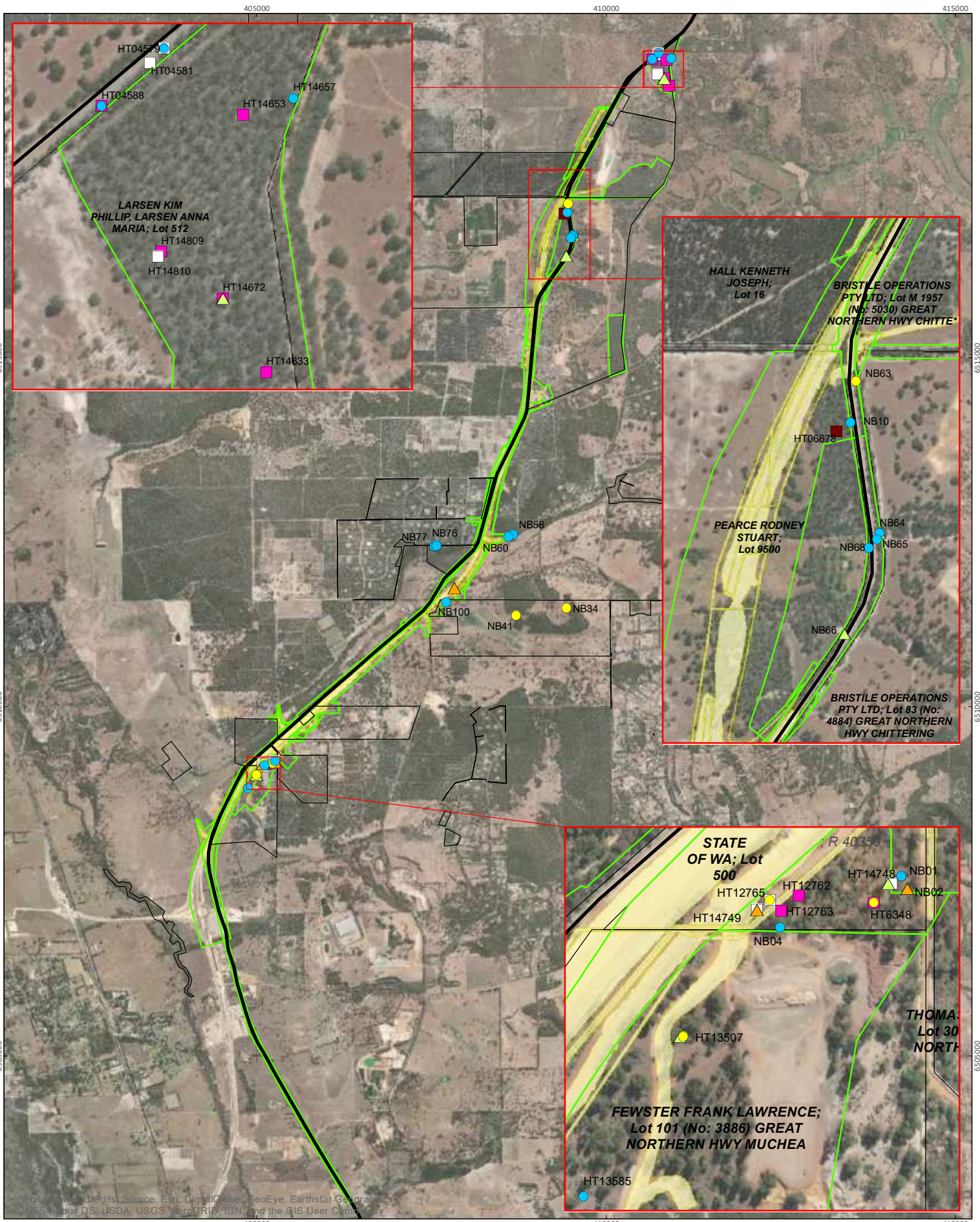
The natural nesting hollows which recorded a confirmed breeding event also had evidence of use in the previous breeding seasons, one had a successful breeding event in the 2017-2018 season. Of the four natural nesting hollows which recorded evidence of nesting activity, two had previous evidence, and of these, one had a confirmed breeding event.

The artificial nesting hollows were installed during the 2018-2019 breeding season so there are a few records of use by Carnaby's Cockatoo. However, the 2019-2020 breeding season recorded a higher number of artificial nesting hollows with both confirmed breeding events and evidence of nesting activity other than in the natural nesting hollows. Three of the four confirmed breeding events were observed in the artificial nesting hollows, and these were also the three that had successful outcome (a chick that hatched and had fledged). An additional 10 artificial nesting hollows had evidence of nesting which was also higher than the natural nesting hollows of which six hollows had evidence of nesting activities. This is a good indication that the artificial nesting hollows are providing a suitable alternative to natural nesting hollows in the Muchea area.

Table 3 Summary of results for 2017-18 and 2018-19 breeding seasons

Result type	Baseline records pre 2017-18¹ Natural hollows and existing artificial hollows	2017-18 breeding season Natural hollows and existing artificial hollows	2018-19 breeding season All hollows (natural & existing artificial hollows/new artificial hollows)	Pre-impact average (2017-18 and 2018-19) All hollows	2019-20 breeding season All hollows (natural & existing artificial hollows/new artificial hollows)
Confirmed breeding event	n/a	6	3 (2/1)	5	6 (3/3)
Evidence of nesting activity	24	14	5 (3/2)	10	15 (4/11)
No evidence of breeding	35	13	63 (30/33)	38	52 (26/26)
No longer suitable, not accessible, cleared	n/a	26	25 (24/1)	23	17 (17/0)

¹ Evidence of nesting activity recorded at some point. Not annual census data and cannot be compared with annual census results.



Service: Mapbox Credits; Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Main Roads WA Great Northern Highway, M2W Upgrade Project	
Project No	1272
Date	01-Apr-20
Drawn by	AJ
Map author	AJ
1:70,000 (at A4) GDA 1994 MGA Zone 50	

- Study area
- Disturbance footprint
- Road
- 2019-2020 breeding season**
- Confirmed breeding event
- Evidence of nesting activity

- 2018-2019 breeding season**
- ▲ Confirmed breeding event
- ▲ Evidence of nesting activity
- 2017-2018 breeding season**
- Confirmed breeding event
- Evidence of nesting activity
- Evidence of nesting activity (FRTBC)

Figure 5
Confirmed breeding events and Evidence of nesting activity across breeding seasons



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4 CONCLUSION

Four confirmed Carnaby's Cockatoo breeding events were observed in the 2019-20 season and evidence of nesting was observed in a further 16 hollows, with both natural and artificial nesting hollows showing activity.

The difference in nesting activity recorded between the breeding seasons is not unexpected as the sample size for this monitoring program is small and breeding activity can be highly variable between years.

The 2019-2020 census results indicate that breeding activity is occurring throughout the Muchea North area. Due to the historic large-scale clearing of trees and continuing decline of suitable trees with hollows in the area, all remaining suitable nesting hollows in the study area should be considered of high value to Carnaby's Cockatoo.

Considering the artificial nesting hollows were installed during the previous season, the uptake of many of these for breeding events and several more with evidence of nesting activity indicate the willingness of Carnaby's Cockatoo to utilise these as an alternative to natural nest hollows.

All of the artificial nesting hollows were in good condition and none required any maintenance.

For future monitoring of the nesting hollows, consistent methodology should be employed to that used in the 2019-2020 breeding census. Where possible, pole cameras should be used to inspect suspected breeding events.

5 REFERENCES

- DPaW. 2015. *Fauna notes: Artificial hollows for Carnaby's Cockatoo*. How to monitor and maintain artificial hollows for Carnaby's cockatoo. Department of Parks and Wildlife, Kensington.
- Phoenix. 2015. *Flora and fauna assessment for Muchea North and Chittering study area*. Phoenix Environmental Sciences Pty Ltd, Balcatta, WA. Unpublished report prepared for Muchea to Wubin Integrated Project Team (Main Roads WA, Jacobs and Arup).
- Phoenix. 2017a. *Flora and fauna assessment for Muchea North and Chittering study area - Report addendum*. Phoenix Environmental Sciences Pty Ltd, Balcatta, WA. Unpublished report prepared for Muchea to Wubin Integrated Project Team (Main Roads WA, Jacobs and Arup).
- Phoenix. 2017b. *Memo: Great Northern Highway Muchea to Wubin Upgrade Stage 2: Artificial black cockatoo nest box selection for Muchea North (including Ippolo Road offset site)*. Phoenix Environmental Sciences Pty Ltd, Balcatta, WA. Unpublished memo prepared for Muchea to Wubin Integrated Project Team (Mainroads WA, ASJV).
- Phoenix. 2018. *Muchea North Black Cockatoo breeding activity census*. Phoenix Environmental Sciences Pty Ltd, Balcatta, WA. Unpublished report prepared for Main Roads Western Australia.
- Phoenix. 2019. *Muchea North Black Cockatoo breeding activity census*. Phoenix Environmental Sciences Pty Ltd, Osbourne Park, WA. Unpublished report prepared for Main Roads Western Australia.

Appendix 1 Results for all hollows in in the 2019-20 breeding season

HT ID	15-Aug-19	17-Sep-19	22-Oct-19	22-Nov-19	21-Dec-19	20-01-2020
HT04274	No flush	No flush	No flush	No flush	No flush	no flush
HT04579	No flush	No flush	Chewing at entrance	No flush	No flush	no flush
HT04581	No flush	No flush	No flush	No flush	No flush	no flush
HT04588	No flush	No flush	Slight chewing at entrance	No flush	No flush	no flush
HT05947	No flush	No flush	No flush	No flush	No flush	no flush
HT05954	No flush	No flush	No flush	No flush	No flush	no flush
HT06017	No flush	No flush	No flush	No flush	No flush	no flush
HT06025	No flush	No flush	No flush	No flush	No flush	no flush
HT06160	No flush	No flush	No flush	No flush	No flush	no flush
HT06201	No flush	No flush	No flush	No flush	No flush	no flush
HT06216	No flush	No flush	No flush	No flush	No flush	no flush
HT06330	No flush	No flush	No flush	No flush	No flush	no flush
HT06348	No flush	No flush	Carnaby flushed. 2 eggs	Eggs predated	No flush	no flush
HT06678	No flush	No flush	No flush	No flush	No flush	no flush
HT12761	No flush	No flush	No flush	No flush	No flush	no flush
HT12762	No flush	No flush	No flush	No flush	No flush	no flush
HT12763	No flush	No flush	No flush	No flush	No flush	no flush
HT12765	No flush	No flush	No flush	Carnaby's flushed	No flush	no flush
HT13484	No flush	No flush	No flush	No flush	No flush	no flush

HT13497	No flush	No flush	No flush	No flush	No flush	no flush
HT13506	No flush	No flush	No flush	No flush	No flush	no flush
HT13507	No flush	Carnaby flushed	No flush	No flush	No flush	no flush
HT13508	No flush	No flush	No flush	No flush	No flush	no flush
HT13585	No flush	No flush	Slight chewing at entrance	No flush	No flush	no flush
HT14633	No flush	No flush	No flush	No flush	No flush	no flush
HT14653	No flush	No flush	No flush	No flush	No flush	no flush
HT14657	No flush	Carnaby flushed	No flush	No flush	Pair prospecting hollows	no flush
HT14672	No flush	No flush	No flush	No flush	No flush	no flush
HT14748	No flush	No flush	No flush	No flush	No flush	no flush
HT14749	No flush	No flush	No flush	No flush	No flush	no flush
HT14809	No flush	No flush	No flush	No flush	No flush	no flush
HT14810	No flush	No flush	No flush	No flush	No flush	no flush
HT14811	No flush	No flush	No flush	No flush	No flush	no flush
NB01	Chewing at post	Chewing at post	No flush	No flush	No flush	no flush
NB02	No flush	No flush	No flush	No flush	No flush	no flush
NB03	No flush	No flush	No flush	No flush	No flush	no flush
NB04	No flush	No flush	No flush	Carnaby's flushed	No flush	no flush
NB05	No flush	No flush	No flush	No flush	No flush	no flush
NB06	No flush	No flush	No flush	No flush	No flush	no flush

NB08	No flush	No flush	No flush	No flush	No flush	no flush
NB09	No flush	No flush	No flush	No flush	No flush	no flush
NB10	No flush	Prospecting: female Carnaby flushed then leaves with male. Probably prospecting	No flush	No flush	No flush	no flush
NB11	No flush	No flush	No flush	No flush	No flush	no flush
NB12	No flush	No flush	No flush	No flush	No flush	no flush
NB13	No flush	No flush	No flush	No flush	No flush	no flush
NB14	No flush	No flush	No flush	No flush	No flush	no flush
NB32	No flush	No flush	No flush	No flush	No flush	no flush
NB33	No flush	No flush	No flush	No flush	No flush	no flush
NB34	no flush	no flush	no flush	No flush	Large chick in nest	Chick fledged
NB41	no flush	No flush	No flush	No flush	Large chick in nest - still has down on neck	Chick fledged
NB42	no flush	No flush	No flush	No flush	No flush	no flush
NB46	No flush	No flush	No flush	No flush	No flush	no flush
NB55	No flush	No flush	No flush	No flush	No flush	no flush
NB57	No flush	No flush	No flush	No flush	No flush	no flush
NB58	No flush	No flush	No flush	Carnaby's flushed	No flush	no flush
NB59	No flush	No flush	No flush	No flush	No flush	no flush
NB60	No flush	No flush	Post chewed	No flush	No flush	no flush
NB61	No flush	No flush	No flush	No flush	No flush	no flush

NB62	No flush	No flush	No flush	No flush	No flush	no flush
NB63	No flush	Carnaby's flushed	Carnaby's flushed	Pin feathered chick in nest	Large chick in nest	Chick fledged
NB64	No flush	Post chewed	No flush	No flush - empty	No flush	no flush
NB65	No flush	Post chewed	No flush	No flush	No flush	no flush
NB66	No flush	No flush	No flush	No flush	No flush	no flush
NB67	No flush	No flush	No flush	No flush	No flush	no flush
NB68	No flush	No flush	No flush	Carnaby flushed	No flush	no flush
NB69	No flush	No flush	No flush	No flush	No flush	no flush
NB71	No flush	No flush	No flush	No flush	No flush	no flush
NB76	No flush	No flush	No flush	Post chewed but nest empty	No flush	no flush
NB77	No flush	No flush	No flush	Post chewed but nest empty	No flush	no flush
NB78	no flush	No flush	No flush	No flush. Pair of Carnaby's nearby. Male making mating call	No flush	no flush
NB79	No flush	No flush	No flush	No flush	No flush	no flush
NB99	No flush	no flush	no flush	No flush	No flush	no flush
NB100	no flush	no flush	no flush	No flush	No flush - very old Carnaby's tail feather in nest	no flush

Appendix 2 Results for all hollows in 2017-18 and 2018-19 breeding season

HT ID	Result 2017-18	Result 2018-19	Result 2019-20
HT04059	No evidence of breeding	No evidence of breeding	Tree cleared. Further monitoring not required
HT04274	No evidence of breeding	No evidence of breeding	No evidence of breeding
HT04579	Confirmed breeding event - failed	No evidence of breeding	No evidence of breeding
HT04581	Confirmed breeding event - failed	No evidence of breeding	No evidence of breeding
HT04588	Evidence of nesting activity	No evidence of breeding	Evidence of nesting activity
HT05911	No access	Hollow not located	Tree cleared. Further monitoring not required
HT05923	No evidence of breeding	Tree cleared. Further monitoring not required	n/a
HT05938	No longer suitable hollow. Further monitoring not required	n/a	n/a
HT05947	No evidence of breeding	Not located	No evidence of breeding
HT05954	No evidence of breeding	No evidence of breeding	No evidence of breeding
HT06017	No access	No evidence of breeding	No evidence of breeding
HT06020	No access	Tree cleared. Further monitoring not required	n/a
HT06025	No access	No evidence of breeding	No evidence of breeding
HT06046	No access	Tree cleared. Further monitoring not required	n/a
HT06148	No longer suitable. Further monitoring not required	n/a	n/a
HT06160	No evidence of breeding	No evidence of breeding	No evidence of breeding
HT06201	No evidence of breeding	No evidence of breeding	No evidence of breeding
HT06216	No evidence of breeding	No evidence of breeding	No evidence of breeding
HT06261	No evidence of breeding	Tree cleared. Further monitoring not required.	n/a

HT ID	Result 2017-18	Result 2018-19	Result 2019-20
HT06278	Evidence of nesting activity	Tree cleared. Further monitoring not required.	n/a
HT06330	Not sampled	No evidence of breeding. Added to breeding census in 2018-19	No evidence of breeding
HT06348	Evidence of nesting activity	No evidence of breeding	Confirmed breeding event - failed
HT06421	No access. Evidence of nesting activity (from a distance)	No access	n/a
HT06655	No longer suitable. Further monitoring not required	Tree cleared. Further monitoring not required	n/a
HT06678	Evidence of nesting activity (FRTBC)	No evidence of breeding	No evidence of breeding
HT08752	No evidence of breeding	Tree cleared. Further monitoring not required	n/a
HT08753	Evidence of nesting activity	No evidence of breeding	Tree cleared. Further monitoring not required
HT08754	No access	Confirmed breeding event	Tree cleared. Further monitoring not required
HT12761	Hollow not located	Hollow not located	No evidence of breeding
HT12762	Evidence of nesting activity	No evidence of breeding	No evidence of breeding
HT12763	Evidence of nesting activity	No evidence of breeding	No evidence of breeding
HT12765	Confirmed breeding event - successful	No evidence of breeding	Confirmed breeding event
HT13484	No access	No evidence of breeding	No evidence of breeding
HT13497	No access	No evidence of breeding	No evidence of breeding
HT13503	No access	No longer suitable. Further monitoring not required	n/a
HT13505	No access	No longer suitable. Further monitoring not required	n/a
HT13506	No access	No evidence of breeding	No evidence of breeding
HT13507	No access	Evidence of nesting activity	

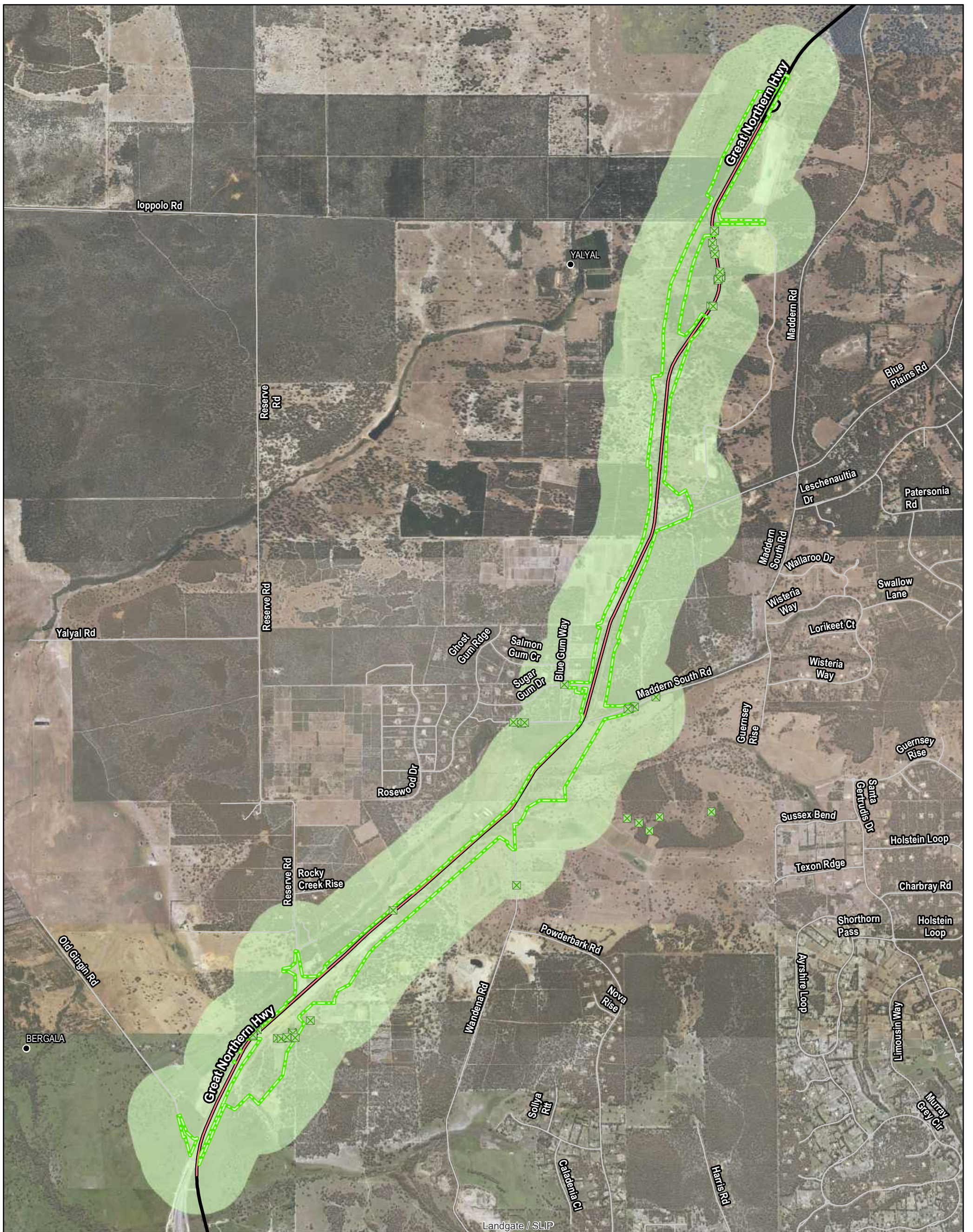
HT ID	Result 2017-18	Result 2018-19	Result 2019-20
HT13508	No access	No evidence of breeding	No evidence of breeding
HT13511	No access	No longer suitable. Further monitoring not required	n/a
HT13523	No access	No longer suitable. Further monitoring not required	n/a
HT13533	No evidence of breeding	No evidence of breeding	Tree cleared. Further monitoring not required
HT13534	Evidence of nesting activity	Tree cleared. Further monitoring not required	n/a
HT13535	Evidence of nesting activity	Tree cleared. Further monitoring not required	n/a
HT13585	Not sampled	No evidence of breeding. Added to breeding census in 2018-19, chewing observed at hollow	Evidence of nesting activity
HT14633	Evidence of nesting activity	No evidence of breeding	No evidence of breeding
HT14653	Evidence of nesting activity	No evidence of breeding	No evidence of breeding
HT14657	No evidence of breeding	No evidence of breeding	Evidence of nesting activity
HT14670	Collapsed, no longer suitable. Further monitoring not required	n/a	n/a
HT14672	Evidence of nesting activity	Evidence of nesting activity	No evidence of breeding
HT14748	Confirmed breeding event - successful	Evidence of nesting activity	No evidence of breeding
HT14749	Confirmed breeding event - successful	Confirmed breeding event	No evidence of breeding
HT14805	No access	No access	No longer suitable. Further monitoring not required
HT14806	No access	No access	No longer suitable. Further monitoring not required
HT14807	No access	No access	No longer suitable. Further monitoring not required
HT14808	No access	No access	No longer suitable. Further monitoring not required
HT14809	Evidence of nesting activity	No evidence of breeding	No evidence of breeding

HT ID	Result 2017-18	Result 2018-19	Result 2019-20
HT14810	Confirmed breeding event - failed	No evidence of breeding	No evidence of breeding
HT14811	No evidence of breeding	No evidence of breeding	No evidence of breeding
NB01	n/a	No evidence of breeding	Evidence of nesting activity
NB02	n/a	Confirmed breeding event	No evidence of breeding
NB03	n/a	No evidence of breeding	No evidence of breeding
NB04	n/a	No evidence of breeding	Evidence of nesting activity
NB05	n/a	No evidence of breeding	No evidence of breeding
NB06	n/a	No evidence of breeding	No evidence of breeding
NB08	n/a	No evidence of breeding	No evidence of breeding
NB09	n/a	No evidence of breeding	No evidence of breeding
NB10	n/a	No evidence of breeding	Evidence of nesting activity
NB11	n/a	No evidence of breeding	No evidence of breeding
NB12	n/a	No evidence of breeding	No evidence of breeding
NB13	n/a	No evidence of breeding	No evidence of breeding
NB14	n/a	No evidence of breeding	No evidence of breeding
NB32	n/a	No evidence of breeding/no access	No evidence of breeding
NB33	n/a	No evidence of breeding/no access	No evidence of breeding
NB34	n/a	n/a	Confirmed breeding event
NB41	n/a	n/a	Confirmed breeding event
NB42	n/a	n/a	No evidence of breeding
NB46	n/a	No evidence of breeding	No evidence of breeding

HT ID	Result 2017-18	Result 2018-19	Result 2019-20
NB55	n/a	No evidence of breeding	No evidence of breeding
NB57	n/a	No evidence of breeding	No evidence of breeding
NB58	n/a	No evidence of breeding	Evidence of nesting activity
NB59	n/a	No evidence of breeding	No evidence of breeding
NB60	n/a	No evidence of breeding	Evidence of nesting activity
NB61	n/a	No evidence of breeding	No evidence of breeding
NB62	n/a	No evidence of breeding	No evidence of breeding
NB63	n/a	No evidence of breeding	Confirmed breeding event
NB64	n/a	Evidence of nesting activity	Evidence of nesting activity
NB65	n/a	No evidence of breeding	Evidence of nesting activity
NB66	n/a	Evidence of nesting activity	No evidence of breeding
NB67	n/a	No evidence of breeding	No evidence of breeding
NB68	n/a	No evidence of breeding	Evidence of nesting activity
NB69	n/a	No evidence of breeding	No evidence of breeding
NB71	n/a	No evidence of breeding	No evidence of breeding
NB76	n/a	No evidence of breeding	Evidence of nesting activity
NB77	n/a	No evidence of breeding	Evidence of nesting activity
NB78	n/a	No evidence of breeding	No evidence of breeding
NB79	n/a	No evidence of breeding	No evidence of breeding
NB99	n/a	No evidence of breeding	No evidence of breeding
NB100	n/a	n/a	Evidence of nesting activity



Attachment 5: Artificial nest box locations



Legend

- Installed Nest Box Trees
- EPBC Approval Boundary
- 500m Buffer to EPBC Approval Boundary
- Locality
- Freeway / Highway
- Major Road
- Minor Road
- GNH Road Centreline (H006)
- GNH Design Alignment

Data Source: Main Roads WA, Landgate



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 Arup Pty Ltd
 Level 14 Exchange Tower
 2 The Esplanade
 Perth WA 6000
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 www.arup.com

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 www.jacobs.com

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0 420 840
 Metres
 Scale at A3
 1:35,000

Coordinate System: GDA 1994 MGA Zone 50



Main Roads Western Australia

Great Northern Highway
 Murchison to Wubin Upgrade Stage 2

Location of installed artificial nest boxes

Drawing No: GNH-CN03-EN01-GIS-0109 Issue: A

Task No: GNH-XXX Drawing Status / Other: Draft / Other Info

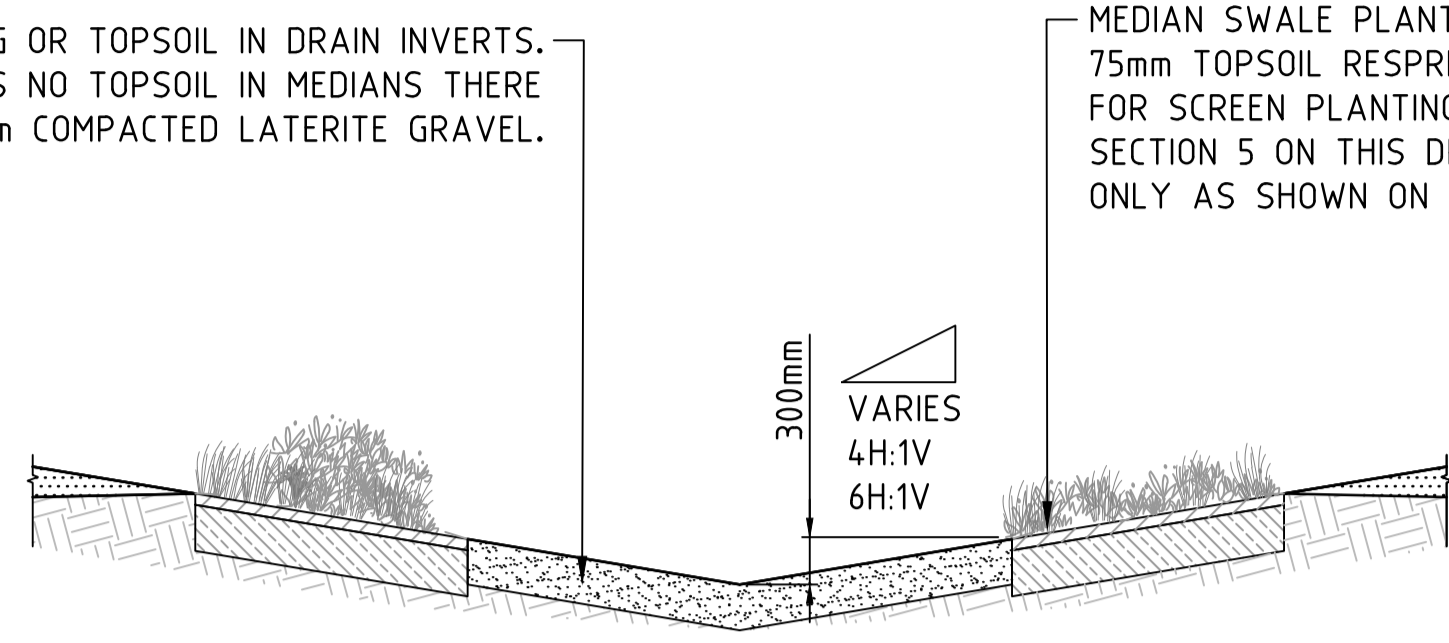
Date	By	Chkd	Appd
12/11/2019	FK	GJ	GJ

Attachment 6: Revegetation Plans and Species Lists

Plot Date : 19 Oct 2018, 3:13pm

LANDSCAPING CURRENTLY BEING COMPLETED. RED-LINE MARK-UPS TO BE ISSUED SEPARATELY ONCE COMPLETE.

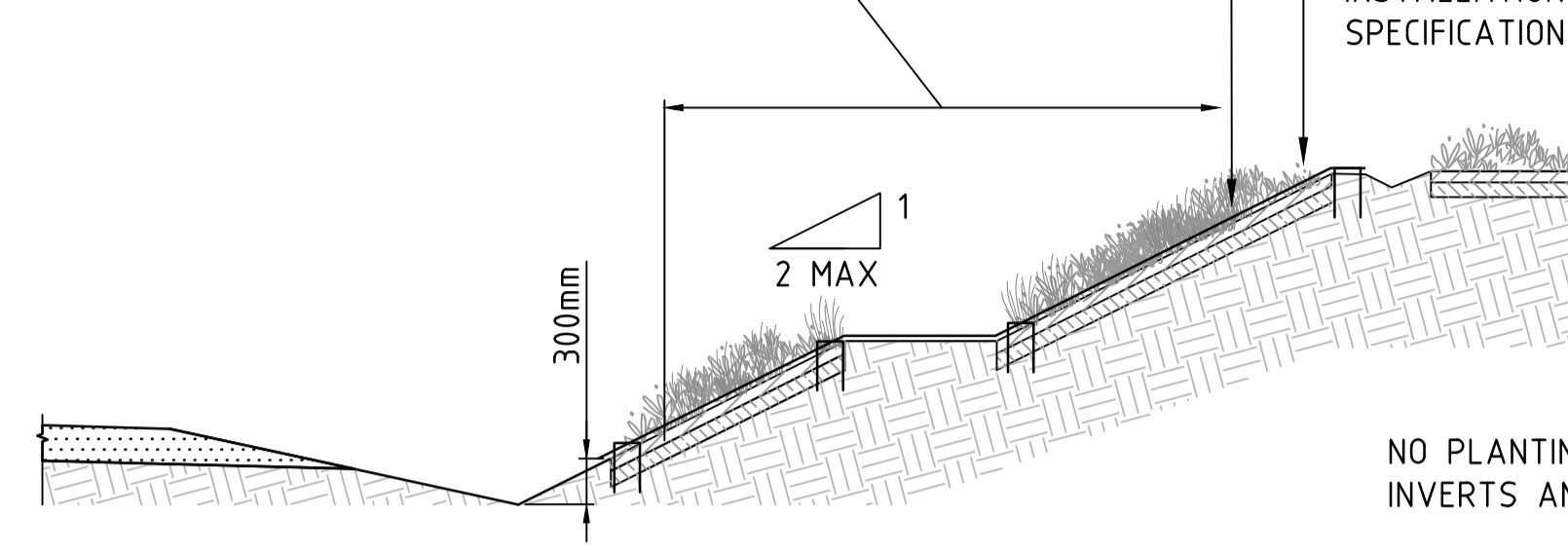
NO PLANTING OR TOPSOIL IN DRAIN INVERTS. WHERE THERE IS NO TOPSOIL IN MEDIANS THERE SHALL BE 300mm COMPACTED LATERITE GRAVEL.



TYPICAL PLANTING SECTION 1 - MEDIAN PLANTING MAX 1:4 SLOPES
1:50

ON 1:2 BATTERS PLACE Max 75mm TOPSOIL AND Max 75mm MULCH ON RIPPED OR CULTIVATED BATTER

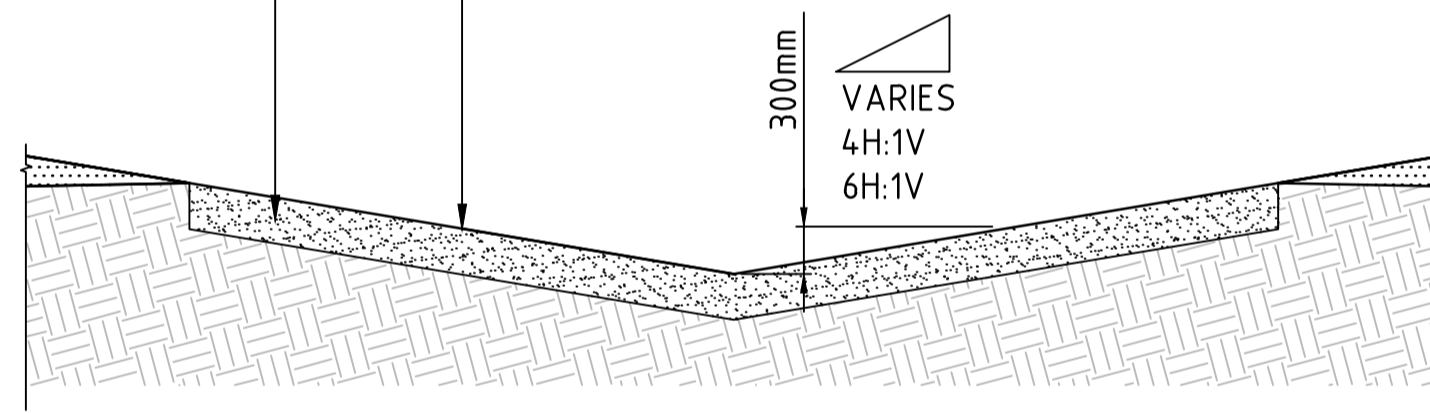
SCREEN TREE PLANTING BEGINS AFTER CLEAR ZONE OFFSET



TYPICAL PLANTING SECTION 4 - PLANTING ON 1:2 BATTERS WITH JUTE MATTING
1:50

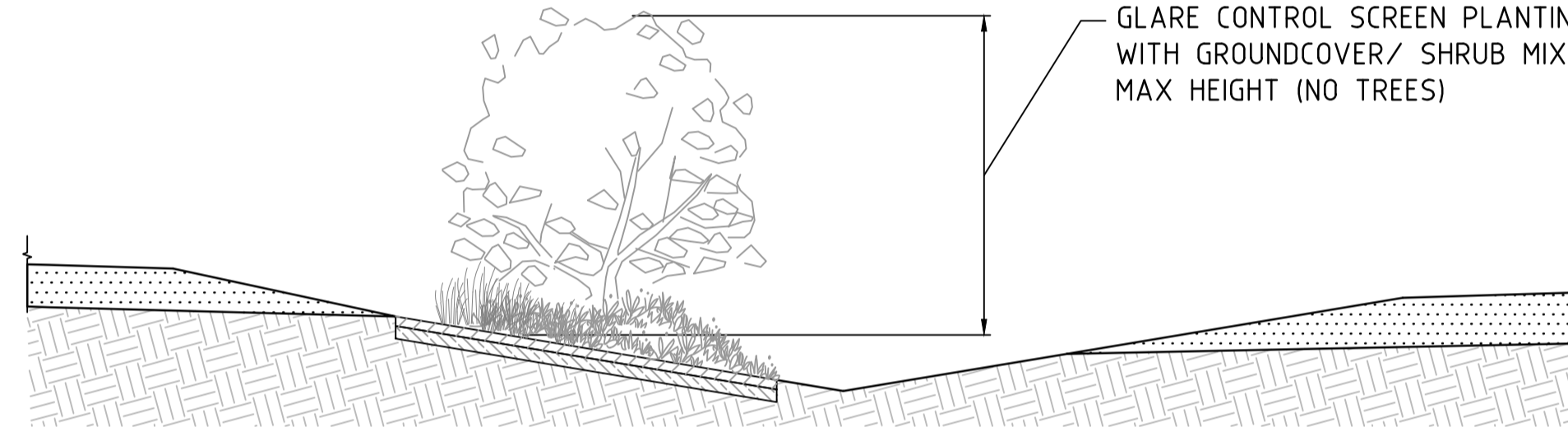
SPECIAL MEDIAN TREATMENT - LATERITE GRAVEL WHERE THERE IS NO TOPSOIL/PLANTING. LATERITE GRAVEL SHALL BE 300mm DEEP COMPACTED AND SOURCED FROM SITE. AREAS SHOWN ON LANDSCAPING PLANS, DRG Nos. GNH-CN03-RW01-DRG-5601 TO 5620

NO PLANTING OR TOPSOIL UNDER OR OVER COMPACTED LATERITE GRAVEL



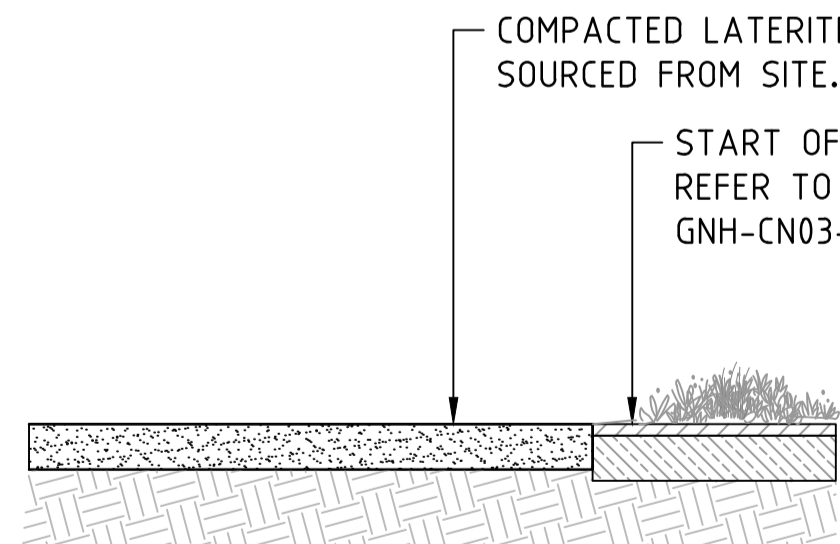
TYPICAL PLANTING SECTION 2 - MEDIAN GRAVEL MAX 1:4 SLOPES
1:50

GLARE CONTROL SCREEN PLANTING WITH GROUND COVER / SHRUB MIX 3m MAX HEIGHT (NO TREES)



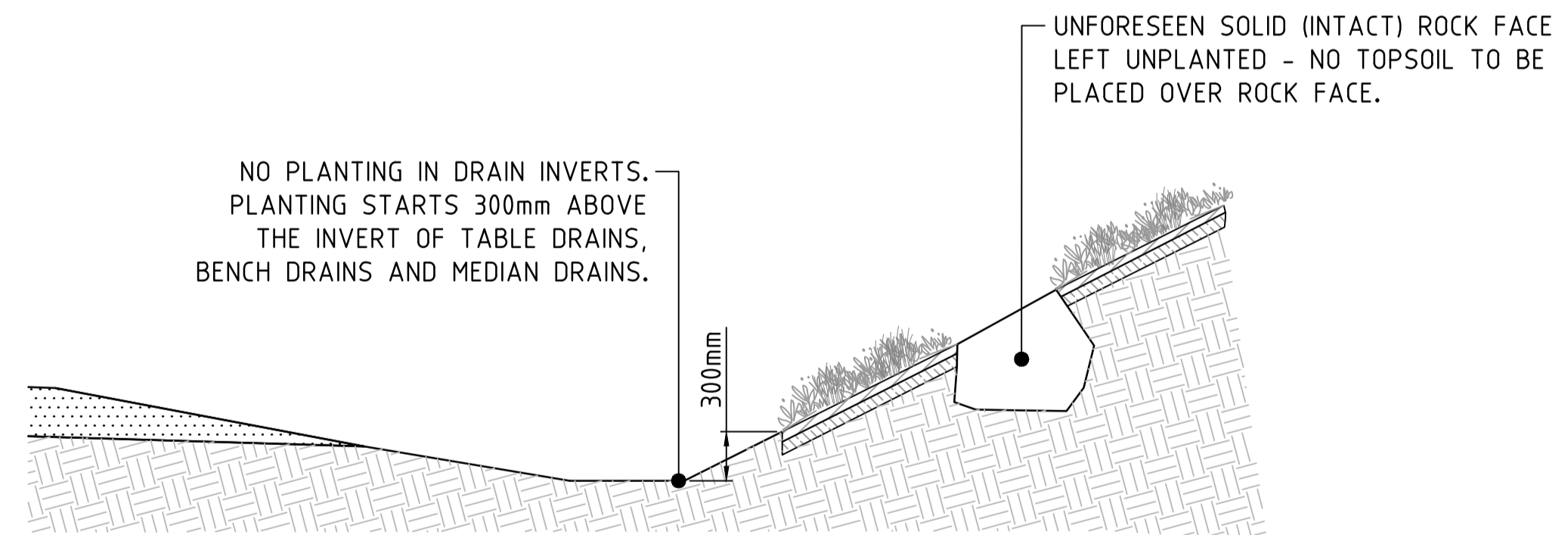
TYPICAL PLANTING SECTION 5 - GLARE CONTROL SHRUB PLANTING IN MEDIANS WHERE SPACE ALLOWS
1:50

COMPACTED LATERITE GRAVEL SOURCED FROM SITE.
START OF PLANTING IN MEDIAN DRAINS REFER TO LANDSCAPING PLANS, DRG Nos. GNH-CN03-RW01-DRG-5601 TO 5620



TYPICAL PLANTING SECTION 3 - MEDIAN GRAVEL INTERSECTION WITH PLANTING
1:50

NO PLANTING IN DRAIN INVERTS. PLANTING STARTS 300mm ABOVE THE INVERT OF TABLE DRAINS, BENCH DRAINS AND MEDIAN DRAINS.



TYPICAL PLANTING SECTION 6 - UNFORESEEN ROCK FACE
1:50

ISSUED FOR CONSTRUCTION

FILENAME : C:\Users\heliwood\Desktop\Prints\2018-10-19\GNH-CN03-RW01-DRG-5101.dwg

1:50 (A1) / 1:100 (A3) 0 500mm 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 6000 6500 7000 7500

A 1

NOTE: ALL DRAWINGS ARE CONSIDERED UNCONTROLLED UNLESS STAMPED 'CONTROLLED COPY' IN RED

METADATA

GROUND SURVEY STANDARD: 67-08-43
DATE OF CAPTURE: 27.02.2012
MAPPING SURVEY STANDARD: 67-08-44
DATE OF CAPTURE: 27.02.2012
MAIN ROADS PROJECT ZONE: MUCHEA94
HEIGHT DATUM: AHD

DRAWN: L. RONCHI
CHECKED: T. SIMPSON
DESIGNED: A. BRADFIELD
CHECKED: C. MADIGAN
APPROVED: J. WEAR
DATE: 17.10.2018



LOCAL AUTHORITY: (502) SHIRE OF CHITTERING
MAIN ROADS RESPONSIBILITY AREA: WHEATBELT



INFRASTRUCTURE DELIVERY DIRECTORATE

HWMA DRAWING NUMBER: 201708-600

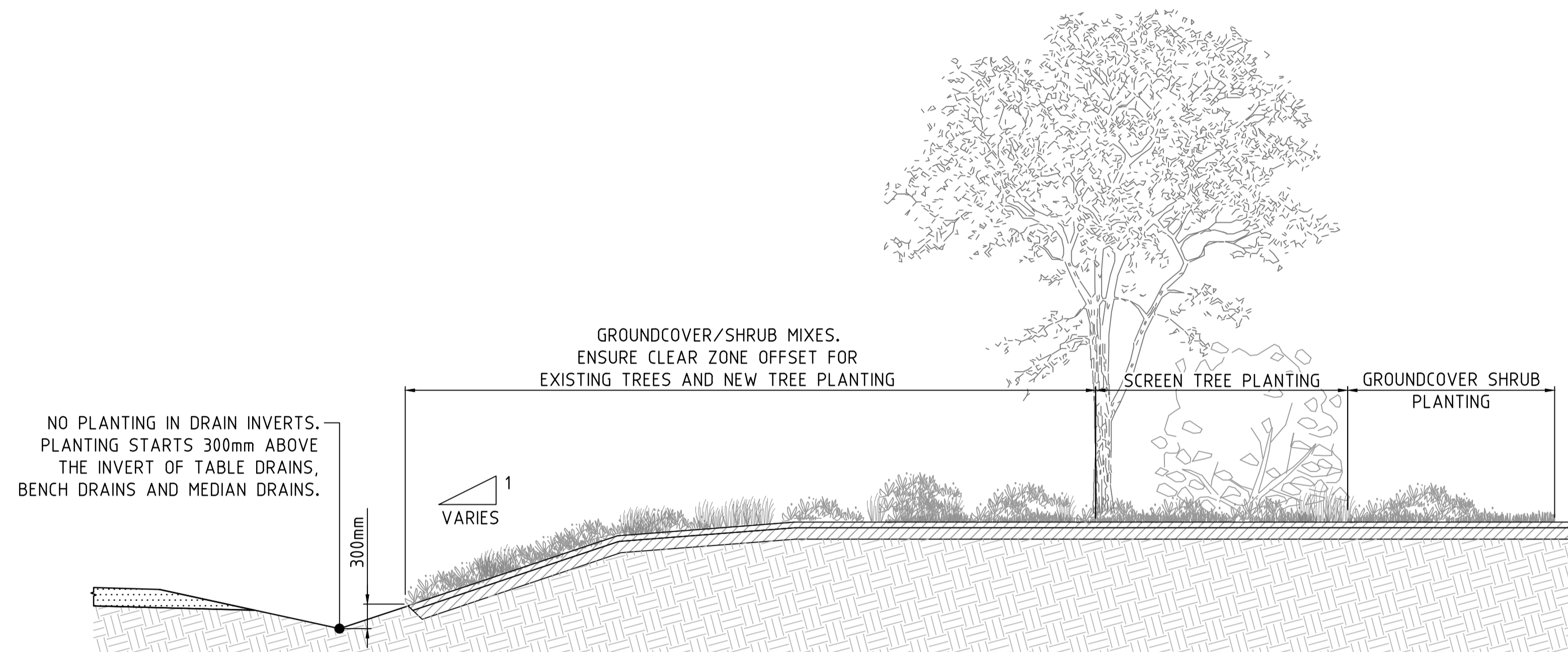
PROJECT TITLE: GREAT NORTHERN HIGHWAY (H006) - MUCHEA TO WUBIN STAGE 2
DRAWING TITLE: OLD GINGIN ROAD TO CHITTERING ROADHOUSE - SLK 38.6 TO SLK 51.1
LANDSCAPING TYPICAL PLANTING SECTIONS SHEET 1

DRAWING STATUS: CONSTRUCTION
DRAWING No.: GNH-CN03-RW01-DRG-5101
REV: 0

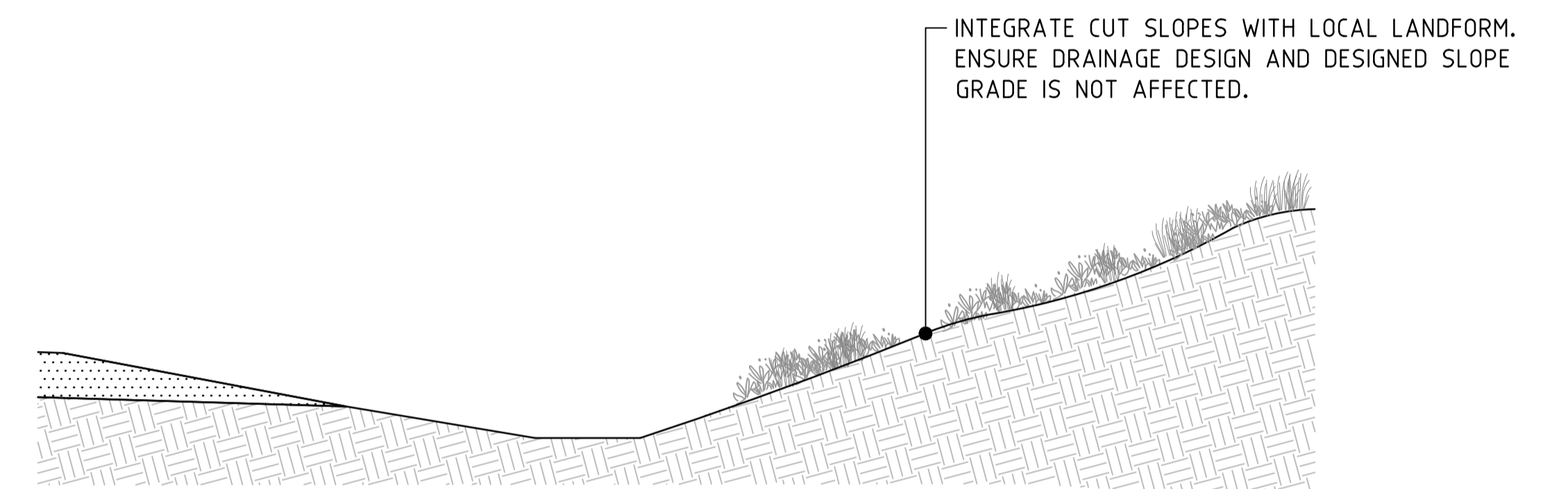
PROJECT DIRECTOR: B. WOODS
DATE: 17.10.2018

PROJECT DIRECTOR: N. FOX
DATE: 17.10.2018

LANDSCAPING CURRENTLY BEING COMPLETED. RED-LINE MARK-UPS TO BE ISSUED SEPARATELY ONCE COMPLETE.



TYPICAL PLANTING SECTION 7 - SCREEN TREE MIX SET BACK FROM ROAD
1:50



TYPICAL PLANTING SECTION 8 - INTEGRATED CUT SLOPES
1:50

ISSUED FOR CONSTRUCTION

NOTE: ALL DRAWINGS ARE CONSIDERED UNCONTROLLED UNLESS STAMPED "CONTROLLED COPY" IN RED



No.	DESCRIPTION	APPROVED & DATE	No.	DESCRIPTION	APPROVED & DATE
0	ISSUED FOR CONSTRUCTION	J.WEAR 17.10.18			
AMENDMENTS					

METADATA	
GROUND SURVEY STANDARD:	67-08-43
DATE OF CAPTURE:	27.02.2012
MAPPING SURVEY STANDARD:	67-08-44
DATE OF CAPTURE:	27.02.2012
MAIN ROADS PROJECT ZONE:	MUCHEA94
HEIGHT DATUM:	AHD

DRAWN	L.RONCHI
CHECKED	J. LACON
DESIGNED	A.BRADFIELD
CHECKED	C. MADIGAN
APPROVED	J.WEAR
DATE	17.10.2018

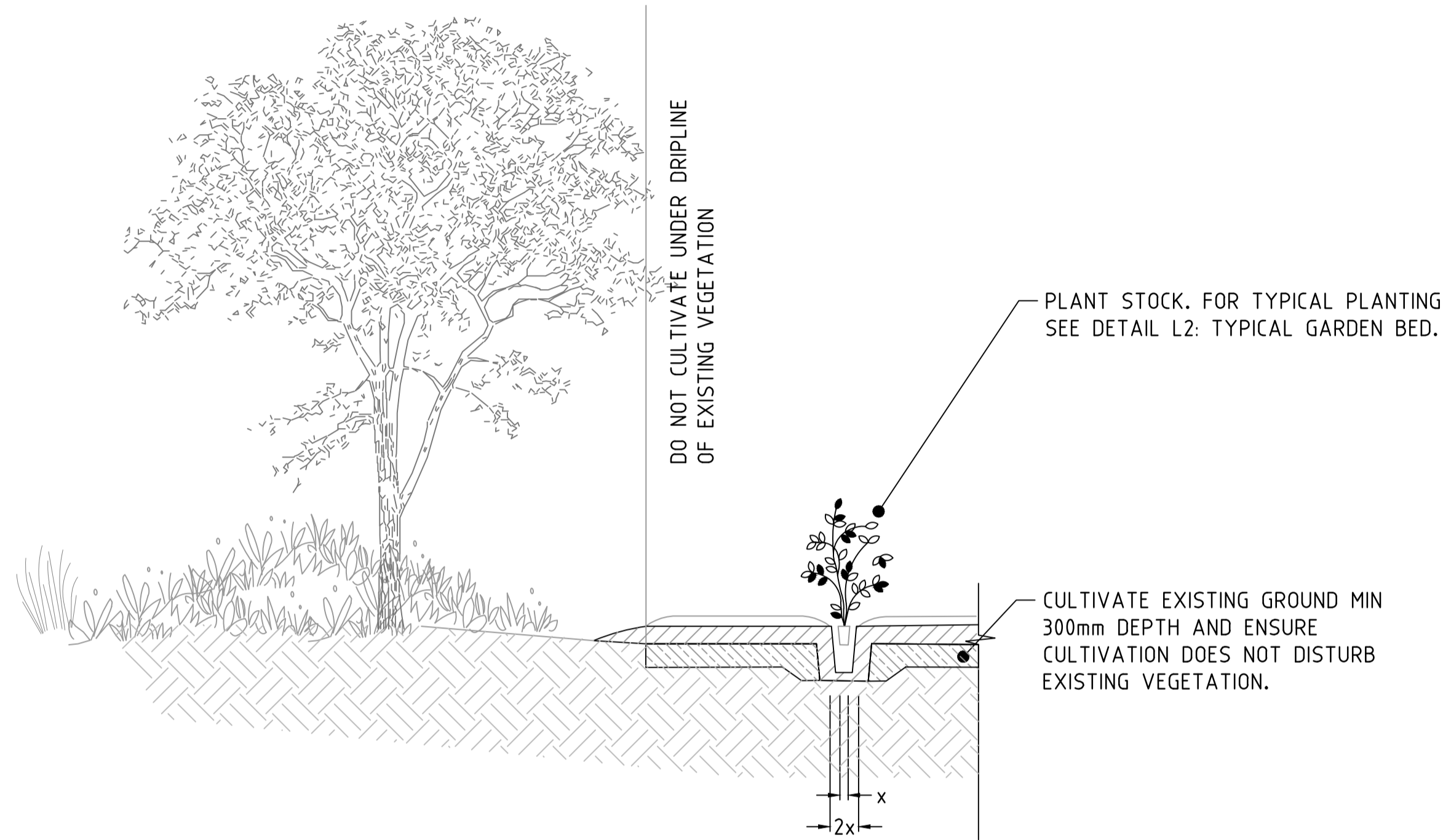




LOCAL AUTHORITY: (502) SHIRE OF CHITTERING
 MAIN ROADS RESPONSIBILITY AREA: WHEATBELT


 INFRASTRUCTURE DELIVERY DIRECTORATE

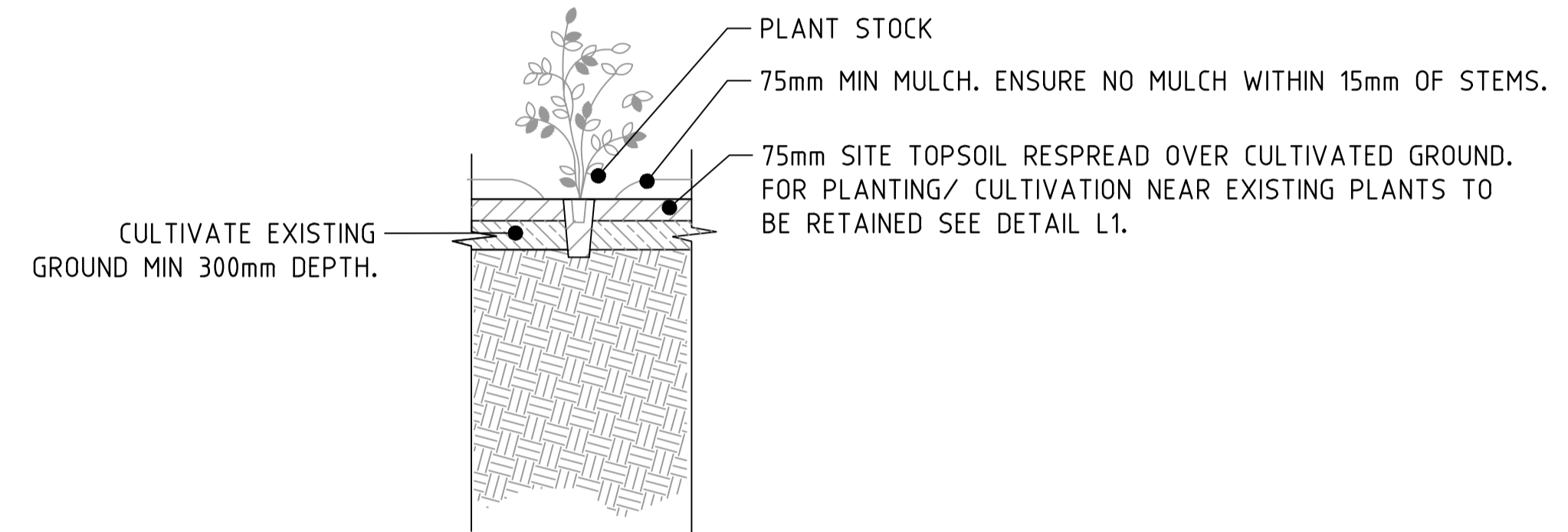
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PROJECT TITLE	GREAT NORTHERN HIGHWAY (H006) - MUCHEA TO WUBIN STAGE 2
DRAWING TITLE	OLD GINGIN ROAD TO CHITTERING ROADHOUSE - SLK 38.6 TO SLK 51.1 LANDSCAPING TYPICAL PLANTING SECTIONS SHEET 2
DRAWING STATUS	CONSTRUCTION
DRAWING No.	GNH-CN03-RW01-DRG-5102
REV	0

LANDSCAPING CURRENTLY BEING COMPLETED. RED-LINE MARK-UPS TO BE ISSUED SEPARATELY ONCE COMPLETE.



DETAIL L1: STANDARD PLANT STOCK PLANTING ADJACENT TO EXISTING VEGETATION

1:20



DETAIL L2: TYPICAL GARDEN BED - SLOPES LESS THAN OR EQUAL TO 1:4

1:20

ISSUED FOR CONSTRUCTION

1:20 (A1) / 1:40 (A3) 0 200mm 400 600 800 1000 1200 1400 1600 1800 2000 2200 2400 2600 2800 3000

A 1

NOTE: ALL DRAWINGS ARE CONSIDERED UNCONTROLLED UNLESS STAMPED 'CONTROLLED COPY' IN RED

METADATA

GROUND SURVEY STANDARD: 67-08-43
 DATE OF CAPTURE: 27.02.2012
 MAPPING SURVEY STANDARD: 67-08-44
 DATE OF CAPTURE: 27.02.2012
 MAIN ROADS PROJECT ZONE: MUCHEA94
 HEIGHT DATUM: AHD

DRAWN: L. RONCHI
 CHECKED: J. LACON
 DESIGNED: A. BRADFIELD
 CHECKED: C. MADIGAN
 APPROVED: J. WEAR
 DATE: 17.10.2018



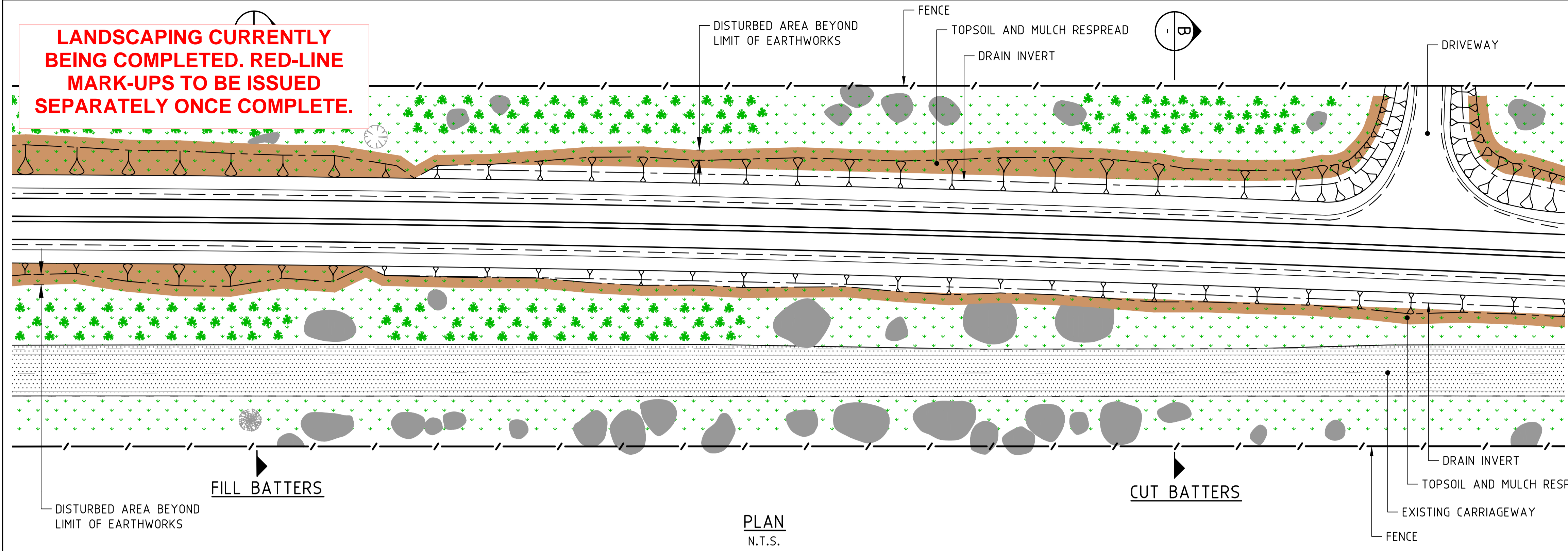
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 INFRASTRUCTURE DELIVERY DIRECTORATE

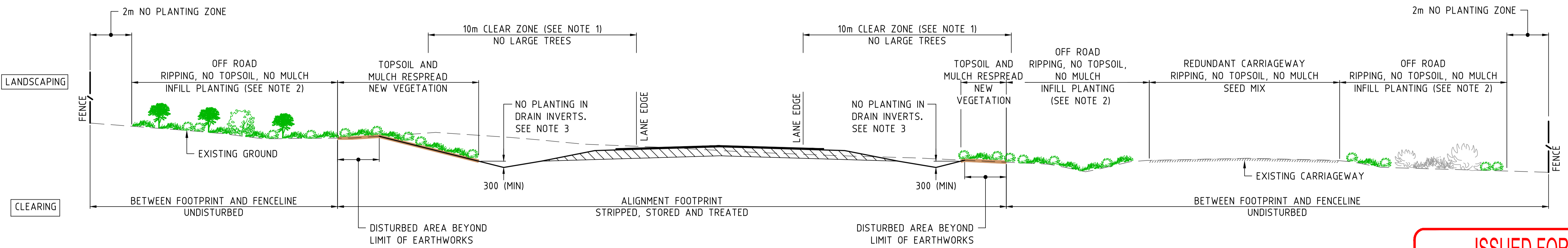
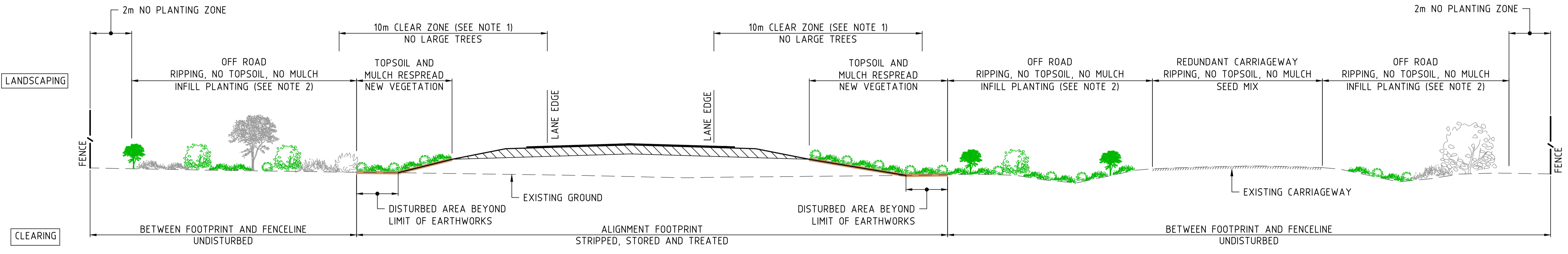
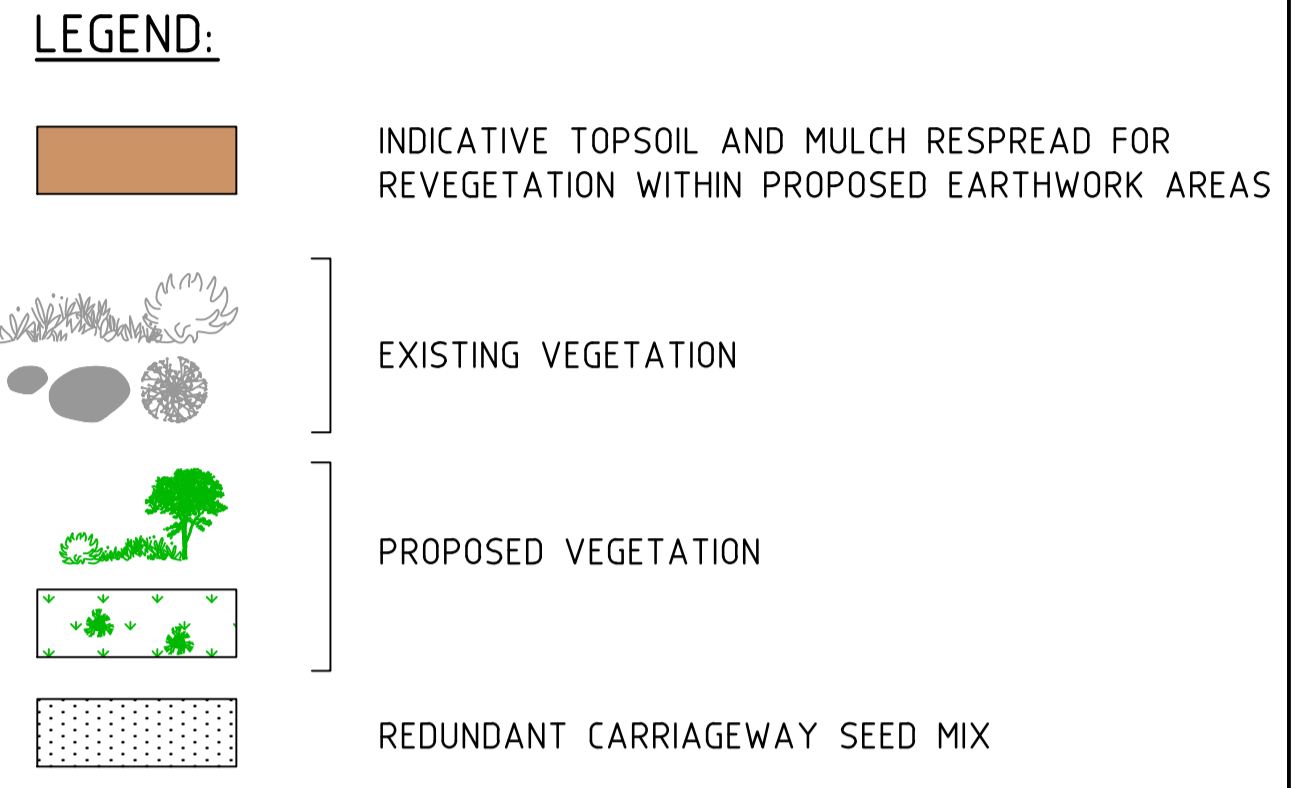
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GREAT NORTHERN HIGHWAY (H006) - MUCHEA TO WUBIN STAGE 2			
DRAWING TITLE		OLD GINGIN ROAD TO CHITTERING ROADHOUSE - SLK 38.6 TO SLK 51.1	
LANDSCAPING TYPICAL DETAILS			
DRAWING STATUS	CONSTRUCTION	DRAWING No.	GNH-CN03-RW01-DRG-5103
REV	0		

Plot Date : 10 Jul 2019, 9:38am

LANDSCAPING CURRENTLY BEING COMPLETED. RED-LINE MARK-UPS TO BE ISSUED SEPARATELY ONCE COMPLETE.



- NOTES:**
- 10m CLEAR ZONE OR AS SHOWN ON LANDSCAPING PLANS.
 - OFF ROAD
 - RIPPING TO AVOID EXISTING NATIVE VEGETATION.
 - NO TOPSOIL AND NO MULCH. EXCESS TOPSOIL AND MULCH TO BE USED IN OFF ROAD AREAS ONLY AFTER TOPSOIL AND MULCH RESPREAD FOR REVEGATION WITHIN PROPOSED EARTHWORK AREAS IS EXHAUSTED.
 - INFILL PLANTING TO BE PLANTSTOCK MIXES. SEED MIXES USED IN LIMITED AREAS (e.g. WILDFLOWER GROUNDCOVER SEED MIX).
 - NO PLANTING IN DRAIN INVERTS. PLANTING STARTS 300mm ABOVE THE INVERT OF TABLE DRAINS, BENCH DRAINS AND MEDIAN DRAINS.



ISSUED FOR CONSTRUCTION

FILENAME: C:\Users\hellwood\AppData\Local\Projectwise\vsjv_norcomex\mins\6618\GNH-CN03-RW01-DRG-5104.dwg

NOTE: ALL DRAWINGS ARE CONSIDERED UNCONTROLLED UNLESS STAMPED "CONTROLLED COPY" IN RED					<p>METADATA</p> <p>GROUND SURVEY STANDARD: DATE OF CAPTURE: MAPPING SURVEY STANDARD: DATE OF CAPTURE: MAIN ROADS PROJECT ZONE: HEIGHT DATUM:</p>		<p>DRAWN: T.SIMPSON CHECKED: H.ELLWOOD DESIGNED: T.SIMPSON CHECKED: S.DEABREU APPROVED: J.WEAR DATE: 10.07.2019</p>				<p>LOCAL AUTHORITY: (502) SHIRE OF CHITTERING MAIN ROADS RESPONSIBILITY AREA: WHEATBELT HWMA DRAWING NUMBER: 201708-605 PROJECT TITLE: GREAT NORTHERN HIGHWAY (H006) - MUCHEA TO WUBIN STAGE 2 DRAWING TITLE: OLD GINGIN ROAD TO CHITTERING ROADHOUSE - SLK 38.6 TO SLK 51.1 LANDSCAPING TYPICAL CROSS SECTIONS - REVEGATION</p>		<p>ISSUED FOR CONSTRUCTION</p> <p>APPROVED & DATE: J.WEAR 10.07.19</p> <p>AMENDMENTS</p> <table border="1"> <thead> <tr> <th>No.</th> <th>DESCRIPTION</th> <th>APPROVED & DATE</th> <th>No.</th> <th>DESCRIPTION</th> <th>APPROVED & DATE</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>ISSUED FOR CONSTRUCTION</td> <td>J.WEAR 10.07.19</td> <td></td> <td></td> <td></td> </tr> </tbody> </table>		No.	DESCRIPTION	APPROVED & DATE	No.	DESCRIPTION	APPROVED & DATE	0	ISSUED FOR CONSTRUCTION	J.WEAR 10.07.19			
No.	DESCRIPTION	APPROVED & DATE	No.	DESCRIPTION	APPROVED & DATE																					
0	ISSUED FOR CONSTRUCTION	J.WEAR 10.07.19																								
<p>PROJECT DIRECTOR: N.SCOTT DATE: 10.07.2019</p>			<p>PROJECT DIRECTOR: N.FOX DATE: 10.07.2019</p>			<p>DRAWING STATUS: CONSTRUCTION DRAWING No: GNH-CN03-RW01-DRG-5104</p>		<p>SHEET: 0</p>																		

Mix 1 Paddock Mix - Shrubs and Groundcover						Total (m ²) =	47429
Botanical Name	Planting Plan Code	Size	Height	%	Density	Total	
Calothamnus quadrifidus	Cal qua	Plantstock	1.5-2.5m	25%	1/3m2	3952	
Eremaea pauciflora	Ere pau	Plantstock	2m	25%	1/3m2	3952	
Grevillea obtusifolia	Gre obt	Plantstock	0.5-1.5m	25%	1/3m2	3952	
Lechenaultia biloba	Lec bil	Plantstock	1m	25%	1/3m2	3952	

Mix 2 Paddock Mix - Screen Trees and Shrubs						Total (m ²) =	4877
Botanical Name	Planting Plan Code	Size	Height	%	Density	Total	
Corymbia calophylla	Cor cal	Plantstock	20-40m	5%	1/5m2	49	
Calothamnus quadrifidus	Cal quad	Plantstock	1.5-2.5m	10%	1/4m2	122	
Grevillea obtusifolia	Gre obt	Plantstock	0.5-1.5m	15%	1/4m2	183	
Leptospermum erubescens	Lep eru	Plantstock	0.3-3m	10%	1/4m2	122	
Hakea lissocarpa	Hak lis	Plantstock	1-1.5m	10%	1/3m2	163	
Melaleuca radula	Mel rad	Plantstock	1.5-2m	10%	1/4m2	122	
Melaleuca raphiophylla	Mel rha	Plantstock	8-10m	20%	1/4m2	244	
Melaleuca viminea	Mel vim	Plantstock	5m	20%	1/4m2	244	

Mix 3 Medium Wandoo Woodland Mix - Shrubs and Groundcover						Total (m ²) =	178065
Botanical Name	Planting Plan Code	Size	Height	%	Density	Total	
Calothamnus sanguineus	Cal san	Plantstock	2m	10%	1/3m2	5936	
Dampiera teres	Dam ter	Plantstock	1m	5%	1/3m2	2968	
Daviesia triflora	Dav tri	Plantstock	2m	5%	1/3m2	2968	
Acacia drummondii	Aca dru	Plantstock	2m	20%	1/3m2	11871	
Hypocalymma angustifolium	Hyp ang	Plantstock	1.5m	20%	1/3m2	11871	
Philotheca spicata	Phi spi	Plantstock	0.5m	10%	1/3m2	5936	
Acacia pulchella	Aca pul	Plantstock	1.5m	20%	1/3m2	11871	
Marianthus bicolor	Mar bic	Plantstock	1m	10%	1/3m2	5936	

Mix 4 Medium Wandoo Woodland Mix - Screen Trees and Shrubs						Total (m ²) =	32226
Botanical Name	Planting Plan Code	Size	Height	%	Density	Total	
Hakea undulata	Hak und	Plantstock	2m	15%	1/3m2	1611	
Corymbia calophylla	Cor cal	Plantstock	20-40m	10%	1/4m2	806	
Eucalyptus accedens	Euc acc	Plantstock	15-25m	15%	1/5m2	967	
Eucalyptus wandoo	Euc wan	Plantstock	20m	20%	1/5m2	1289	
Grevillea obtusifolia	Gre obt	Plantstock	1.5m	10%	1/4m2	806	
Acacia celastriifolia	Aca cel	Plantstock	2m	10%	1/3m2	1074	
Melaleuca raphiophylla	Mel rha	Plantstock	6-10m	10%	1/4m2	806	
Melaleuca viminea	Mel vim	Plantstock	5m	10%	1/4m2	806	

Mix 5 Medium Jarrah and Marri Woodland Mix - Shrubs and Groundcovers						Total (m ²) =	431779
Botanical Name	Planting Plan Code	Size	Height	%	Density	Total	
Calothamnus sanguineus	Cal san	Plantstock	2m	15%	1/3m2	21589	
Acacia pulchella	Aca pul	Plantstock	2m	20%	1/3m2	28785	
Eremaea pauciflora	Ere pau	Plantstock	2m	2%	1/3m2	2879	
Grevillea obtusifolia	Gre obt	Plantstock	1.5m	2%	1/3m2	2879	
Leptospermum erubescens	Lep eru	Plantstock	3m	8%	1/3m2	11514	
Acacia lasiocarpa	Aca las	Plantstock	2m	20%	1/3m2	28785	
Melaleuca lateritia	Mel lat	Plantstock	2m	15%	1/3m2	21589	
Allocasuarina humilis	All hum	Plantstock	2m	18%	1/3m2	25907	

Mix 6 Medium Jarrah and Marri Woodland Mix - Screen Trees and Shrubs						Total (m ²) =	49579
Botanical Name	Planting Plan Code	Size	Height	%	Density	Total	
Hakea lissocarpa	Hak liss	Plantstock		7%	1/3m2	1157	
Corymbia calophylla	Cor cal	Plantstock		10%	1/5m2	992	
Eucalyptus accedens	Euc acc	Plantstock		10%	1/5m2	992	
Eucalyptus marginata	Euc mar	Plantstock		7%	1/5m2	694	
Eucalyptus rudis	Euc rud	Plantstock		10%	1/5m2	992	
Eucalyptus wandoo	Euc wan	Plantstock		13%	1/5m2	1289	
Acacia pulchella	Aca pul	Plantstock		10%	1/3m2	1653	
Grevillea vestita	Gre ves	Plantstock		5%	1/3m2	826	

Mix 7 Shrubland Scrub Heath Mix - Shrubs and Groundcovers						Total (m ²) =	47030
Botanical Name	Planting Plan Code	Size	Height	%	Density	Total	
Melaleuca hamata	Mel ham	Plantstock		10%	1/3m2	1653	
Melaleuca raphiophylla	Mel rha	Plantstock		10%	1/4m2	1239	
Melaleuca viminea	Mel vim	Plantstock		5%	1/3m2	826	
Nuytsia floribunda	Nuy flo	Plantstock		3%	1/10m2	149	

Mix 8 Shrubland Scrub Heath Mix - Screen Trees and Shrubs						Total (m ²) =	15285
Botanical Name	Planting Plan Code	Size	Height	%	Density	Total	
Calothamnus sanguineus	Cal san	Plantstock		10%	1/3m2	1568	
Hakea lissocarpa	Hak lis	Plantstock		20%	1/3m2	3135	
Eremaea pauciflora	Ere pau	Plantstock		25%	1/3m2	3919	
Grevillea obtusifolia	Gre obt	Plantstock		20%	1/3m2	3135	
Hypocalymma angustifolium	Hyp aug	Plantstock		20%	1/3m2	3135	
Leptospermum erubescens	Lep eru	Plantstock		5%	1/3m2	784	

Mix 9 Median Mix 1 - Dianella						Total (m ²) =	9585
Botanical Name	Planting Plan Code	Size	Height	%	Density	Total	
Hakea ruscifolia	Hak rus	Plantstock		10%	1/4m2	382	
Eucalyptus drummondii x rudis	Euc drum	Plantstock		15%	1/5m2	459	
Eucalyptus wandoo	Euc wan	Plantstock		15%	1/5m2	459	
Grevillea vestita	Gre ves	Plantstock		5%	1/4m2	191	
Leptospermum erubescens	Lep eru	Plantstock		5%	1/4m2	191	
Hakea undulata	Hak und	Plantstock		10%	1/3m2	510	
Melaleuca raphiophylla	Mel rha	Plantstock		20%	1/4m2	764	
Melaleuca viminea	Mel vim	Plantstock		20%	1/4m2	764	

Mix 10 Medium Marri Woodland Mix - Screen Trees and Shrubs						Total (m ²) =	16591
Botanical Name	Planting Plan Code	Size	Height	%	Density	Total	
Hakea prostrata	Hak pro	Plantstock	2m	20%	1/4m2	830	
Corymbia calophylla	Cor cal	Plantstock	20-40m	20%	1/5m2	664	
Grevillea obtusifolia	Gre obt	Plantstock	1.5m	5%	1/4m2	207	
Kunzea recurva	Kun rec	Plantstock	2m	13%	1/4m2	539	
Melaleuca raphiophylla	Mel rha	Plantstock	8-10m	20%	1/4m2	830	
Melaleuca viminea	Mel vim	Plantstock	5m	20%	1/4m2	830	
Nuytsia floribunda	Nuy flo	Plantstock	5-8m	2%	1/10m2	33	

Mix 11 Redundant Carriageway Mix - Shrubs and Groundcover						Total (m ²) =	36914
Botanical Name	Planting Plan Code	Size	Height	%	Density	Total	
Acacia pulchella	Aca pul	Plantstock	2m	20%	1/3m2	2461	
Calothamnus sanguineus	Cal san	Plantstock	2m	20%	1/3m2	2461	
Eremaea pauciflora	Ere pau	Plantstock	2m	5%	1/3m2	615	
Allocasuarina humilis	All hum	Plantstock	2m	15%	1/3m2	1846	
Leptospermum erubescens	Lep eru	Plantstock	3m	5%	1/3m2	615	
Dianella revoluta	Dia rev	Plantstock	1m	10%	1/3m2	1230	
Acacia drummondii	Aca dru	Plantstock	2m	20%	1/3m2	2461	
Vericordia densiflora	Ver den	Plantstock	2m	5%	1/3m2	615	

Mix 12 Median Mix 2 - Hardy Groundcover						Total (m ²) =	5809
Botanical Name	Planting Plan Code	Size	Height	%	Density	Total	
Acacia salinga prostrate	Aca sal pro	Plantstock		50%	1/2m2	1452	
Acacia lasiocarpa prostrate	Aca las pro	Plantstock		50%	1/2m2	1452	

Mix 13 Wildflower Mix - Plant Stock and Seed						Total (m ²) =	66589
Botanical Name	Planting Plan Code	Size	Height	%	Density	Total	
Anigozanthos manglesii	Ani man	Plantstock		10%	1/2m2	3329	
Grevillea bipinnatifida	Gre bip	Plantstock		10%	1/2m2	3329	
Grevillea drummondii	Gre dru	Plantstock		5%	1/2m2	1665	
Grevillea obtusifolia	Gre obt	Plantstock		10%	1/2m2	3329	
Banksia peholaris	Ban pet	Plantstock		10%	1/2m2	3329	
Hardenbergia comptoniana	Har com	Plantstock		10%	1/2m2	3329	
Isopogon divergens	Iso div	Plantstock		10%	1/2m2	3329	
Orthosanthus laxus	Ort lax	Plantstock		10%	1/2m2	3329	
Patersonia occidentalis	Pat occ	Plantstock		10%	1/2m2	3329	
Isopogon dubius	Iso dub	Plantstock		5%	1/2m2	1665	
Adenanthos cuneatus 'Coral Carpet' pbr	Ade cun	Plantstock		10%	1/2m2	3329	

All plant stock species to be planted in a mixed evenly spaced distribution						Total (m ²) =	66589
Botanical Name	Planting Plan Code	Size	Height	%	Density	Total	
Anigozanthos manglesii	Ani man	Seed		n/a	600	3995	
Philotus exaltatus	Pti exa	Seed		n/a	200	1332	
Conostylis candicans	Con can	Seed		n/a	100	666	
Kennedia prostrata	Ken pro	Seed		n/a	400	2664	
Neurachne alopecuroidea	Neu alo	Seed		n/a	200	1332	
Rhodanthe chlorocephala subsp. Rosea	Rho chl R	Seed		n/a	400	2664	
Rhodanthe manglesii	Rho man	Seed		n/a	100	666	
Kennedia coccinea	Ken coc	Seed		n/a	100	666	
Hardenbergia comptoniana	Har com	Seed		n/a	600	3995	
Gompholobim tomentosum	Gom tom	Seed		n/a	300	1998	
Burchardia congesta	Bur con	Seed		N/A	60	400	
Lechenaultia floribunda	Lec flo	Seed		N/A	100	666	
Chorizema cordatum	Cho cor	Seed		N/A	300	1998	

Compacted Laterite Gravel To Median Drains Where There Is No Planting						Total (m ³) =	4548
Botanical Name	Planting Plan Code	Size	Height	%	Density	Total	
Laterite Gravel						4548	

LANDSCAPING CURRENTLY BEING COMPLETED. RED-LINE MARK-UPS TO BE ISSUED SEPARATELY ONCE COMPLETE.

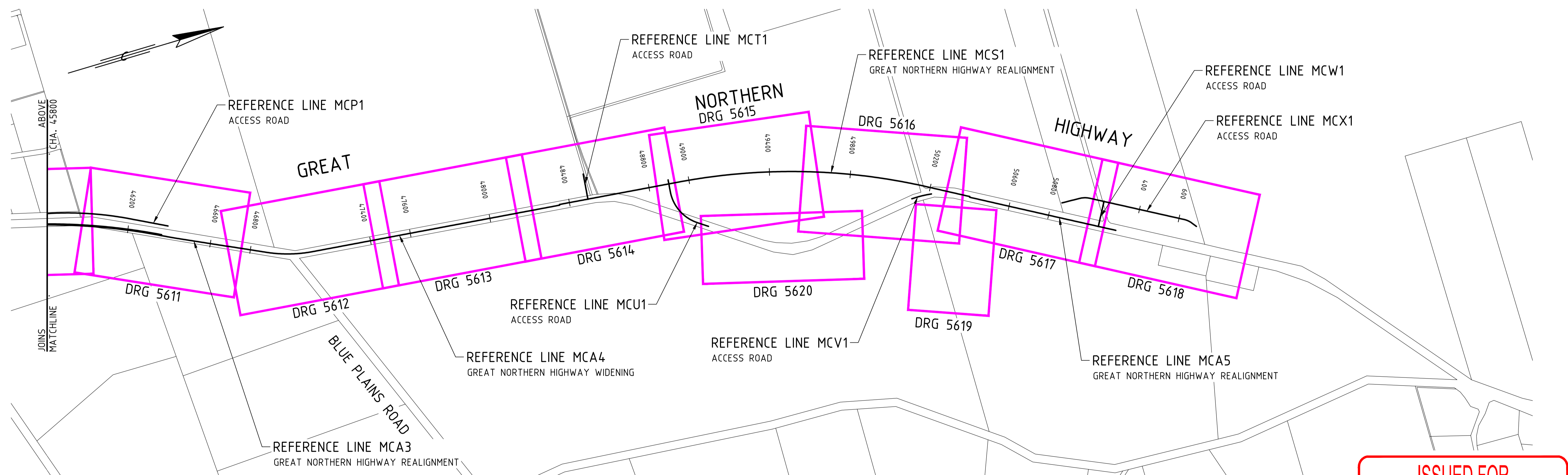
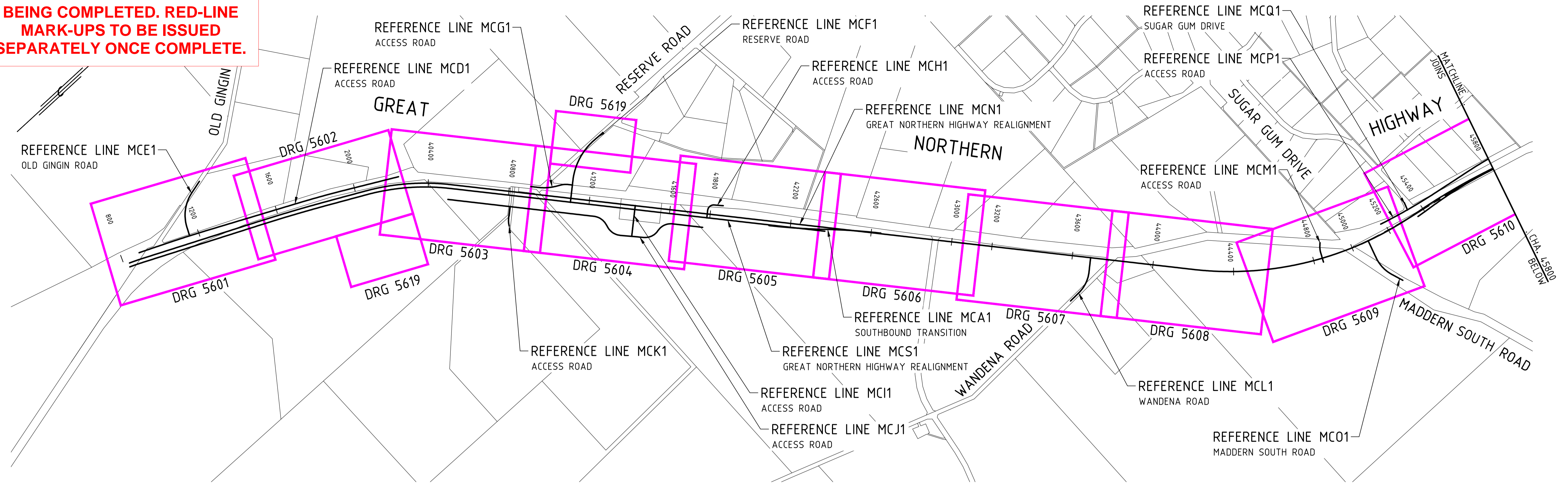
PLANTS IN EACH MIX ARE DESIGNED TO BE PLANTED IN A MIXED EVENLY DISTRIBUTED PATTERN ACCORDING TO THE DENSITIES. TOTAL NUMBERS HAVE BEEN CALCULATED ACCORDING TO DENSITY AND PERCENTAGE OF THE SPECIES IN THE MIX. THE PERCENTAGE HELPS TO INDICATE THE DESIGNED RATIO.

ISSUED FOR CONSTRUCTION

NOTE: ALL DRAWINGS ARE CONSIDERED UNCONTROLLED UNLESS STAMPED 'CONTROLLED COPY' IN RED		METADATA		DRAWN: J. LACON CHECKED: C.HICK DESIGNED: A. BRADFIELD CHECKED: C.MADIGAN APPROVED: J.WEAR DATE: 17.10.2018	LOCAL AUTHORITY: (502) SHIRE OF CHITTERING MAIN ROADS RESPONSIBILITY AREA: WHEATBELT GNWA DRAWING NUMBER: 201708-607-1 PROJECT TITLE: GREAT NORTHERN HIGHWAY (H006) - MUCHEA TO WUBIN STAGE 2 DRAWING TITLE: OLD GINGIN ROAD TO CHITTERING ROADHOUSE - SLK 38.6 TO SLK 51.1 LANDSCAPING SCHEDULE DRAWING STATUS: CONSTRUCTION DRAWING No: GNH-CN03-RW01-DRG-5201
1 LANDSCAPING MIXES AMENDED 0 ISSUED FOR CONSTRUCTION	J.WEAR 20.11.19 J.WEAR 17.10.18	GROUND SURVEY STANDARD: 67-08-43 DATE OF CAPTURE: 27.02.2012 MAPPING SURVEY STANDARD: 67-08-44 DATE OF CAPTURE: 27.02.2012 MAIN ROADS PROJECT ZONE: MUCHEA94 HEIGHT DATUM: AHD			SHEET: 1

Plot Date : 19 Oct 2018, 3:13pm

LANDSCAPING CURRENTLY BEING COMPLETED. RED-LINE MARK-UPS TO BE ISSUED SEPARATELY ONCE COMPLETE.



ISSUED FOR CONSTRUCTION

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No.	DESCRIPTION	APPROVED & DATE	No.	DESCRIPTION	APPROVED & DATE
0	ISSUED FOR CONSTRUCTION	J. WEAR 17.10.18			

AMENDMENTS

METADATA	
GROUND SURVEY STANDARD:	67-08-43
DATE OF CAPTURE:	27.02.2012
MAPPING SURVEY STANDARD:	67-08-44
DATE OF CAPTURE:	27.02.2012
MAIN ROADS PROJECT ZONE:	MUCHEA94
HEIGHT DATUM:	AHD

DRAWN	T. SIMPSON
CHECKED	J. LACON
DESIGNED	A. BRADFIELD
CHECKED	C. MADIGAN
APPROVED	J. WEAR
DATE	17.10.2018

PROJECT DIRECTOR: B. WOODS DATE: 17.10.2018

LOCAL AUTHORITY: (502) SHIRE OF CHITTERING MAIN ROADS RESPONSIBILITY AREA: WHEATBELT

INFRASTRUCTURE DELIVERY DIRECTORATE

HWMA DRAWING NUMBER	201708-610
PROJECT TITLE	GREAT NORTHERN HIGHWAY (H006) - MUCHEA TO WUBIN STAGE 2
DRAWING TITLE	OLD GINGIN ROAD TO CHITTERING ROADHOUSE - SLK 38.6 TO SLK 51.1 LANDSCAPING KEY PLAN
DRAWING STATUS	CONSTRUCTION
DRAWING No.	GNH-CN03-RW01-DRG-5251
REV	0

FILENAME: C:\Users\heliwood\Desktop\Prints\2018-10-19\GNH-CN03-RW01-DRG-5251.dwg

N.T.S. A 1

Plot Date: 20 Nov 2019: 5:28pm

LANDSCAPING CURRENTLY BEING COMPLETED. RED-LINE MARK-UPS TO BE ISSUED SEPARATELY ONCE COMPLETE.

NOTES:
 1. FOR GENERAL NOTES REFER TO DRG Nos. GNH-CN03-RW01-DRG-0031 AND 0032. FOR LEGEND REFER TO DRG Nos. GNH-CN03-RW01-DRG-0041 AND 0042.
 2. FOR PLANTING SCHEDULE REFER TO DRG No. GNH-CN03-RW01-DRG-5201.

Mix 11	
Area 1 (m²)=	4601
No.	Plant Code
307	Aca pul
307	Cal san
77	Ere pau
230	All hum
77	Lep eru
153	Dia ref
307	Aca dru
77	Vert den
Seed g/ha	Plant Code
207	Aca dru
322	Aca pul
299	Cal qua
276	Aca las
322	All hum
138	Hak lis
138	Lep eru
230	Kun rec

Mix 1	
Area 2 (m²)=	6976
No.	Plant Code
581	Cal qua
581	Ere pau
581	Gre obt
581	Lec bil

Mix 2	
Area 1 (m²)=	935
No.	Plant Code
9	Cor cal
23	Cal qua
35	Gre obt
23	Lep eru
31	Hak lis
23	Mel rad
47	Mel rha
47	Mel vim

Mix 2	
Area 2 (m²)=	1306
No.	Plant Code
13	Cor cal
33	Cal qua
49	Gre obt
33	Lep eru
44	Hak lis
33	Mel rad
65	Mel rha
65	Mel vim

Mix 1	
Area 3 (m²)=	7115
No.	Plant Code
593	Cal qua
593	Ere pau
593	Gre obt
593	Lec bil

Mix 12	
Area 1 (m²)=	1244
No.	Plant Code
311	Aca sal pro
311	Aca las pro

Mix 12	
Area 2 (m²)=	134
No.	Plant Code
34	Aca sal pro
34	Aca las pro

Mix 13	
Area 1 (m²)=	1824
No.	Plant Code
91	Ani man
91	Gre bip
46	Gre dru
91	Gre obt
91	Ban pet
91	Har com
91	Iso div
91	Ort lax
91	Pat occ
46	Iso dub
91	Ade cun
Seed g/ha	Plant Code
109	Ani man
36	Pti exa
18	Con can
73	Ken pro
36	Neu alo
73	Rho chl R
18	Rho man
18	Ken coc
109	Har com
55	Gom tom
11	Bur con
18	Lec flo
55	Cho cor

Mix 12	
Area 3 (m²)=	1209
No.	Plant Code
302	Aca sal pro
302	Aca las pro

Mix 1	
Area 1 (m²)=	13890
No.	Plant Code
1158	Cal qua
1158	Ere pau
1158	Gre obt
1158	Lec bil

Laterite Gravel	
Area 1 (m²)=	10259

Mix 5	
Area 1 (m²)=	7563
No.	Plant Code
378	Cal san
504	Aca pul
50	Ere pau
50	Gre obt
202	Lep eru
504	Aca las
378	Mel lat
454	All hum

Mix 9	
Area 1 (m²)=	8032
No.	Plant Code
4016	Dia rev

Mix 2	
Area 4 (m²)=	1030
No.	Plant Code
10	Cor cal
26	Cal qua
39	Gre obt
26	Lep eru
34	Hak lis
26	Mel rad
52	Mel rha
52	Mel vim

FILENAME: C:\Users\hellow\Desktop\Prints\2019-11-20\CN03\GNH-CN03-RW01-DRG-5601.dwg

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AMENDMENTS					
No.	DESCRIPTION	APPROVED & DATE	No.	DESCRIPTION	APPROVED & DATE
1	LANDSCAPING MIXES AMENDED	J.WEAR 20.11.19			
0	ISSUED FOR CONSTRUCTION	J. WEAR 17.10.18			

METADATA	
GROUND SURVEY STANDARD:	67-08-43
DATE OF CAPTURE:	27.02.2012
MAPPING SURVEY STANDARD:	67-08-44
DATE OF CAPTURE:	27.02.2012
MAIN ROADS PROJECT ZONE:	MUCHEA94
HEIGHT DATUM:	AHD

DRAWN: T.SIMPSON	CHECKED: C.HICK	DESIGNED: A. BRADFIELD	CHECKED: C.MADIGAN	APPROVED: J.WEAR
DATE: 17.10.2018	DATE: 17.10.2018	DATE: 17.10.2018	DATE: 17.10.2018	DATE: 17.10.2018

PROJECT DIRECTOR: B. WOODS

LOCAL AUTHORITY: (502) SHIRE OF CHITTERING

MAIN ROADS RESPONSIBILITY AREA: WHEATBELT

GNH MUCHEA TO WUBIN

ARUP TRADING AS ASJV

JACOBS

mainroads WESTERN AUSTRALIA

INFRASTRUCTURE DELIVERY DIRECTORATE

HWMA DRAWING NUMBER: 201708-611-1

PROJECT TITLE: GREAT NORTHERN HIGHWAY (H006) - MUCHEA TO WUBIN STAGE 2

DRAWING TITLE: OLD GINGIN ROAD TO CHITTERING ROADHOUSE - SLK 38.6 TO SLK 51.1

LANDSCAPING PLAN - MCN1(CHA. 38962.362) TO CHA. 39520

SHEET 1

DRAWING STATUS: CONSTRUCTION

DRAWING No.: GNH-CN03-RW01-DRG-5601

REV: 1

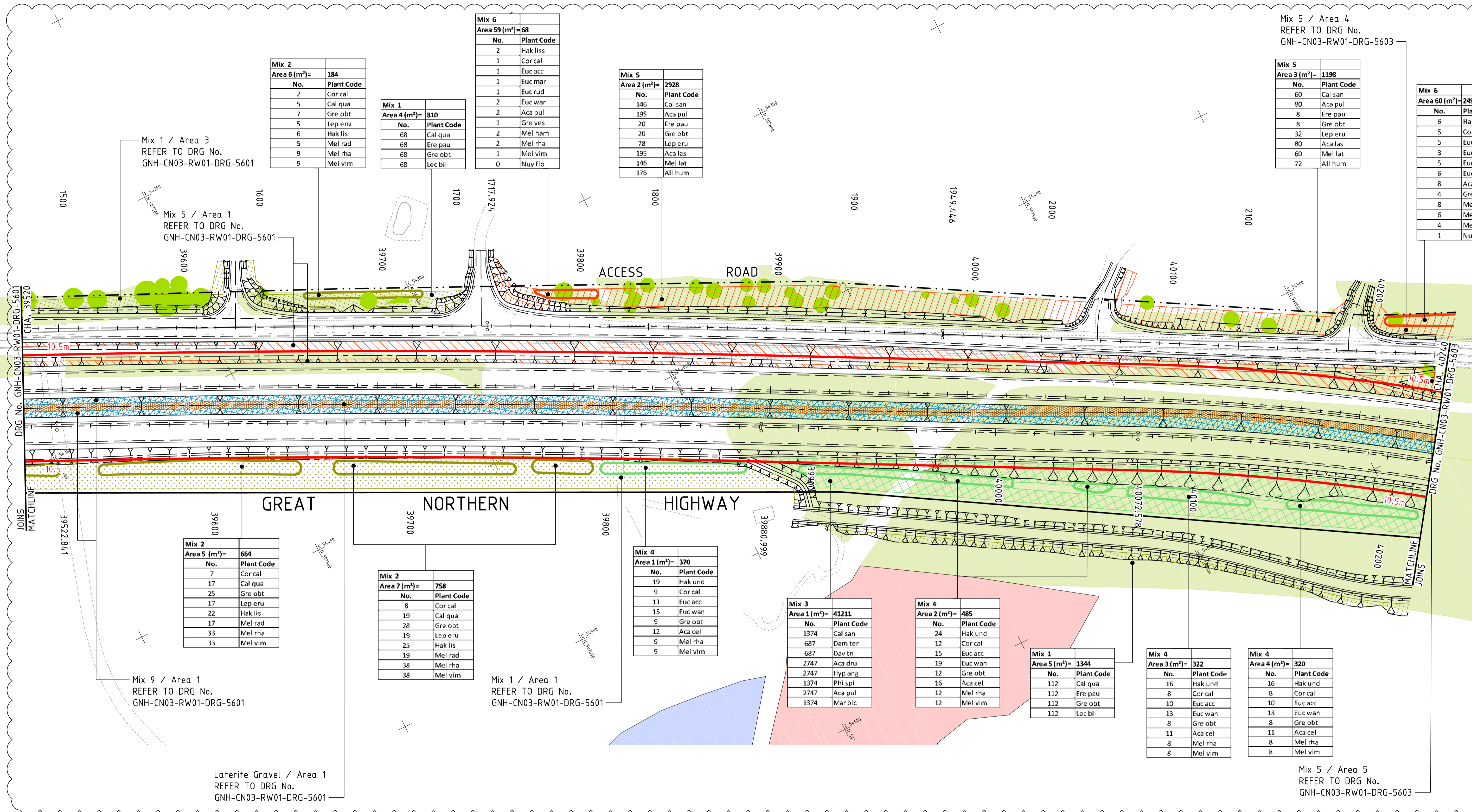
ISSUED FOR CONSTRUCTION

1:1000 (A1) / 1:2000 (A3)

A 1

LANDSCAPING CURRENTLY BEING COMPLETED. RED-LINE MARK-UPS TO BE ISSUED SEPARATELY ONCE COMPLETE.

NOTES:
 1. FOR GENERAL NOTES REFER TO DRG Nos. GNH-CN03-RW01-DRG-0031 AND 0032. FOR LEGEND REFER TO DRG Nos. GNH-CN03-RW01-DRG-0041 AND 0042.
 2. FOR PLANTING SCHEDULE REFER TO DRG No. GNH-CN03-RW01-DRG-5201.



ISSUED FOR CONSTRUCTION

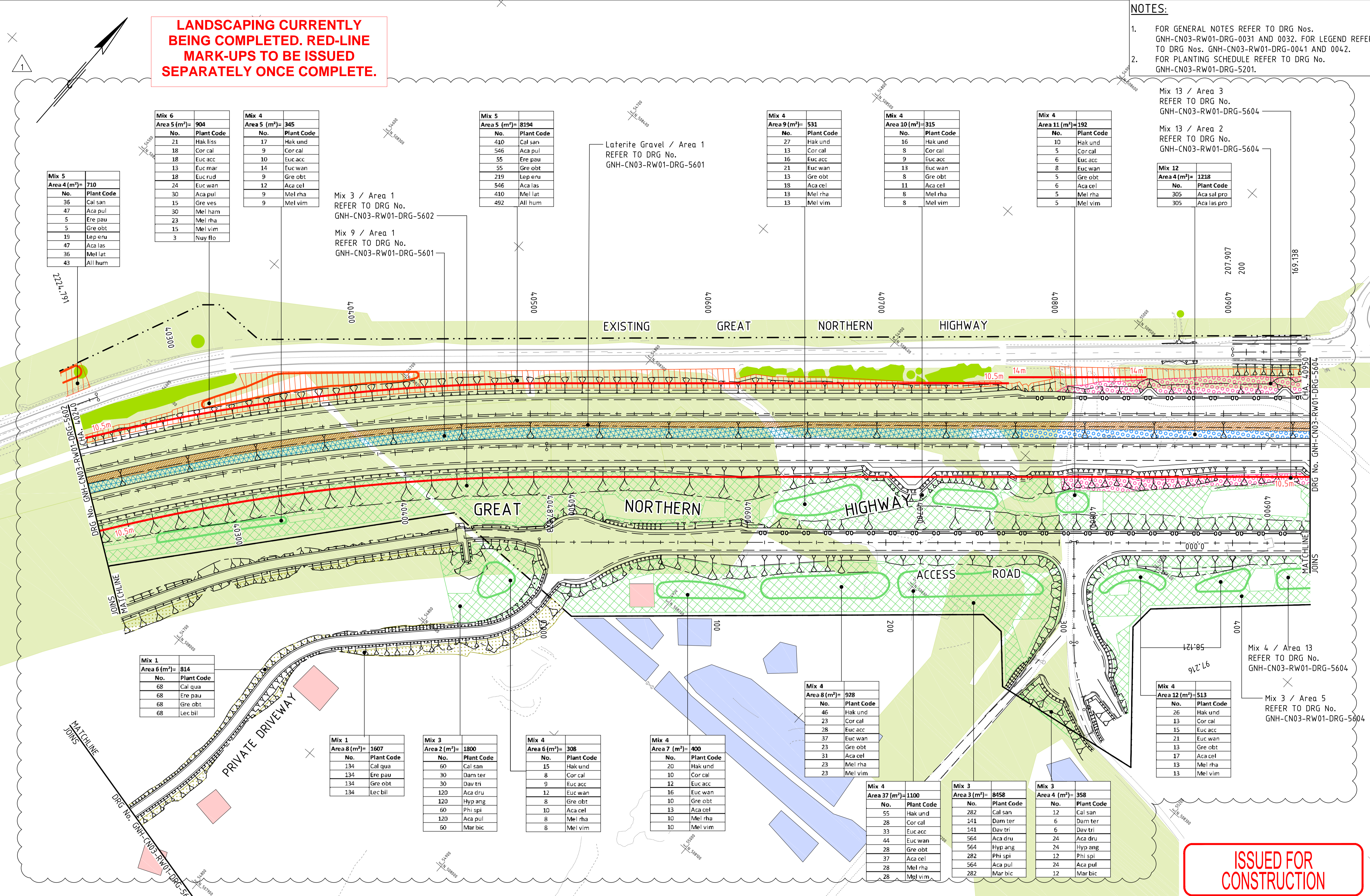
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AMENDMENTS		METADATA		DRAWN		LOCAL AUTHORITY		MAIN ROADS RESPONSIBILITY AREA		HWA DRAWING NUMBER	
No.	DESCRIPTION	APPROVED & DATE	DATE	NO.	DESCRIPTION	APPROVED & DATE	DATE	(502) SHIRE OF CHITTERING	WHEATBELT	201708-612-1	
1	LANDSCAPING MIXES AMENDED	J.WEAR 20.11.19		1	LANDSCAPING MIXES AMENDED	J.WEAR 20.11.19		WHEATBELT		PROJECT TITLE	
0	ISSUED FOR CONSTRUCTION	J.WEAR 17.10.18		2	DATE OF CAPTURE: 27.02.2012	J.WEAR 17.10.18		WHEATBELT		GREAT NORTHERN HIGHWAY (H006) - MUCHEA TO WUBIN STAGE 2	
				DESIGNED: A. BRADFIELD				WHEATBELT		DRAWING TITLE	
				CHECKED: C.MADIGAN				WHEATBELT		OLD GINGIN ROAD TO CHITTERING ROADHOUSE - SLK 38.6 TO SLK 51.1	
				APPROVED: J.WEAR				WHEATBELT		LANDSCAPING PLAN - MCN1 CHA. 39520 TO CHA. 40240	
				DATE: 17.10.2018				WHEATBELT		SHEET 2	
				PROJECT DIRECTOR: B. WOODS		DATE: 17.10.2018		WHEATBELT		DRAWING STATUS	
				PROJECT DIRECTOR: N. FOX		DATE: 17.10.2018		WHEATBELT		CONSTRUCTION	
				PROJECT DIRECTOR: N. FOX		DATE: 17.10.2018		WHEATBELT		DRAWING No. GNH-CN03-RW01-DRG-5602	
				PROJECT DIRECTOR: N. FOX		DATE: 17.10.2018		WHEATBELT		REV 1	

LANDSCAPING CURRENTLY BEING COMPLETED. RED-LINE MARK-UPS TO BE ISSUED SEPARATELY ONCE COMPLETE.

NOTES:
 1. FOR GENERAL NOTES REFER TO DRG Nos. GNH-CN03-RW01-DRG-0031 AND 0032. FOR LEGEND REFER TO DRG Nos. GNH-CN03-RW01-DRG-0041 AND 0042.
 2. FOR PLANTING SCHEDULE REFER TO DRG No. GNH-CN03-RW01-DRG-5201.

Plot Date: 20 Nov 2019, 5:29pm
 FILENAME: C:\Users\hickwood\Desktop\Prints\2019-11-20\GNH-CN03-RW01-DRG-5603.dwg



Mix 6
Area 5 (m²)= 904

No.	Plant Code
21	Hak liss
18	Cor cal
18	Euc acc
13	Euc mar
18	Euc rud
24	Euc wan
30	Aca pul
15	Gre ves
30	Mel ham
23	Mel rha
15	Mel vim
3	Nuy flo

Mix 4
Area 5 (m²)= 345

No.	Plant Code
17	Hak und
9	Cor cal
10	Euc acc
14	Euc wan
9	Gre obt
12	Aca cel
9	Mel rha
9	Mel vim

Mix 5
Area 5 (m²)= 8194

No.	Plant Code
410	Cal san
546	Aca pul
55	Ere pau
55	Gre obt
219	Lep eru
546	Aca las
410	Mel lat
492	Alli hum

Mix 4
Area 9 (m²)= 531

No.	Plant Code
27	Hak und
13	Cor cal
16	Euc acc
21	Euc wan
13	Gre obt
18	Aca cel
13	Mel rha
13	Mel vim

Mix 4
Area 10 (m²)= 315

No.	Plant Code
16	Hak und
8	Cor cal
9	Euc acc
13	Euc wan
8	Gre obt
11	Aca cel
8	Mel rha
8	Mel vim

Mix 4
Area 11 (m²)= 192

No.	Plant Code
10	Hak und
5	Cor cal
6	Euc acc
8	Euc wan
5	Gre obt
6	Aca cel
5	Mel rha
5	Mel vim

Mix 12
Area 4 (m²)= 1218

No.	Plant Code
305	Aca sal pro
305	Aca las pro

Mix 5
Area 4 (m²)= 710

No.	Plant Code
36	Cal san
47	Aca pul
5	Ere pau
5	Gre obt
19	Lep eru
47	Aca las
36	Mel lat
43	Alli hum

Mix 3 / Area 1
REFER TO DRG No. GNH-CN03-RW01-DRG-5602

Mix 9 / Area 1
REFER TO DRG No. GNH-CN03-RW01-DRG-5601

Laterite Gravel / Area 1
REFER TO DRG No. GNH-CN03-RW01-DRG-5601

Mix 13 / Area 3
REFER TO DRG No. GNH-CN03-RW01-DRG-5604

Mix 13 / Area 2
REFER TO DRG No. GNH-CN03-RW01-DRG-5604

Mix 4 / Area 13
REFER TO DRG No. GNH-CN03-RW01-DRG-5604

Mix 3 / Area 5
REFER TO DRG No. GNH-CN03-RW01-DRG-5604

ISSUED FOR CONSTRUCTION

NOTE: ALL DRAWINGS ARE CONSIDERED UNCONTROLLED UNLESS STAMPED 'CONTROLLED COPY' IN RED

AMENDMENTS		METADATA		DRAWN		LOCAL AUTHORITY		DRAWING STATUS	
No.	DESCRIPTION	APPROVED & DATE	DESCRIPTION	APPROVED & DATE	DATE	DATE	DATE	DATE	DATE
1	LANDSCAPING MIXES AMENDED	J.WEAR 20.11.19	GROUND SURVEY STANDARD: 67-08-43	T.SIMPSON	17.10.2018	(502) SHIRE OF CHITTERING	CONSTRUCTION	201708-613-1	1
2	ISSUED FOR CONSTRUCTION	J.WEAR 17.10.18	DATE OF CAPTURE: 27.02.2012	C.HICK	17.10.2018	WHEATBELT	CONSTRUCTION	201708-613-1	1
			MAPPING SURVEY STANDARD: 67-08-44	A. BRADFIELD					
			DATE OF CAPTURE: 27.02.2012	C.MADIGAN					
			MAIN ROADS PROJECT ZONE: MUCHEA94	J.WEAR					
			HEIGHT DATUM: AHD						

ARUP TRADING AS ASJV
JACOBS

INFRASTRUCTURE DELIVERY DIRECTORATE

PROJECT TITLE: GREAT NORTHERN HIGHWAY (H006) - MUCHEA TO WUBIN STAGE 2
 DRAWING TITLE: OLD GINGIN ROAD TO CHITTERING ROADHOUSE - SLK 38.6 TO SLK 51.1
 LANDSCAPING PLAN - MCN1 CHA. 40240 TO CHA. 40950
 SHEET 3

Plot Date: 20 Nov 2019 5:29pm
 FILENAME: C:\Users\hellow\Desktop\Prints\2019-11-20\CN03\GNH-CN03-RW01-DRG-5604.dwg

LANDSCAPING CURRENTLY BEING COMPLETED. RED-LINE MARK-UPS TO BE ISSUED SEPARATELY ONCE COMPLETE.

NOTES:
 1. FOR GENERAL NOTES REFER TO DRG Nos. GNH-CN03-RW01-DRG-0031 AND 0032. FOR LEGEND REFER TO DRG Nos. GNH-CN03-RW01-DRG-0041 AND 0042.
 2. FOR PLANTING SCHEDULE REFER TO DRG No. GNH-CN03-RW01-DRG-5201.

Mix 11
 Area 2 (m²)= 5351

No.	Plant Code
357	Aca pul
357	Cal san
89	Ere pau
268	All hum
89	Lep eru
178	Dia ref
357	Aca dru
89	Vert den
Seed g/ha	Plant Code
241	Aca dru
375	Aca pul
348	Cal qua
321	Aca las
375	All hum
161	Hak lis
161	Lep eru
268	Kun rec

Mix 5
 Area 6 (m²)= 6100

No.	Plant Code
305	Cal san
407	Aca pul
41	Ere pau
41	Gre obt
163	Lep eru
407	Aca las
305	Mel lat
366	All hum

Mix 10
 Area 2 (m²)= 1547

No.	Plant Code
77	Hak pro
62	Cor cal
19	Gre obt
50	Kun rec
77	Mel rha
77	Mel vim
3	Nuy flo

Mix 5
 Area 11 (m²)= 6642

No.	Plant Code
332	Cal san
443	Aca pul
44	Ere pau
44	Gre obt
443	Aca las
332	Mel lat
399	All hum

Mix 13
 Area 4 (m²)= 6118

No.	Plant Code
306	Ani man
306	Gre bip
153	Gre dru
306	Gre obt
306	Ban pet
306	Har com
306	Iso div
306	Ort lax
306	Pat occ
153	Iso dub
306	Ade cun
Seed g/ha	Plant Code
367	Ani man
121	Pti exa
61	Con can
245	Ken pro
122	Neu alo
245	Rho chl R
61	Rho man
61	Ken coc
367	Har com
184	Gom tom
37	Bur con
61	Lec flo
184	Cho cor

Mix 11
 Area 3 (m²)= 11146

No.	Plant Code
743	Aca pul
743	Cal san
186	Ere pau
557	All hum
186	Lep eru
372	Dia ref
743	Aca dru
186	Vert den
Seed g/ha	Plant Code
502	Aca dru
780	Aca pul
724	Cal qua
669	Aca las
780	All hum
334	Hak lis
334	Lep eru
557	Kun rec

Mix 13
 Area 5 (m²)= 1987

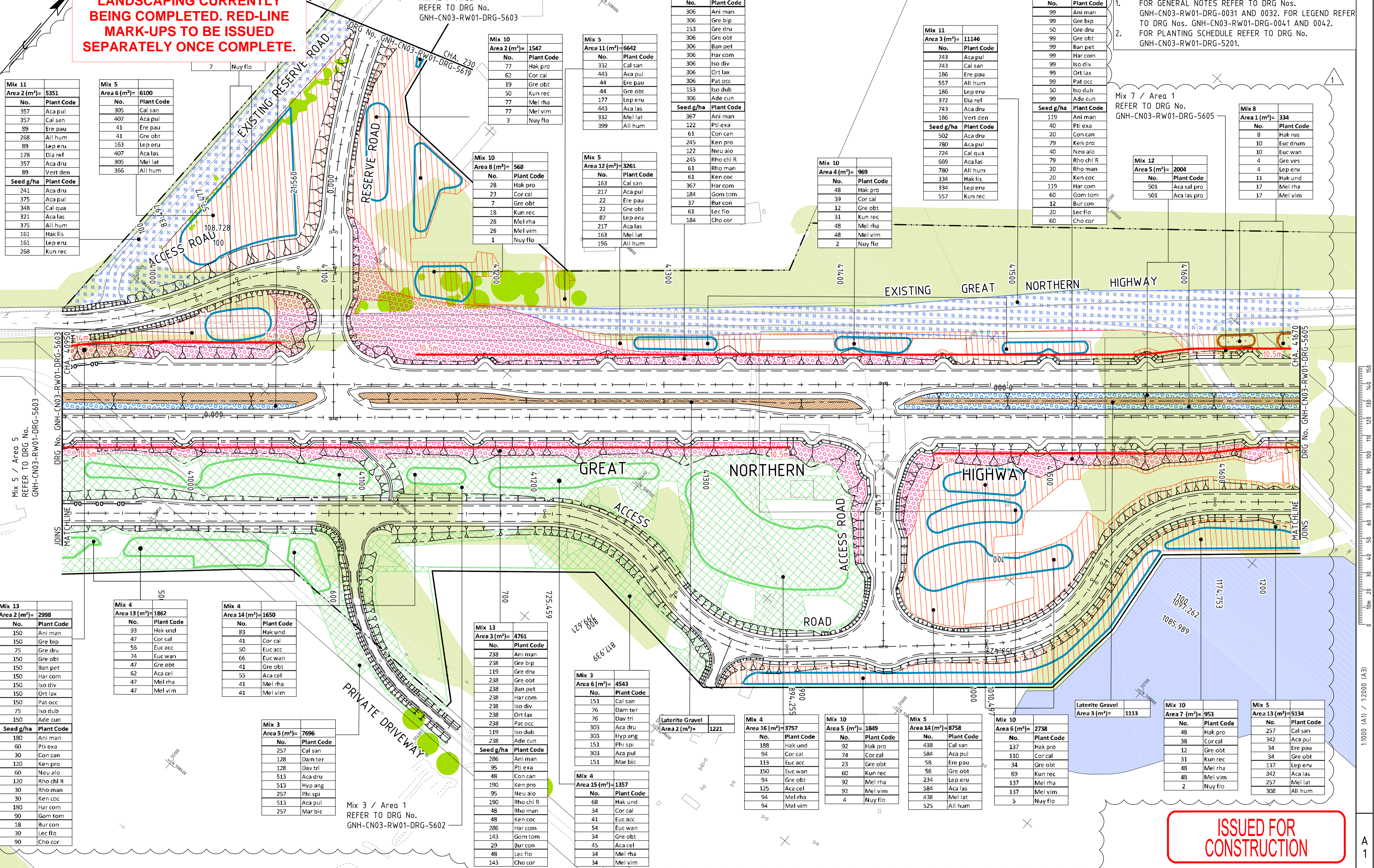
No.	Plant Code
99	Ani man
99	Gre bip
50	Gre dru
99	Gre obt
99	Ban pet
99	Har com
99	Iso div
99	Ort lax
99	Pat occ
50	Iso dub
99	Ade cun
Seed g/ha	Plant Code
119	Ani man
40	Pti exa
20	Con can
79	Ken pro
40	Neu alo
79	Rho chl R
20	Rho man
20	Ken coc
119	Har com
60	Gom tom
12	Bur con
20	Lec flo
60	Cho cor

Mix 12
 Area 5 (m²)= 2004

No.	Plant Code
501	Aca sal pro
501	Aca las pro

Mix 8
 Area 1 (m²)= 334

No.	Plant Code
8	Hak rus
10	Euc drum
10	Euc wan
4	Gre ves
4	Lep eru
11	Hak und
17	Mel rha
17	Mel vim



Mix 13
 Area 2 (m²)= 2998

No.	Plant Code
150	Ani man
150	Gre bip
75	Gre dru
150	Gre obt
150	Ban pet
150	Har com
150	Iso div
150	Ort lax
150	Pat occ
75	Iso dub
150	Ade cun
Seed g/ha	Plant Code
180	Ani man
60	Pti exa
30	Con can
120	Ken pro
60	Neu alo
120	Rho chl R
30	Rho man
30	Ken coc
180	Har com
90	Gom tom
18	Bur con
30	Lec flo
90	Cho cor

Mix 4
 Area 13 (m²)= 1862

No.	Plant Code
93	Hak und
47	Cor cal
56	Euc acc
74	Euc wan
47	Gre obt
62	Aca cel
47	Mel rha
47	Mel vim

Mix 4
 Area 14 (m²)= 1650

No.	Plant Code
83	Hak und
41	Cor cal
50	Euc acc
66	Euc wan
41	Gre obt
55	Aca cel
41	Mel rha
41	Mel vim

Mix 3
 Area 5 (m²)= 7696

No.	Plant Code
257	Cal san
128	Dam ter
128	Dav tri
513	Aca dru
513	Hyp ang
257	Phi spi
513	Aca pul
257	Mar bic

Mix 13
 Area 3 (m²)= 4761

No.	Plant Code
238	Ani man
238	Gre bip
119	Gre dru
238	Gre obt
238	Ban pet
238	Har com
238	Iso div
238	Ort lax
238	Pat occ
119	Iso dub
238	Ade cun
Seed g/ha	Plant Code
286	Ani man
95	Pti exa
48	Con can
190	Ken pro
95	Neu alo
190	Rho chl R
48	Rho man
48	Ken coc
286	Har com
143	Gom tom
29	Bur con
48	Lec flo
143	Cho cor

Mix 3
 Area 6 (m²)= 4543

No.	Plant Code
151	Cal san
76	Dam ter
76	Dav tri
303	Aca dru
303	Hyp ang
151	Phi spi
303	Aca pul
151	Mar bic

Mix 4
 Area 15 (m²)= 1357

No.	Plant Code
68	Hak und
34	Cor cal
41	Euc acc
54	Euc wan
34	Gre obt
45	Aca cel
34	Mel rha
34	Mel vim

Mix 4
 Area 16 (m²)= 3757

No.	Plant Code
188	Hak und
94	Cor cal
113	Euc acc
150	Euc wan
94	Gre obt
125	Aca cel
94	Mel rha
94	Mel vim

Mix 10
 Area 5 (m²)= 1849

No.	Plant Code
92	Hak pro
74	Cor cal
23	Gre obt
60	Kun rec
92	Mel rha
92	Mel vim
4	Nuy flo

Mix 5
 Area 14 (m²)= 8758

No.	Plant Code
438	Cal san
584	Aca pul
58	Ere pau
58	Gre obt
234	Lep eru
584	Aca las
438	Mel lat
525	All hum

Mix 10
 Area 6 (m²)= 2738

No.	Plant Code
137	Hak pro
110	Cor cal
34	Gre obt
89	Kun rec
137	Mel rha
137	Mel vim
5	Nuy flo

Mix 10
 Area 7 (m²)= 953

No.	Plant Code
48	Hak pro
38	Cor cal
12	Gre obt
31	Kun rec
41	Mel rha
48	Mel vim
2	Nuy flo

Mix 5
 Area 13 (m²)= 5134

No.	Plant Code
257	Cal san
342	Aca pul
34	Ere pau
34	Gre obt
137	Lep eru
342	Aca las
257	Mel lat
308	All hum

ISSUED FOR CONSTRUCTION

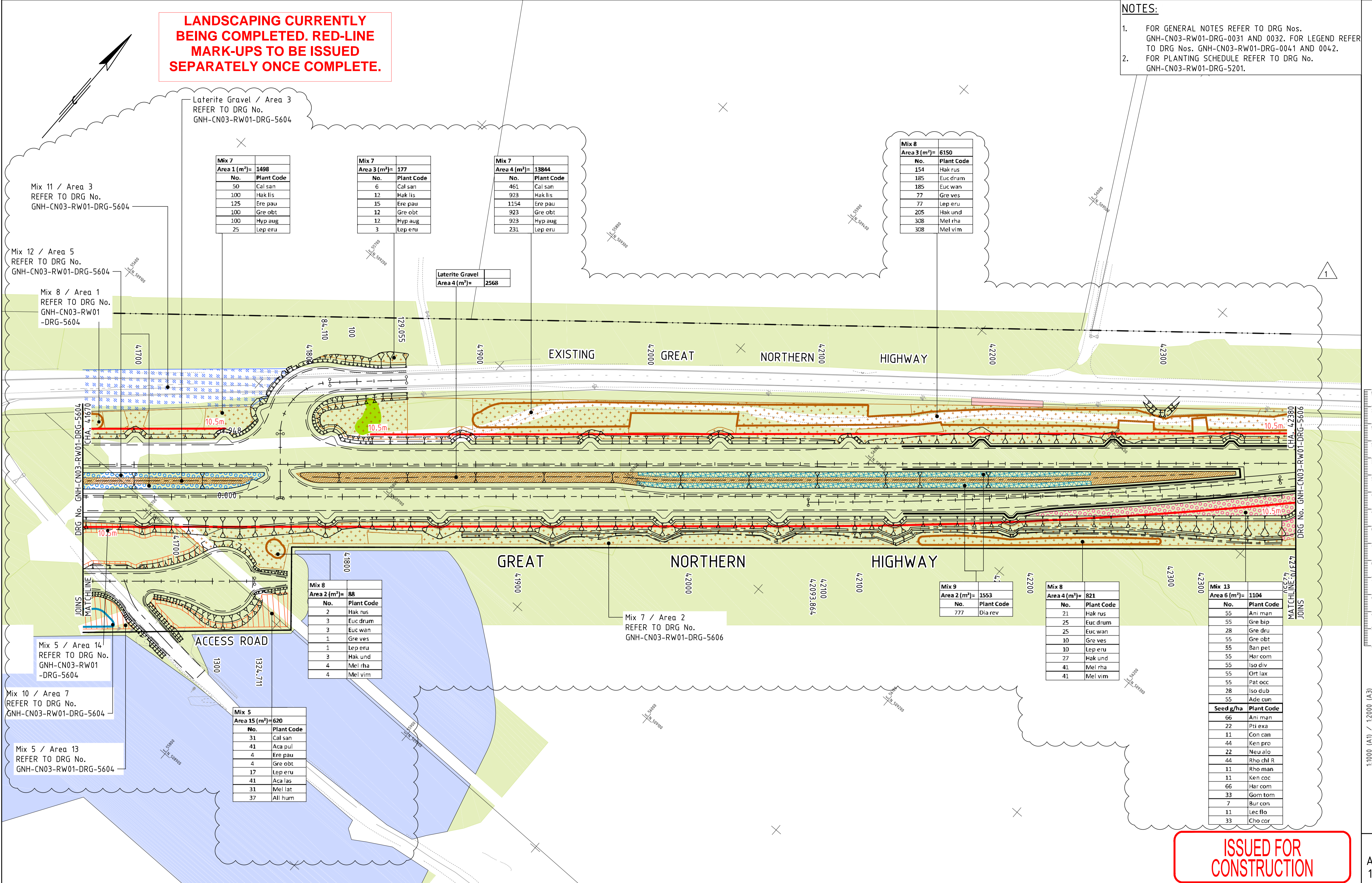
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AMENDMENTS		METADATA		DRAWN		LOCAL AUTHORITY		MAIN ROADS RESPONSIBILITY AREA		HWA4 DRAWING NUMBER	
No.	DESCRIPTION	APPROVED & DATE	No.	DESCRIPTION	APPROVED & DATE	GROUND SURVEY STANDARD: 67-08-43	DATE OF CAPTURE: 27.02.2012	DATE OF CAPTURE: 27.02.2012	DATE OF CAPTURE: 27.02.2012	DATE OF CAPTURE: 27.02.2012	DATE OF CAPTURE: 27.02.2012
1	LANDSCAPING MIXES AMENDED	J.WEAR 20.11.19									
0	ISSUED FOR CONSTRUCTION	J.WEAR 17.10.18									
AMENDMENTS		METADATA		DRAWN		LOCAL AUTHORITY		MAIN ROADS RESPONSIBILITY AREA		HWA4 DRAWING NUMBER	
		GROUND SURVEY STANDARD: 67-08-43		DRAWN T.SIMPSON		(502) SHIRE OF CHITTERING		WHEATBELT		201708-614-1	
		DATE OF CAPTURE: 27.02.2012		CHECKED C.HICK		ARUP TRADING AS ASJV		JACOBS		PROJECT TITLE	
		DATE OF CAPTURE: 27.02.2012		CHECKED A. BRADFIELD		mainroads WESTERN AUSTRALIA		INFRASTRUCTURE DELIVERY DIRECTORATE		GREAT NORTHERN HIGHWAY (H006) - MUCCHA TO WUBIN STAGE 2	
		DATE OF CAPTURE: 27.02.2012		CHECKED C.MADIGAN		PROJECT DIRECTOR		N. FOX		DRAWING TITLE	
		DATE OF CAPTURE: 27.02.2012		APPROVED J.WEAR		PROJECT DIRECTOR		B. WOODS		OLD GINGIN ROAD TO CHITTERING ROADHOUSE - SLK 38.6 TO SLK 51.1	
		DATE OF CAPTURE: 27.02.2012		DATE 17.10.2018		DATE 17.10.2018		DATE 17.10.2018		LANDSCAPING PLAN - MCN1 CHA. 40950 TO CHA. 41670	
		DATE OF CAPTURE: 27.02.2012		DATE 17.10.2018		DATE 17.10.2018		DATE 17.10.2018		SHEET 4	
		DATE OF CAPTURE: 27.02.2012		DATE 17.10.2018		DATE 17.10.2018		DATE 17.10.2018		DRAWING STATUS	
		DATE OF CAPTURE: 27.02.2012		DATE 17.10.2018		DATE 17.10.2018		DATE 17.10.2018		CONSTRUCTION	
		DATE OF CAPTURE: 27.02.2012		DATE 17.10.2018		DATE 17.10.2018		DATE 17.10.2018		DRAWING No.	
		DATE OF CAPTURE: 27.02.2012		DATE 17.10.2018		DATE 17.10.2018		DATE 17.10.2018		GNH-CN03-RW01-DRG-5604	
		DATE OF CAPTURE: 27.02.2012		DATE 17.10.2018		DATE 17.10.2018		DATE 17.10.2018		REV	
		DATE OF CAPTURE: 27.02.2012		DATE 17.10.2018		DATE 17.10.2018		DATE 17.10.2018		1	

LANDSCAPING CURRENTLY BEING COMPLETED. RED-LINE MARK-UPS TO BE ISSUED SEPARATELY ONCE COMPLETE.

NOTES:
 1. FOR GENERAL NOTES REFER TO DRG Nos. GNH-CN03-RW01-DRG-0031 AND 0032. FOR LEGEND REFER TO DRG Nos. GNH-CN03-RW01-DRG-0041 AND 0042.
 2. FOR PLANTING SCHEDULE REFER TO DRG No. GNH-CN03-RW01-DRG-5201.

Plot Date: 20 Nov 2019 5:30pm
 FILENAME: C:\Users\hellow\OneDrive\Prints\2019-11-20\CN03\GNH-CN03-RW01-DRG-5605.dwg



Laterite Gravel / Area 3
 REFER TO DRG No.
 GNH-CN03-RW01-DRG-5604

Mix 7	
Area 1 (m²)= 1498	
No.	Plant Code
50	Cal san
100	Hak lis
125	Ere pau
100	Gre obt
100	Hyp aug
25	Lep eru

Mix 7	
Area 3 (m²)= 177	
No.	Plant Code
6	Cal san
12	Hak lis
15	Ere pau
12	Gre obt
12	Hyp aug
3	Lep eru

Mix 7	
Area 4 (m²)= 13844	
No.	Plant Code
461	Cal san
923	Hak lis
1154	Ere pau
923	Gre obt
923	Hyp aug
231	Lep eru

Mix 8	
Area 3 (m²)= 6150	
No.	Plant Code
154	Hak rus
185	Euc drum
185	Euc wan
77	Gre ves
77	Lep eru
205	Hak und
308	Mel rha
308	Mel vim

Laterite Gravel
 Area 4 (m²)= 2568

Mix 8	
Area 2 (m²)= 88	
No.	Plant Code
2	Hak rus
3	Euc drum
3	Euc wan
1	Gre ves
1	Lep eru
3	Hak und
4	Mel rha
4	Mel vim

Mix 7 / Area 2
 REFER TO DRG No.
 GNH-CN03-RW01-DRG-5606

Mix 9	
Area 2 (m²)= 1553	
No.	Plant Code
777	Dia rev

Mix 8	
Area 4 (m²)= 821	
No.	Plant Code
21	Hak rus
25	Euc drum
25	Euc wan
10	Gre ves
10	Lep eru
27	Hak und
41	Mel rha
41	Mel vim

Mix 13	
Area 6 (m²)= 1104	
No.	Plant Code
55	Ani man
55	Gre bip
28	Gre dru
55	Gre obt
55	Ban pet
55	Har com
55	Iso div
55	Ort lax
55	Pat occ
28	Iso dub
55	Ade cun
Seed g/ha	
No.	Plant Code
66	Ani man
22	Pti exa
11	Con can
44	Ken pro
22	Neu alo
44	Rho chl R
11	Rho man
11	Ken coc
66	Har com
33	Gom tom
7	Bur con
11	Lec flo
33	Cho cor

ISSUED FOR CONSTRUCTION

NOTE: ALL DRAWINGS ARE CONSIDERED UNCONTROLLED UNLESS STAMPED "CONTROLLED COPY" IN RED

AMENDMENTS		METADATA		DRAWN		LOCAL AUTHORITY		MAIN ROADS RESPONSIBILITY AREA		HWA1A DRAWING NUMBER	
1	LANDSCAPING MIXES AMENDED	J.WEAR	20.11.19	GROUND SURVEY STANDARD:	67-08-43	T.SIMPSON	(502) SHIRE OF CHITTERING	WHEATBELT	201708-615-1		
0	ISSUED FOR CONSTRUCTION	J.WEAR	17.10.18	DATE OF CAPTURE:	27.02.2012	C.HICK	WHEATBELT		PROJECT TITLE		
				MAPPING SURVEY STANDARD:	67-08-44	A. BRADFIELD	WHEATBELT		GREAT NORTHERN HIGHWAY (H006) - MUCHEA TO WUBIN STAGE 2		
				DATE OF CAPTURE:	27.02.2012	C.MADIGAN	WHEATBELT		DRAWING TITLE		
				MAIN ROADS PROJECT ZONE:	MUCHEA94	J.WEAR	WHEATBELT		OLD GINGIN ROAD TO CHITTERING ROADHOUSE - SLK 38.6 TO SLK 51.1		
				HEIGHT DATUM:	AHD	17.10.2018	WHEATBELT		LANDSCAPING PLAN - MCN1 CHA. 41670 TO CHA. 42380		
				PROJECT DIRECTOR		B. WOODS	WHEATBELT		SHEET 5		
				DATE		17.10.2018	WHEATBELT		DRAWING STATUS		
				PROJECT DIRECTOR		N. FOX	WHEATBELT		CONSTRUCTION		
				DATE		17.10.2018	WHEATBELT		DRAWING No.		
				PROJECT DIRECTOR		N. FOX	WHEATBELT		GNH-CN03-RW01-DRG-5605		
				DATE		17.10.2018	WHEATBELT		REV		
				DATE		17.10.2018	WHEATBELT		1		



1:1000 (A1) / 1:2000 (A3)

A 1

LANDSCAPING CURRENTLY BEING COMPLETED. RED-LINE MARK-UPS TO BE ISSUED SEPARATELY ONCE COMPLETE.

NOTES:
 1. FOR GENERAL NOTES REFER TO DRG Nos. GNH-CN03-RW01-DRG-0031 AND 0032. FOR LEGEND REFER TO DRG Nos. GNH-CN03-RW01-DRG-0041 AND 0042.
 2. FOR PLANTING SCHEDULE REFER TO DRG No. GNH-CN03-RW01-DRG-5201.

Mix 13	
No.	Plant Code
90	Ani man
90	Gre bip
45	Gre dru
90	Gre obt
90	Ban pet
90	Hac com
90	Iso div
90	Ort lax
90	Pat occ
45	Iso dub
90	Ade cun
Seed g/ha	
108	Ani man
36	Pti exa
18	Con can
72	Ken pro
36	Neu alo
72	Rho chl R
18	Rho man
18	Ken coc
108	Hac com
54	Gom tom
11	Bur con
18	Lec flo
54	Cho cor

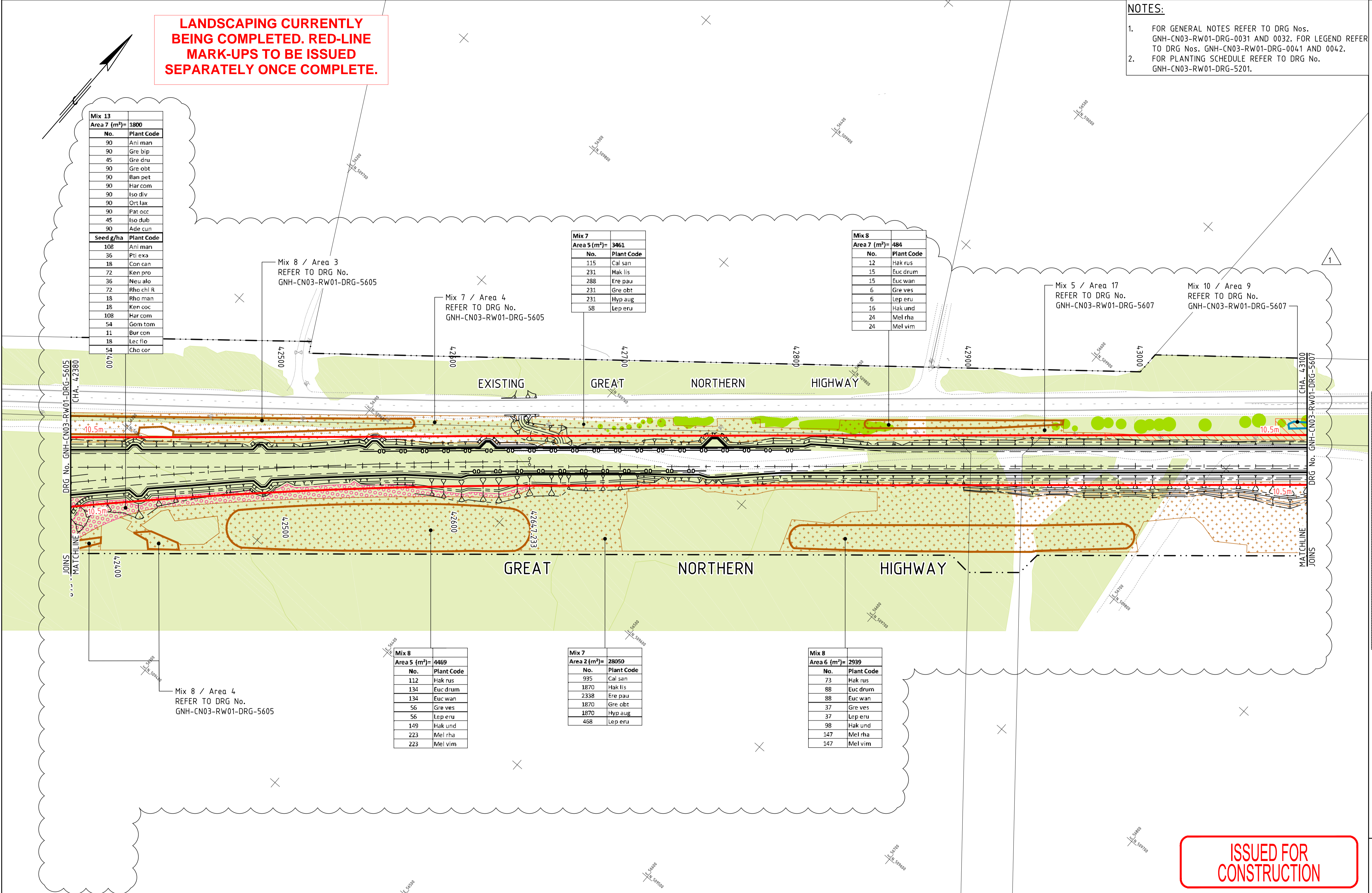
Mix 7	
No.	Plant Code
115	Cal san
231	Hak lis
288	Ere pau
231	Gre obt
231	Hyp aug
58	Lep eru

Mix 8	
No.	Plant Code
12	Hak rus
15	Euc drum
15	Euc wan
6	Gre ves
6	Lep eru
16	Hak und
24	Mel rha
24	Mel vim

Mix 8	
No.	Plant Code
112	Hak rus
134	Euc drum
134	Euc wan
56	Gre ves
56	Lep eru
149	Hak und
223	Mel rha
223	Mel vim

Mix 7	
No.	Plant Code
935	Cal san
1870	Hak lis
2338	Ere pau
1870	Gre obt
1870	Hyp aug
468	Lep eru

Mix 8	
No.	Plant Code
73	Hak rus
88	Euc drum
88	Euc wan
37	Gre ves
37	Lep eru
98	Hak und
147	Mel rha
147	Mel vim

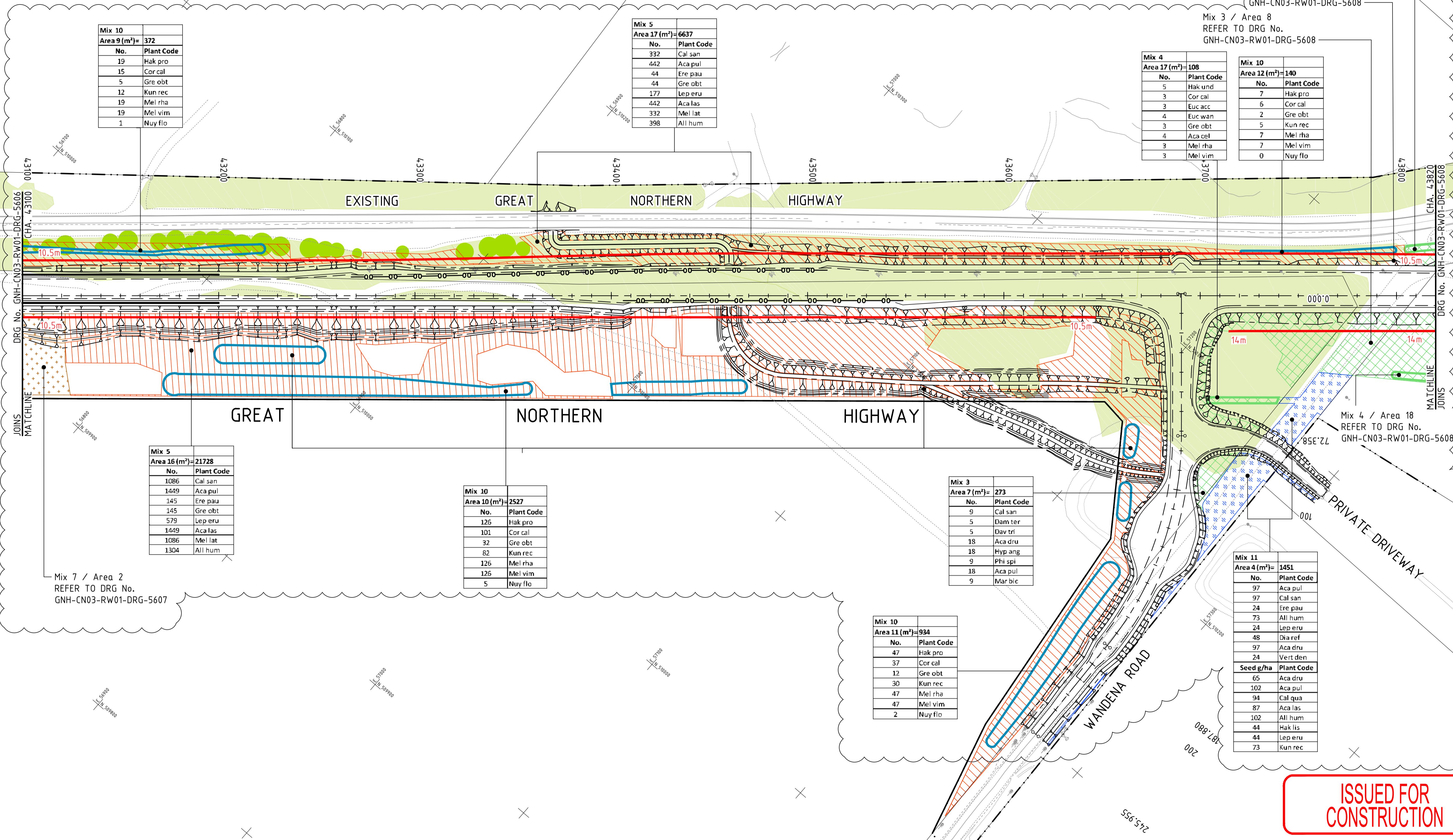


ISSUED FOR CONSTRUCTION

NOTE: ALL DRAWINGS ARE CONSIDERED UNCONTROLLED UNLESS STAMPED 'CONTROLLED COPY' IN RED		METADATA		DRAWN: T.SIMPSON		LOCAL AUTHORITY: (502) SHIRE OF CHITTERING		MAIN ROADS RESPONSIBILITY AREA: WHEATBELT		HWMA DRAWING NUMBER: 201708-616-1	
		GROUND SURVEY STANDARD: 67-08-43		DESIGNED: C.HICK		ARUP TRADING AS ASJV		mainroads WESTERN AUSTRALIA		PROJECT TITLE: GREAT NORTHERN HIGHWAY (H006) - MUCHEA TO WUBIN STAGE 2	
		DATE OF CAPTURE: 27.02.2012		DESIGNED: A. BRADFIELD		JACOBS		INFRASTRUCTURE DELIVERY DIRECTORATE		DRAWING TITLE: OLD GINGIN ROAD TO CHITTERING ROADHOUSE - SLK 38.6 TO SLK 51.1	
		MAPPING SURVEY STANDARD: 67-08-44		CHECKED: C.MADIGAN		MUCHEA TO WUBIN				DRAWING STATUS: CONSTRUCTION	
		DATE OF CAPTURE: 27.02.2012		APPROVED: J.WEAR						DRAWING No. GNH-CN03-RW01-DRG-5606	
		MAIN ROADS PROJECT ZONE: MUCHEA94		DATE: 17.10.2018		PROJECT DIRECTOR: B. WOODS		DATE: 17.10.2018		REV: 1	
		HEIGHT DATUM: AHD									
AMENDMENTS											
No.	DESCRIPTION	APPROVED & DATE	No.	DESCRIPTION	APPROVED & DATE						
1	LANDSCAPING MIXES AMENDED	J.WEAR 20.11.19									
0	ISSUED FOR CONSTRUCTION	J.WEAR 17.10.18									

LANDSCAPING CURRENTLY BEING COMPLETED. RED-LINE MARK-UPS TO BE ISSUED SEPARATELY ONCE COMPLETE.

NOTES:
 1. FOR GENERAL NOTES REFER TO DRG Nos. GNH-CN03-RW01-DRG-0031 AND 0032. FOR LEGEND REFER TO DRG Nos. GNH-CN03-RW01-DRG-0041 AND 0042.
 2. FOR PLANTING SCHEDULE REFER TO DRG No. GNH-CN03-RW01-DRG-5201.



Mix 10
Area 9 (m²)= 372

No.	Plant Code
19	Hak pro
15	Cor cal
5	Gre obt
12	Kun rec
19	Mel rha
19	Mel vim
1	Nuy flo

Mix 5
Area 17 (m²)=6637

No.	Plant Code
332	Cal san
442	Aca pul
44	Ere pau
44	Gre obt
177	Lep eru
442	Aca las
332	Mel lat
398	All hum

Mix 4
Area 17 (m²)=108

No.	Plant Code
5	Hak und
3	Cor cal
3	Euc acc
4	Euc wan
3	Gre obt
4	Aca cel
3	Mel rha
3	Mel vim

Mix 10
Area 12 (m²)=140

No.	Plant Code
7	Hak pro
6	Cor cal
2	Gre obt
5	Kun rec
7	Mel rha
7	Mel vim
0	Nuy flo

Mix 5
Area 16 (m²)= 21728

No.	Plant Code
1086	Cal san
1449	Aca pul
145	Ere pau
145	Gre obt
579	Lep eru
1449	Aca las
1086	Mel lat
1304	All hum

Mix 10
Area 10 (m²)=2527

No.	Plant Code
126	Hak pro
101	Cor cal
32	Gre obt
82	Kun rec
126	Mel rha
126	Mel vim
5	Nuy flo

Mix 3
Area 7 (m²)= 273

No.	Plant Code
9	Cal san
5	Dam ter
5	Dav tri
18	Aca dru
18	Hyp ang
9	Phi spi
18	Aca pul
9	Mar bic

Mix 10
Area 11 (m²)=934

No.	Plant Code
47	Hak pro
37	Cor cal
12	Gre obt
30	Kun rec
47	Mel rha
47	Mel vim
2	Nuy flo

Mix 11
Area 4 (m²)= 1451

No.	Plant Code
97	Aca pul
97	Cal san
24	Ere pau
73	All hum
24	Lep eru
48	Dia ref
97	Aca dru
24	Vert den
Seed g/ha	Plant Code
65	Aca dru
102	Aca pul
94	Cal qua
87	Aca las
102	All hum
44	Hak lis
44	Lep eru
73	Kun rec

ISSUED FOR CONSTRUCTION

NOTE: ALL DRAWINGS ARE CONSIDERED UNCONTROLLED UNLESS STAMPED 'CONTROLLED COPY' IN RED

AMENDMENTS		METADATA		DRAWN		LOCAL AUTHORITY		MAIN ROADS RESPONSIBILITY AREA		HWA1 DRAWING NUMBER	
1	LANDSCAPING MIXES AMENDED	J.WEAR	20.11.19	T.SIMPSON		(502) SHIRE OF CHITTERING	WHEATBELT	201708-617-1		PROJECT TITLE	
0	ISSUED FOR CONSTRUCTION	J.WEAR	17.10.18	C.HICK				GREAT NORTHERN HIGHWAY (H006) - MUCHEA TO WUBIN STAGE 2		DRAWING TITLE	
		GROUND SURVEY STANDARD: 67-08-43		DESIGNED: A. BRADFIELD		THE GOVERNMENT OF WESTERN AUSTRALIA		mainroads WESTERN AUSTRALIA		OLD GINGIN ROAD TO CHITTERING ROADHOUSE - SLK 38.6 TO SLK 51.1	
		DATE OF CAPTURE: 27.02.2012		CHECKED: C.MADIGAN		INFRASTRUCTURE DELIVERY DIRECTORATE				LANDSCAPING PLAN - MCN1 CHA. 43100 TO CHA. 43820	
		MAPPING SURVEY STANDARD: 67-08-44		APPROVED: J.WEAR						SHEET 7	
		DATE OF CAPTURE: 27.02.2012		DATE 17.10.2018		PROJECT DIRECTOR B. WOODS		DATE 17.10.2018		DRAWING STATUS CONSTRUCTION	
		MAIN ROADS PROJECT ZONE: MUCHEA94		PROJECT DIRECTOR N. FOX		DATE 17.10.2018		DATE 17.10.2018		DRAWING No. GNH-CN03-RW01-DRG-5607	
		HEIGHT DATUM: AHD		DATE 17.10.2018						REV 1	

LANDSCAPING CURRENTLY BEING COMPLETED. RED-LINE MARK-UPS TO BE ISSUED SEPARATELY ONCE COMPLETE.

NOTES:
 1. FOR GENERAL NOTES REFER TO DRG Nos. GNH-CN03-RW01-DRG-0031 AND 0032. FOR LEGEND REFER TO DRG Nos. GNH-CN03-RW01-DRG-0041 AND 0042.
 2. FOR PLANTING SCHEDULE REFER TO DRG No. GNH-CN03-RW01-DRG-5201.

Mix 4	
No.	Plant Code
46	Hak und
23	Cor cal
28	Euc acc
37	Euc wan
23	Gre obt
31	Aca cel
23	Mel rha
23	Mel vim

Mix 4	
No.	Plant Code
178	Hak und
89	Cor cal
107	Euc acc
143	Euc wan
89	Gre obt
119	Aca cel
89	Mel rha
89	Mel vim

Mix 3	
No.	Plant Code
454	Cal san
227	Dam ter
227	Dav tri
907	Aca dru
907	Hyp ang
454	Phi spi
907	Aca pul
454	Mar bic

Mix 4	
No.	Plant Code
6	Hak und
3	Cor cal
4	Euc acc
5	Euc wan
3	Gre obt
4	Aca cel
3	Mel rha
3	Mel vim

Mix 4	
No.	Plant Code
39	Hak und
19	Cor cal
23	Euc acc
31	Euc wan
19	Gre obt
26	Aca cel
19	Mel rha
19	Mel vim

Mix 4	
No.	Plant Code
134	Hak und
67	Cor cal
80	Euc acc
107	Euc wan
67	Gre obt
89	Aca cel
67	Mel rha
67	Mel vim

Mix 3	
No.	Plant Code
1711	Cal san
855	Dam ter
855	Dav tri
3421	Aca dru
3421	Hyp ang
1711	Phi spi
3421	Aca pul
1711	Mar bic

Mix 4	
No.	Plant Code
87	Hak und
44	Cor cal
52	Euc acc
70	Euc wan
44	Gre obt
58	Aca cel
44	Mel rha
44	Mel vim

Mix 13	
No.	Plant Code
152	Ani man
152	Gre bip
76	Gre dru
152	Gre obt
152	Ban pet
152	Har com
152	Iso div
152	Ort lax
152	Pat occ
76	Iso dub
152	Ade cun

Seed g/ha	Plant Code
182	Ani man
61	Pti exa
30	Con can
121	Ken pro
61	Neu alo
121	Rho chi R
30	Rho man
30	Ken coc
182	Har com
91	Gom tom
18	Bur con
30	Lec flo
91	Cho cor

Mix 13	
No.	Plant Code
174	Ani man
174	Gre bip
87	Gre dru
174	Gre obt
174	Ban pet
174	Har com
174	Iso div
174	Ort lax
174	Pat occ
87	Iso dub
174	Ade cun

Seed g/ha	Plant Code
209	Ani man
70	Pti exa
35	Con can
139	Ken pro
70	Neu alo
139	Rho chi R
35	Rho man
35	Ken coc
209	Har com
105	Gom tom
21	Bur con
35	Lec flo
105	Cho cor

Mix 4 / Area 24
REFER TO DRG No. GNH-CN03-RW01-DRG-5609

Mix 1 / Area 9
REFER TO DRG No. GNH-CN03-RW01-DRG-5609

ISSUED FOR CONSTRUCTION

Plot Date: 20 Nov 2019 5:31pm
 FILENAME: C:\Users\hellow\OneDrive\Prints\2019-11-20\CN03\GNH-CN03-RW01-DRG-5608.dwg

NOTE: ALL DRAWINGS ARE CONSIDERED UNCONTROLLED UNLESS STAMPED 'CONTROLLED COPY' IN RED

No.	DESCRIPTION	APPROVED & DATE	No.	DESCRIPTION	APPROVED & DATE
1	LANDSCAPING MIXES AMENDED	J.WEAR 20.11.19			
0	ISSUED FOR CONSTRUCTION	J.WEAR 17.10.18			

METADATA	
GROUND SURVEY STANDARD:	67-08-43
DATE OF CAPTURE:	27.02.2012
MAPPING SURVEY STANDARD:	67-08-44
DATE OF CAPTURE:	27.02.2012
MAIN ROADS PROJECT ZONE:	MUCHEA94
HEIGHT DATUM:	AHD

DRAWN	T.SIMPSON
CHECKED	C.HICK
DESIGNED	A. BRADFIELD
CHECKED	C.MADIGAN
APPROVED	J.WEAR
DATE	17.10.2018

PROJECT DIRECTOR: B. WOODS
 DATE: 17.10.2018

LOCAL AUTHORITY: (502) SHIRE OF CHITTINGING
 MAIN ROADS RESPONSIBILITY AREA: WHEATBELT

INFRASTRUCTURE DELIVERY DIRECTORATE

PROJECT TITLE: GREAT NORTHERN HIGHWAY (H006) - MUCHEA TO WUBIN STAGE 2
 DRAWING TITLE: OLD GINGIN ROAD TO CHITTING ROADHOUSE - SLK 38.6 TO SLK 51.1
 LANDSCAPING PLAN - MCN1 CHA. 43820 TO CHA. 44520
 SHEET 8

201708-618-1

CONSTRUCTION

GNH-CN03-RW01-DRG-5608

REV 1

1:1000 (A1) / 1:2000 (A3)

Plot Date: 20 Nov 2019: 5:32pm

NOTES:

- FOR GENERAL NOTES REFER TO DRG Nos. GNH-CN03-RW01-DRG-0031 AND 0032. FOR LEGEND REFER TO DRG Nos. GNH-CN03-RW01-DRG-0041 AND 0042.
- FOR PLANTING SCHEDULE REFER TO DRG No. GNH-CN03-RW01-DRG-5201.

Mix 13 / Area 8
REFER TO DRG No.
GNH-CN03-RW01-DRG-5608

Mix 4 / Area 22
REFER TO DRG No.
GNH-CN03-RW01-DRG-5608

Mix 3 / Area 9
REFER TO DRG No.
GNH-CN03-RW01-DRG-5608

Mix 5 / Area 36
REFER TO DRG No.
GNH-CN03-RW01-DRG-5610

Mix 13 / Area 9
REFER TO DRG No.
GNH-CN03-RW01-DRG-5608

Mix 3 / Area 8
REFER TO DRG No.
GNH-CN03-RW01-DRG-5608

Mix 4	
Area 24 (m ²)=3106	
No.	Plant Code
155	Hak und
78	Cor cal
93	Euc acc
124	Euc wan
78	Gre obt
104	Aca cel
78	Mel rha
78	Mel vim

Mix 1	
Area 9 (m ²)= 3594	
No.	Plant Code
300	Cal qua
300	Ere pau
300	Gre obt
300	Lec bil

Mix 4	
Area 25 (m ²)=3485	
No.	Plant Code
74	Hak und
37	Cor cal
45	Euc acc
59	Euc wan
37	Gre obt
50	Aca cel
37	Mel rha
37	Mel vim

Mix 4	
Area 26 (m ²)=709	
No.	Plant Code
35	Hak und
18	Cor cal
21	Euc acc
28	Euc wan
24	Aca cel
18	Mel rha
18	Mel vim

Mix 13	
Area 11 (m ²)= 1167	
No.	Plant Code
58	Ani man
58	Gre bip
29	Gre dru
58	Gre obt
58	Ban pet
58	Har com
58	Iso div
58	Ort lax
58	Pat occ
29	Iso dub
58	Ade cun
Seed g/ha	Plant Code
70	Ani man
23	Pti exa
12	Con can
47	Ken pro
23	Neu alo
47	Rho chl R
12	Rho man
12	Ken coc
70	Har com
35	Gom tom
7	Bur con
12	Lec flo
35	Cho car

Mix 11	
Area 5 (m ²)= 1942	
No.	Plant Code
129	Aca pul
129	Cal san
32	Ere pau
97	All hum
32	Lep eru
65	Dia ref
129	Aca dru
32	Vert den
Seed g/ha	Plant Code
87	Aca dru
136	Aca pul
126	Cal qua
117	Aca las
58	Hak lis
58	Lep eru
97	Kun rec

Mix 11	
Area 6 (m ²)= 2292	
No.	Plant Code
153	Aca pul
153	Cal san
38	Ere pau
115	All hum
38	Lep eru
76	Dia ref
153	Aca dru
38	Vert den
Seed g/ha	Plant Code
103	Aca dru
160	Aca pul
149	Cal qua
138	Aca las
160	All hum
69	Hak lis
69	Lep eru
115	Kun rec

Mix 5	
Area 21 (m ²)= 42217	
No.	Plant Code
2111	Cal san
2814	Aca pul
281	Ere pau
281	Gre obt
1126	Lep eru
2814	Aca las
2111	Mel lat
2533	All hum

Mix 13	
Area 10 (m ²)= 656	
No.	Plant Code
33	Ani man
33	Gre bip
16	Gre dru
33	Gre obt
33	Ban pet
33	Har com
33	Iso div
33	Ort lax
33	Pat occ
16	Iso dub
33	Ade cun
Seed g/ha	Plant Code
39	Ani man
13	Pti exa
7	Con can
26	Ken pro
13	Neu alo
26	Rho chl R
7	Rho man
7	Ken coc
39	Har com
20	Gom tom
4	Bur con
7	Lec flo
20	Cho car

Mix 3	
Area 10 (m ²)= 635	
No.	Plant Code
21	Cal san
11	Dam ter
11	Dav tri
42	Aca dru
42	Hyp ang
21	Phi spi
42	Aca pul
21	Mar bic

Mix 5	
Area 18 (m ²)= 30565	
No.	Plant Code
1528	Cal san
2038	Aca pul
204	Ere pau
204	Gre obt
815	Lep eru
2038	Aca las
1528	Mel lat
1834	All hum

Mix 6	
Area 6 (m ²)= 183	
No.	Plant Code
4	Hak lis
4	Cor cal
4	Euc acc
3	Euc mar
4	Euc rud
5	Euc wan
6	Aca pul
3	Gre ves
6	Mel ham
5	Mel rha
3	Mel vim
1	Nuy flo

Mix 5	
Area 19 (m ²)= 364	
No.	Plant Code
18	Cal san
24	Aca pul
2	Ere pau
2	Gre obt
10	Lep eru
24	Aca las
18	Mel lat
22	All hum

Mix 5	
Area 20 (m ²)= 706	
No.	Plant Code
35	Cal san
47	Aca pul
5	Ere pau
5	Gre obt
19	Lep eru
47	Aca las
35	Mel lat
42	All hum

LANDSCAPING CURRENTLY BEING COMPLETED. RED-LINE MARK-UPS TO BE ISSUED SEPARATELY ONCE COMPLETE.

ISSUED FOR CONSTRUCTION

NOTE: ALL DRAWINGS ARE CONSIDERED UNCONTROLLED UNLESS STAMPED 'CONTROLLED COPY' IN RED

No.	DESCRIPTION	APPROVED & DATE	No.	DESCRIPTION	APPROVED & DATE
1	LANDSCAPING MIXES AMENDED	J.WEAR 20.11.19			
0	ISSUED FOR CONSTRUCTION	J.WEAR 17.10.18			

METADATA	
GROUND SURVEY STANDARD:	67-08-43
DATE OF CAPTURE:	27.02.2012
MAPPING SURVEY STANDARD:	67-08-44
DATE OF CAPTURE:	27.02.2012
MAIN ROADS PROJECT ZONE:	MUCHEA94
HEIGHT DATUM:	AHD

DRAWN	T.SIMPSON
CHECKED	C.HICK
DESIGNED	A. BRADFIELD
CHECKED	C.MADIGAN
APPROVED	J.WEAR
DATE	17.10.2018



LOCAL AUTHORITY	(502) SHIRE OF CHITTERING
MAIN ROADS RESPONSIBILITY AREA	WHEATBELT
HSWA DRAWING NUMBER	201708-619-1
PROJECT TITLE	GREAT NORTHERN HIGHWAY (H006) - MUCHEA TO WUBIN STAGE 2
DRAWING TITLE	OLD GINGIN ROAD TO CHITTERING ROADHOUSE - SLK 38.6 TO SLK 51.1
DRAWING STATUS	CONSTRUCTION
DRAWING No.	GNH-CN03-RW01-DRG-5609
DATE	17.10.2018
PROJECT DIRECTOR	N. FOX
DATE	17.10.2018

PROJECT TITLE	GREAT NORTHERN HIGHWAY (H006) - MUCHEA TO WUBIN STAGE 2
DRAWING TITLE	OLD GINGIN ROAD TO CHITTERING ROADHOUSE - SLK 38.6 TO SLK 51.1
DRAWING STATUS	CONSTRUCTION
DRAWING No.	GNH-CN03-RW01-DRG-5609
DATE	17.10.2018
PROJECT DIRECTOR	N. FOX
DATE	17.10.2018

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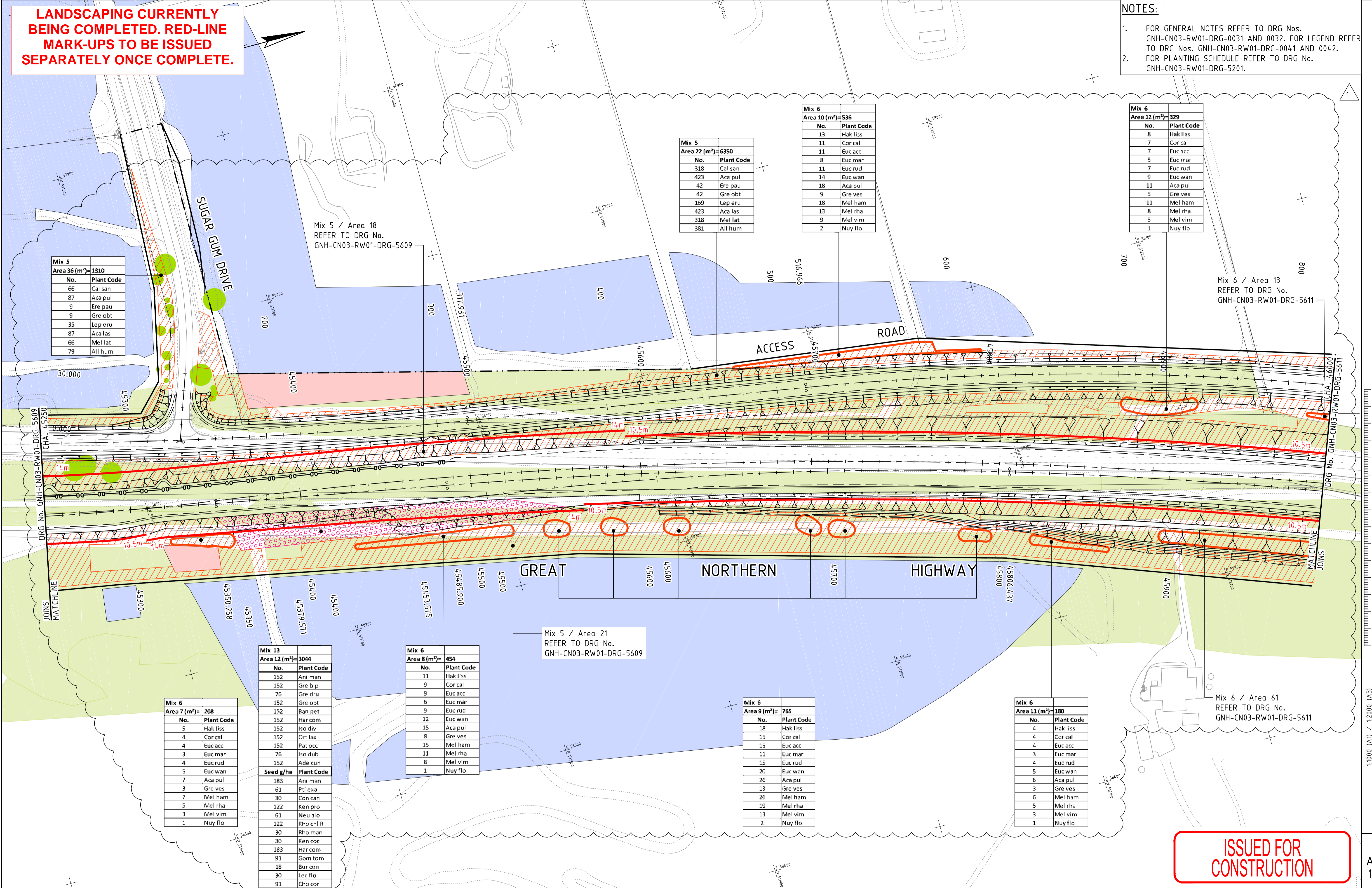
1:1000 (A1) / 1:2000 (A3)

A 1

SHEET 1

LANDSCAPING CURRENTLY BEING COMPLETED. RED-LINE MARK-UPS TO BE ISSUED SEPARATELY ONCE COMPLETE.

NOTES:
1. FOR GENERAL NOTES REFER TO DRG Nos. GNH-CN03-RW01-DRG-0031 AND 0032. FOR LEGEND REFER TO DRG Nos. GNH-CN03-RW01-DRG-0041 AND 0042.
2. FOR PLANTING SCHEDULE REFER TO DRG No. GNH-CN03-RW01-DRG-5201.



Mix 5	
No.	Plant Code
66	Cal san
87	Aca pul
9	Ere pau
9	Gre obt
35	Lep eru
87	Aca las
66	Mel lat
79	All hum

Mix 5	
No.	Plant Code
318	Cal san
423	Aca pul
42	Ere pau
42	Gre obt
169	Lep eru
423	Aca las
318	Mel lat
381	All hum

Mix 6	
No.	Plant Code
13	Hak liss
11	Cor cal
11	Euc acc
8	Euc mar
11	Euc rud
14	Euc wan
18	Aca pul
9	Gre ves
18	Mel ham
13	Mel rha
9	Mel vim
2	Nuy flo

Mix 6	
No.	Plant Code
8	Hak liss
7	Cor cal
7	Euc acc
5	Euc mar
7	Euc rud
9	Euc wan
11	Aca pul
5	Gre ves
11	Mel ham
8	Mel rha
5	Mel vim
1	Nuy flo

Mix 13	
No.	Plant Code
152	Ani man
152	Gre bip
76	Gre dru
152	Gre obt
152	Ban pet
152	Har com
152	Iso div
152	Ort lax
152	Pat occ
76	Iso dub
152	Ade cun
Seed g/ha	
183	Ani man
61	Pti exa
30	Con can
122	Ken pro
61	Neu alo
122	Rho chl R
30	Rho man
30	Ken coc
183	Har com
91	Gom tom
18	Bur con
30	Lec flo
91	Cho cor

Mix 6	
No.	Plant Code
11	Hak liss
9	Cor cal
9	Euc acc
6	Euc mar
9	Euc rud
12	Euc wan
15	Aca pul
8	Gre ves
15	Mel ham
11	Mel rha
8	Mel vim
1	Nuy flo

Mix 6	
No.	Plant Code
18	Hak liss
15	Cor cal
15	Euc acc
11	Euc mar
15	Euc rud
20	Euc wan
26	Aca pul
13	Gre ves
26	Mel ham
19	Mel rha
13	Mel vim
2	Nuy flo

Mix 6	
No.	Plant Code
4	Hak liss
4	Cor cal
4	Euc acc
3	Euc mar
4	Euc rud
5	Euc wan
6	Aca pul
3	Gre ves
6	Mel ham
5	Mel rha
3	Mel vim
1	Nuy flo

ISSUED FOR CONSTRUCTION

NOTE: ALL DRAWINGS ARE CONSIDERED UNCONTROLLED UNLESS STAMPED 'CONTROLLED COPY' IN RED

AMENDMENTS	
No.	DESCRIPTION
1	LANDSCAPING MIXES AMENDED
0	ISSUED FOR CONSTRUCTION

METADATA	
GROUND SURVEY STANDARD:	67-08-43
DATE OF CAPTURE:	27.02.2012
MAPPING SURVEY STANDARD:	67-08-44
DATE OF CAPTURE:	27.02.2012
MAIN ROADS PROJECT ZONE:	MUCHEA94
HEIGHT DATUM:	AHD

DRAWN	T.SIMPSON
CHECKED	C.HICK
DESIGNED	A. BRADFIELD
CHECKED	C.MADIGAN
APPROVED	J.WEAR
DATE	17.10.2018

LOCAL AUTHORITY (502) SHIRE OF CHITTERING MAIN ROADS RESPONSIBILITY AREA WHEATBELT

PROJECT DIRECTOR B. WOODS DATE 17.10.2018

INFRASTRUCTURE DELIVERY DIRECTORATE

PROJECT DIRECTOR N. FOX DATE 17.10.2018

PROJECT TITLE	201708-620-1
PROJECT TITLE	GREAT NORTHERN HIGHWAY (H006) - MUCHEA TO WUBIN STAGE 2
DRAWING TITLE	LANDSCAPING PLAN - MCN1 CHA. 45250 TO CHA. 46000 SHEET 10
DRAWING STATUS	CONSTRUCTION
DRAWING No.	GNH-CN03-RW01-DRG-5610
REV	1

LANDSCAPING CURRENTLY BEING COMPLETED. RED-LINE MARK-UPS TO BE ISSUED SEPARATELY ONCE COMPLETE.

NOTES:
 1. FOR GENERAL NOTES REFER TO DRG Nos. GNH-CN03-RW01-DRG-0031 AND 0032. FOR LEGEND REFER TO DRG Nos. GNH-CN03-RW01-DRG-0041 AND 0042.
 2. FOR PLANTING SCHEDULE REFER TO DRG No. GNH-CN03-RW01-DRG-5201.

Mix 6 Area 20 (m²)=284		Mix 6 Area 22 (m²)=559	
No.	Plant Code	No.	Plant Code
7	Hak liss	13	Hak liss
6	Cor cal	11	Cor cal
6	Euc acc	11	Euc acc
4	Euc mar	8	Euc mar
6	Euc rud	11	Euc rud
7	Euc wan	15	Euc wan
9	Aca pul	19	Aca pul
5	Gre ves	9	Gre ves
9	Mel ham	19	Mel ham
7	Mel rha	14	Mel rha
5	Mel vim	9	Mel vim
1	Nuy flo	2	Nuy flo

Mix 6 Area 62 (m²)=3101	
No.	Plant Code
72	Hak liss
62	Cor cal
62	Euc acc
43	Euc mar
62	Euc rud
81	Euc wan
103	Aca pul
52	Gre ves
103	Mel ham
78	Mel rha
52	Mel vim
9	Nuy flo

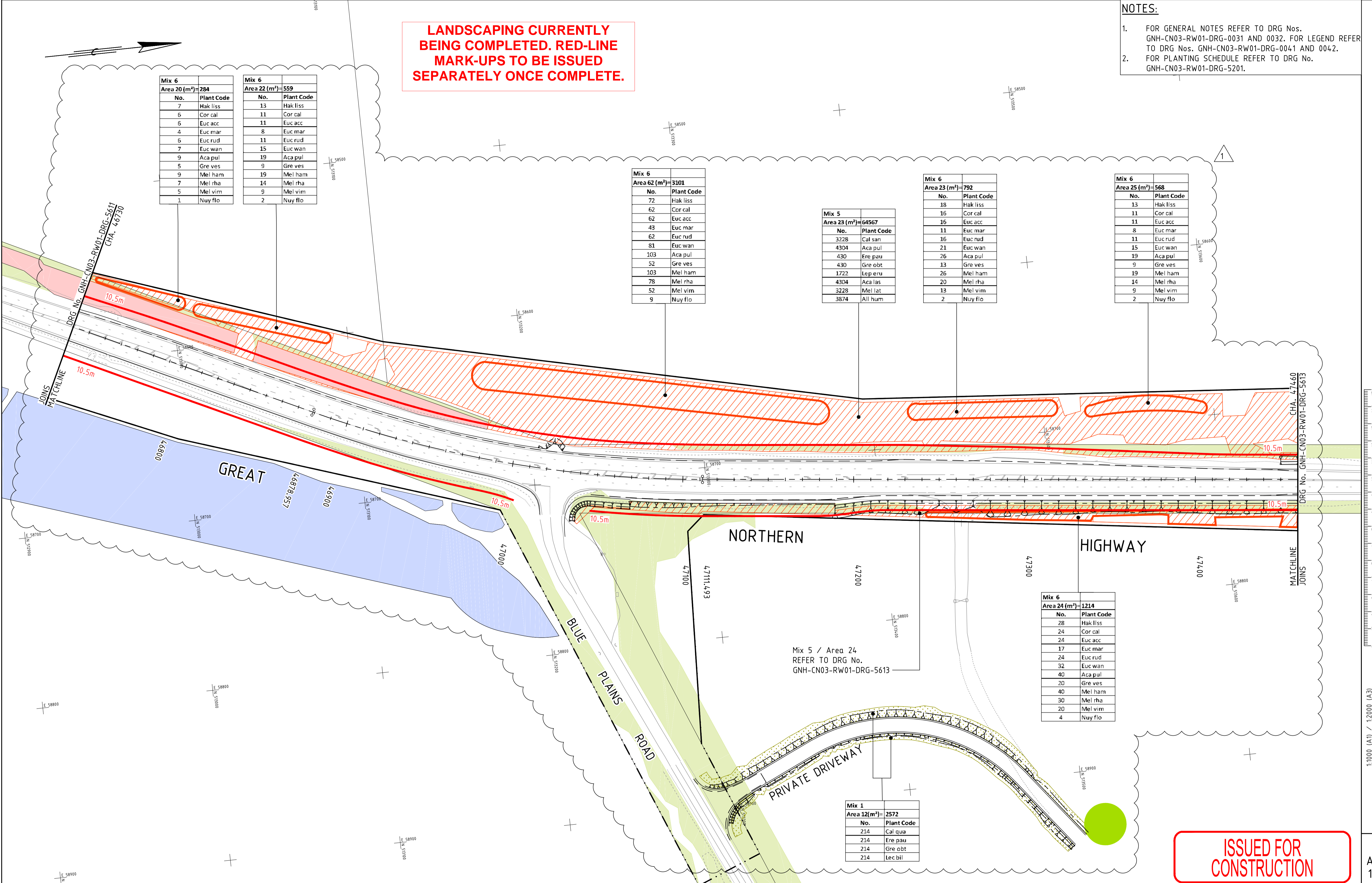
Mix 5 Area 23 (m²)=64567	
No.	Plant Code
3228	Cal san
4304	Aca pul
430	Ere pau
430	Gre obt
1722	Lep eru
4304	Aca las
3228	Mel lat
3874	All hum

Mix 6 Area 23 (m²)=792	
No.	Plant Code
18	Hak liss
16	Cor cal
16	Euc acc
11	Euc mar
16	Euc rud
21	Euc wan
26	Aca pul
13	Gre ves
26	Mel ham
20	Mel rha
13	Mel vim
2	Nuy flo

Mix 6 Area 25 (m²)=568	
No.	Plant Code
13	Hak liss
11	Cor cal
11	Euc acc
8	Euc mar
11	Euc rud
15	Euc wan
19	Aca pul
9	Gre ves
19	Mel ham
14	Mel rha
9	Mel vim
2	Nuy flo

Mix 6 Area 24 (m²)=1214	
No.	Plant Code
28	Hak liss
24	Cor cal
24	Euc acc
17	Euc mar
24	Euc rud
32	Euc wan
40	Aca pul
20	Gre ves
40	Mel ham
30	Mel rha
20	Mel vim
4	Nuy flo

Mix 1 Area 12 (m²)=2572	
No.	Plant Code
214	Cal qua
214	Ere pau
214	Gre obt
214	Lec bil



ISSUED FOR CONSTRUCTION

NOTE: ALL DRAWINGS ARE CONSIDERED UNCONTROLLED UNLESS STAMPED 'CONTROLLED COPY' IN RED

AMENDMENTS		METADATA		DRAWN		LOCAL AUTHORITY		MAIN ROADS RESPONSIBILITY AREA		HWA DRAWING NUMBER		
1	LANDSCAPING MIXES AMENDED	J.WEAR	20.11.19	T.SIMPSON	(502) SHIRE OF CHITTERING	WHEATBELT	201708-622-1		PROJECT TITLE			
0	ISSUED FOR CONSTRUCTION	J.WEAR	17.10.18	C.HICK	ARUP TRADING AS ASJV		GREAT NORTHERN HIGHWAY (H006) - MUCHEA TO WUBIN STAGE 2		DRAWING TITLE			
		GROUND SURVEY STANDARD: 67-08-43		A. BRADFIELD	JACOBS		THE GOVERNMENT OF WESTERN AUSTRALIA		OLD GINGIN ROAD TO CHITTERING ROADHOUSE - SLK 38.6 TO SLK 51.1			
		DATE OF CAPTURE: 27.02.2012		C.MADIGAN	INFRASTRUCTURE DELIVERY DIRECTORATE		WESTERN AUSTRALIA		LANDSCAPING PLAN - MCA4 CHA. 46730 TO CHA. 47460			
		MAPPING SURVEY STANDARD: 67-08-44		J.WEAR	PROJECT DIRECTOR		N. FOX		SHEET 12			
		DATE OF CAPTURE: 27.02.2012		17.10.2018	DATE		17.10.2018		DRAWING STATUS			
		MAIN ROADS PROJECT ZONE: MUCHEA94		B. WOODS	DATE		17.10.2018		CONSTRUCTION			
		HEIGHT DATUM: AHD		PROJECT DIRECTOR		DATE		17.10.2018		DRAWING No. GNH-CN03-RW01-DRG-5612		
				PROJECT DIRECTOR		DATE		17.10.2018		REV 1		

NOTES:
 1. FOR GENERAL NOTES REFER TO DRG Nos. GNH-CN03-RW01-DRG-0031 AND 0032. FOR LEGEND REFER TO DRG Nos. GNH-CN03-RW01-DRG-0041 AND 0042.
 2. FOR PLANTING SCHEDULE REFER TO DRG No. GNH-CN03-RW01-DRG-5201.

LANDSCAPING CURRENTLY BEING COMPLETED. RED-LINE MARK-UPS TO BE ISSUED SEPARATELY ONCE COMPLETE.

Mix 6	
No.	Plant Code
Area 26 (m ²)=587	
14	Hak liss
12	Cor cal
12	Euc acc
8	Euc mar
12	Euc rud
15	Euc wan
20	Aca pul
10	Gre ves
20	Mel ham
15	Mel rha
10	Mel vim
2	Nuy flo

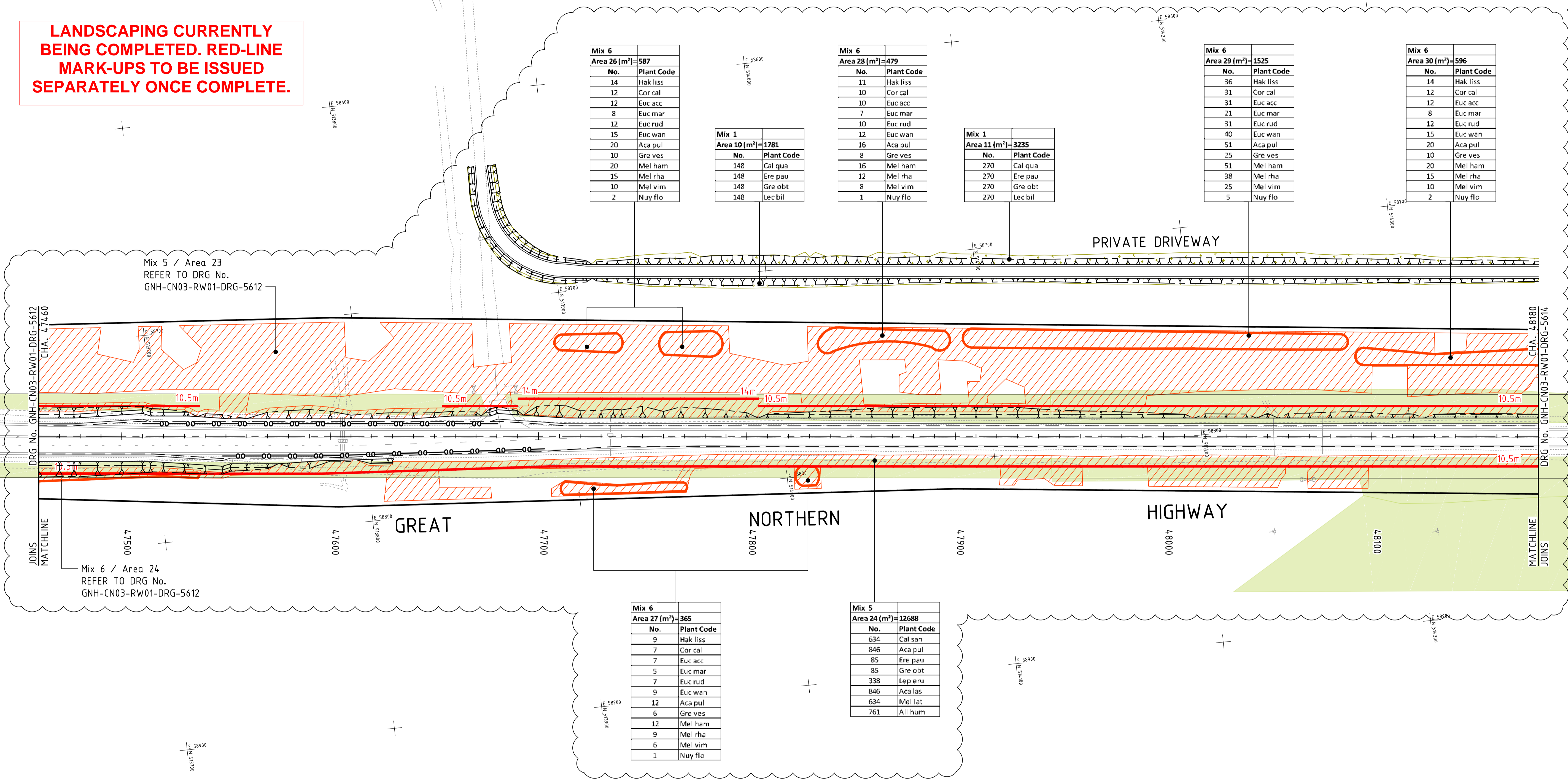
Mix 1	
No.	Plant Code
Area 10 (m ²)=1781	
148	Cal qua
148	Ere pau
148	Gre obt
148	Lec bil

Mix 6	
No.	Plant Code
Area 28 (m ²)=479	
11	Hak liss
10	Cor cal
10	Euc acc
7	Euc mar
10	Euc rud
12	Euc wan
16	Aca pul
8	Gre ves
16	Mel ham
12	Mel rha
8	Mel vim
1	Nuy flo

Mix 1	
No.	Plant Code
Area 11 (m ²)=3235	
270	Cal qua
270	Ere pau
270	Gre obt
270	Lec bil

Mix 6	
No.	Plant Code
Area 29 (m ²)=1525	
36	Hak liss
31	Cor cal
31	Euc acc
21	Euc mar
31	Euc rud
40	Euc wan
51	Aca pul
25	Gre ves
51	Mel ham
38	Mel rha
25	Mel vim
5	Nuy flo

Mix 6	
No.	Plant Code
Area 30 (m ²)=596	
14	Hak liss
12	Cor cal
12	Euc acc
8	Euc mar
12	Euc rud
15	Euc wan
20	Aca pul
10	Gre ves
20	Mel ham
15	Mel rha
10	Mel vim
2	Nuy flo



Mix 5 / Area 23
 REFER TO DRG No.
 GNH-CN03-RW01-DRG-5612

Mix 6 / Area 24
 REFER TO DRG No.
 GNH-CN03-RW01-DRG-5612

Mix 6	
No.	Plant Code
Area 27 (m ²)=365	
9	Hak liss
7	Cor cal
7	Euc acc
5	Euc mar
7	Euc rud
9	Euc wan
12	Aca pul
6	Gre ves
12	Mel ham
9	Mel rha
6	Mel vim
1	Nuy flo

Mix 5	
No.	Plant Code
Area 24 (m ²)=12688	
634	Cal san
846	Aca pul
85	Ere pau
85	Gre obt
338	Lep eru
846	Aca las
634	Mel lat
761	Alli hum

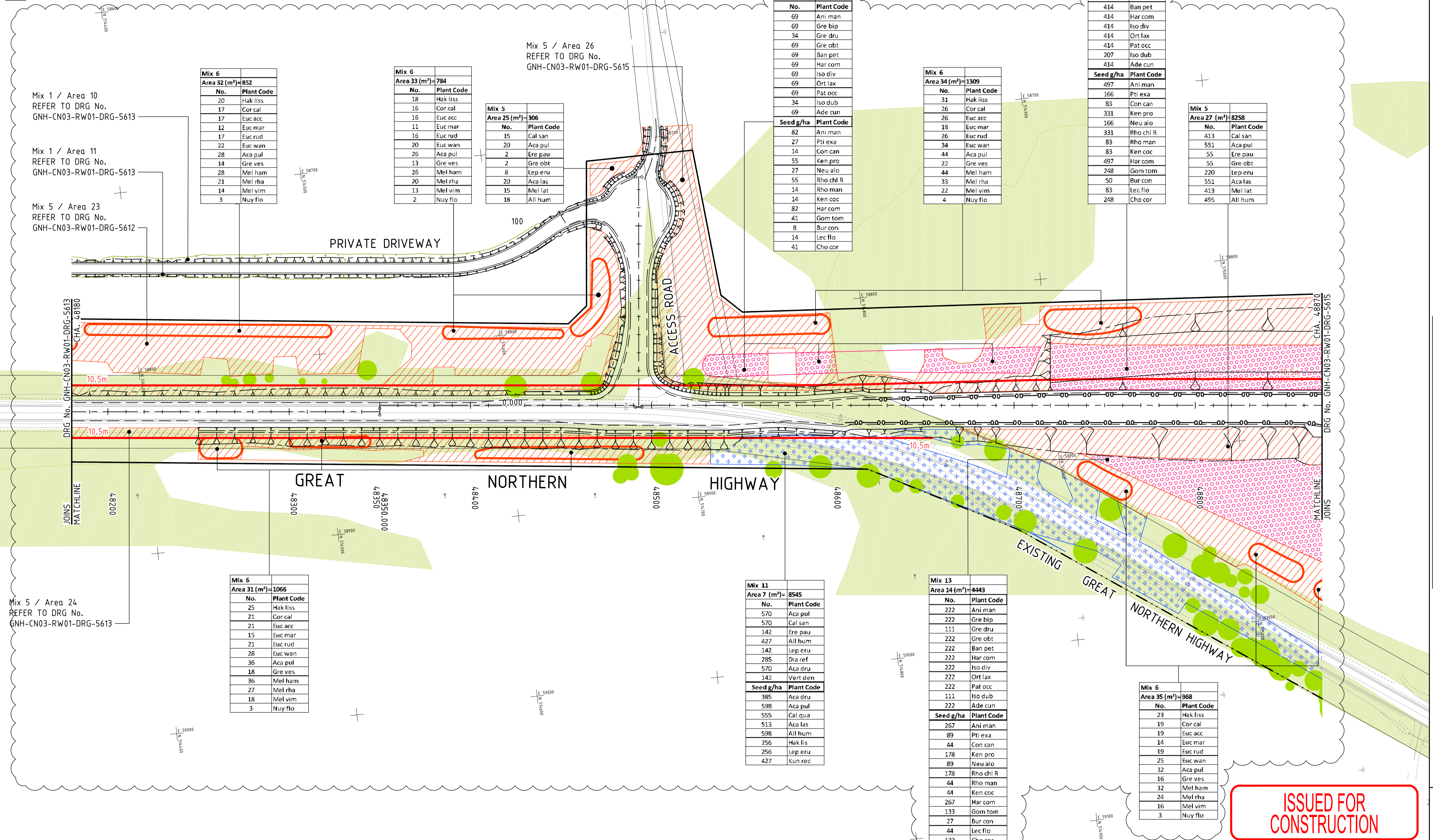
ISSUED FOR CONSTRUCTION

NOTE: ALL DRAWINGS ARE CONSIDERED UNCONTROLLED UNLESS STAMPED 'CONTROLLED COPY' IN RED

AMENDMENTS		METADATA		DRAWN		LOCAL AUTHORITY		MAIN ROADS RESPONSIBILITY AREA		HWMA DRAWING NUMBER	
1	LANDSCAPING MIXES AMENDED	J.WEAR	20.11.19	T.SIMPSON		(502) SHIRE OF CHITTERING	WHEATBELT	201708-623-1		PROJECT TITLE	
0	ISSUED FOR CONSTRUCTION	J.WEAR	17.10.18	C.HICK		THE GOVERNMENT OF WESTERN AUSTRALIA		GREAT NORTHERN HIGHWAY (H006) - MUCHEA TO WUBIN STAGE 2		DRAWING TITLE	
		GROUND SURVEY STANDARD: 67-08-43		DESIGNED: A. BRADFIELD		mainroads WESTERN AUSTRALIA		OLD GINGIN ROAD TO CHITTERING ROADHOUSE - SLK 38.6 TO SLK 51.1		DRAWING STATUS	
		DATE OF CAPTURE: 27.02.2012		CHECKED: C.MADIGAN		INFRASTRUCTURE DELIVERY DIRECTORATE		LANDSCAPING PLAN - MCA4 CHA. 47460 TO CHA. 48180		CONSTRUCTION	
		MAPPING SURVEY STANDARD: 67-08-44		APPROVED: J.WEAR		PROJECT DIRECTOR: B. WOODS		SHEET 13		GNH-CN03-RW01-DRG-5613	
		DATE OF CAPTURE: 27.02.2012		DATE: 17.10.2018		PROJECT DIRECTOR: N. FOX		DATE: 17.10.2018		REV 1	
		MAIN ROADS PROJECT ZONE: MUCHEA94		DATE: 17.10.2018		DATE: 17.10.2018					
		HEIGHT DATUM: AHD									

LANDSCAPING CURRENTLY BEING COMPLETED. RED-LINE MARK-UPS TO BE ISSUED SEPARATELY ONCE COMPLETE.

NOTES:
 1. FOR GENERAL NOTES REFER TO DRG Nos. GNH-CN03-RW01-DRG-0031 AND 0032. FOR LEGEND REFER TO DRG Nos. GNH-CN03-RW01-DRG-0041 AND 0042.
 2. FOR PLANTING SCHEDULE REFER TO DRG No. GNH-CN03-RW01-DRG-5201.



Mix 1 / Area 10
REFER TO DRG No.
GNH-CN03-RW01-DRG-5613

Mix 1 / Area 11
REFER TO DRG No.
GNH-CN03-RW01-DRG-5613

Mix 5 / Area 23
REFER TO DRG No.
GNH-CN03-RW01-DRG-5612

Mix 5 / Area 24
REFER TO DRG No.
GNH-CN03-RW01-DRG-5613

Mix 6
Area 32 (m²)=852

No.	Plant Code
20	Hak liss
17	Cor cal
17	Euc acc
12	Euc mar
17	Euc rud
22	Euc wan
28	Aca pul
14	Gre ves
28	Mel ham
21	Mel rha
14	Mel vim
3	Nuy flo

Mix 6
Area 33 (m²)=784

No.	Plant Code
18	Hak liss
16	Cor cal
16	Euc acc
11	Euc mar
16	Euc rud
20	Euc wan
26	Aca pul
13	Gre ves
26	Mel ham
20	Mel rha
13	Mel vim
2	Nuy flo

Mix 5
Area 25 (m²)=306

No.	Plant Code
15	Cal san
20	Aca pul
2	Ere pau
2	Gre obt
8	Lep eru
20	Aca las
15	Mel lat
18	All hum

Mix 13
Area 13 (m²)=1373

No.	Plant Code
69	Ani man
69	Gre bip
34	Gre dru
69	Gre obt
69	Ban pet
69	Har com
69	Iso div
69	Ort lax
69	Pat occ
34	Iso dub
69	Ade cun

Seed g/ha Plant Code

82	Ani man
27	Pti exa
14	Con can
55	Ken pro
27	Neu alo
55	Rho chl R
14	Rho man
14	Ken coc
82	Har com
41	Gom tom
8	Bur con
14	Lec flo
41	Cho cor

Mix 6
Area 34 (m²)=1309

No.	Plant Code
31	Hak liss
26	Cor cal
26	Euc acc
18	Euc mar
26	Euc rud
34	Euc wan
44	Aca pul
22	Gre ves
44	Mel ham
33	Mel rha
22	Mel vim
4	Nuy flo

Mix 13
Area 15 (m²)=8276

No.	Plant Code
414	Ani man
414	Gre bip
207	Gre dru
414	Gre obt
414	Ban pet
414	Har com
414	Iso div
414	Ort lax
414	Pat occ
207	Iso dub
414	Ade cun

Seed g/ha Plant Code

497	Ani man
166	Pti exa
83	Con can
331	Ken pro
166	Neu alo
331	Rho chl R
83	Rho man
83	Ken coc
497	Har com
248	Gom tom
50	Bur con
83	Lec flo
248	Cho cor

Mix 5
Area 27 (m²)=8258

No.	Plant Code
413	Cal san
551	Aca pul
55	Ere pau
55	Gre obt
220	Lep eru
551	Aca las
413	Mel lat
495	All hum

Mix 6
Area 31 (m²)=1066

No.	Plant Code
25	Hak liss
21	Cor cal
21	Euc acc
15	Euc mar
21	Euc rud
28	Euc wan
36	Aca pul
18	Gre ves
36	Mel ham
27	Mel rha
18	Mel vim
3	Nuy flo

Mix 11
Area 7 (m²)=8545

No.	Plant Code
570	Aca pul
570	Cal san
142	Ere pau
427	All hum
142	Lep eru
285	Dia ref
570	Aca dru
142	Vert den

Seed g/ha Plant Code

385	Aca dru
598	Aca pul
555	Cal qua
513	Aca las
598	All hum
256	Hak liss
256	Lep eru
427	Kun rec

Mix 13
Area 14 (m²)=4443

No.	Plant Code
222	Ani man
222	Gre bip
111	Gre dru
222	Gre obt
222	Ban pet
222	Har com
222	Iso div
222	Ort lax
222	Pat occ
111	Iso dub
222	Ade cun

Seed g/ha Plant Code

267	Ani man
89	Pti exa
44	Con can
178	Ken pro
89	Neu alo
178	Rho chl R
44	Rho man
44	Ken coc
267	Har com
133	Gom tom
27	Bur con
44	Lec flo
133	Cho cor

Mix 6
Area 35 (m²)=968

No.	Plant Code
23	Hak liss
19	Cor cal
19	Euc acc
14	Euc mar
19	Euc rud
25	Euc wan
32	Aca pul
16	Gre ves
32	Mel ham
24	Mel rha
16	Mel vim
3	Nuy flo

ISSUED FOR CONSTRUCTION

NOTE: ALL DRAWINGS ARE CONSIDERED UNCONTROLLED UNLESS STAMPED 'CONTROLLED COPY' IN RED

METADATA	
GROUND SURVEY STANDARD:	67-08-43
DATE OF CAPTURE:	27.02.2012
MAPPING SURVEY STANDARD:	67-08-44
DATE OF CAPTURE:	27.02.2012
MAIN ROADS PROJECT ZONE:	MUCHEA94
HEIGHT DATUM:	AHD

DRAWN	T.SIMPSON
CHECKED	C.HICK
DESIGNED	A. BRADFIELD
CHECKED	C.MADIGAN
APPROVED	J.WEAR
DATE	17.10.2018

PROJECT DIRECTOR: B. WOODS DATE: 17.10.2018

LOCAL AUTHORITY: (502) SHIRE OF CHITTERING MAIN ROADS RESPONSIBILITY AREA: WHEATBELT

ARUP | TRADING AS ASJV
 JACOBS

mainroads WESTERN AUSTRALIA
 INFRASTRUCTURE DELIVERY DIRECTORATE

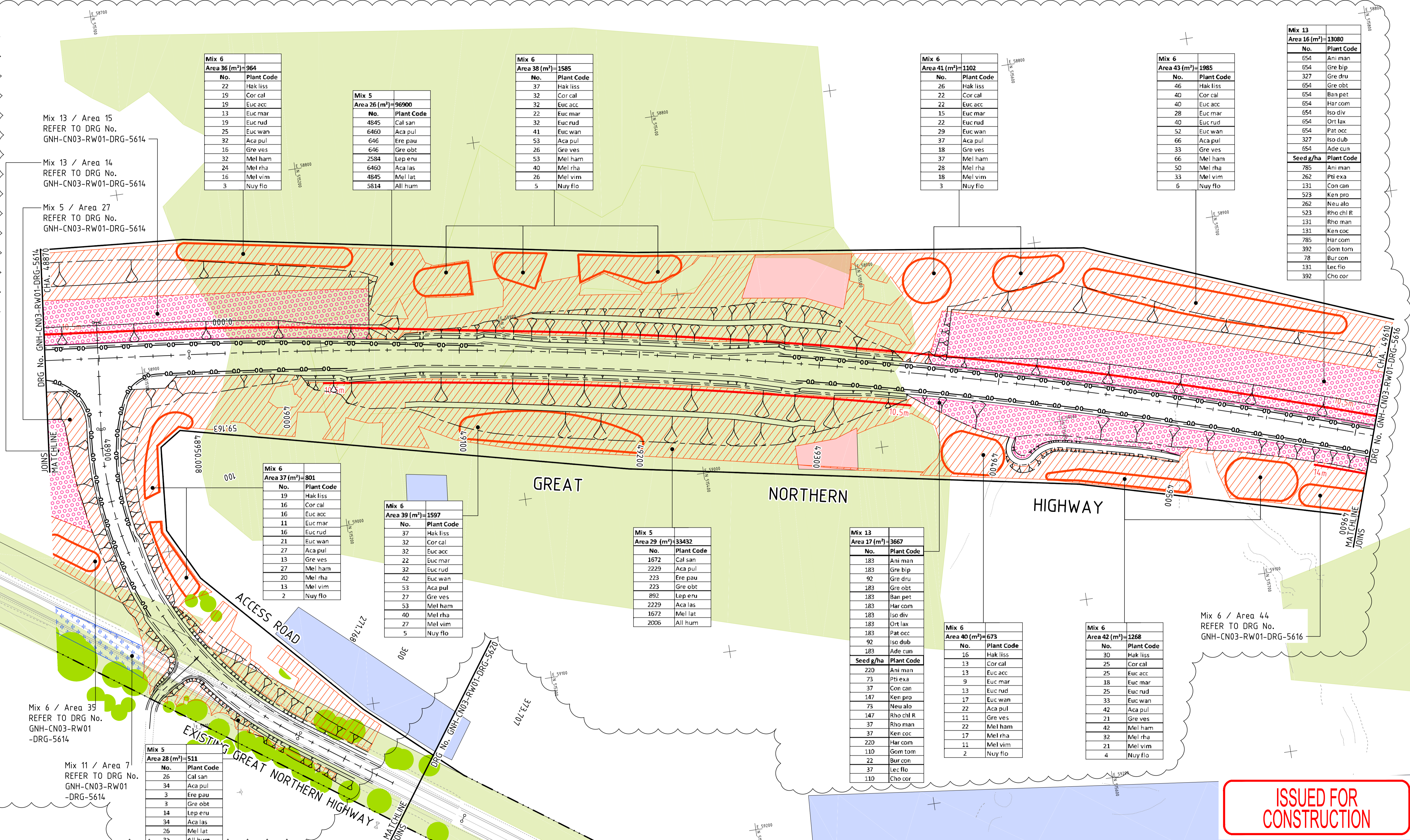
PROJECT TITLE	201708-624-1
GREAT NORTHERN HIGHWAY (H006) - MUCHEA TO WUBIN STAGE 2	
DRAWING TITLE	OLD GINGIN ROAD TO CHITTERING ROADHOUSE - SLK 38.6 TO SLK 51.1
LANDSCAPING PLAN - MCA4 CHA. 48180 TO CHA. 48870	
SHEET 14	
DRAWING STATUS	CONSTRUCTION
DRAWING No.	GNH-CN03-RW01-DRG-5614
REV	1

1:1000 (A1) / 1:2000 (A3)

A 1

LANDSCAPING CURRENTLY BEING COMPLETED. RED-LINE MARK-UPS TO BE ISSUED SEPARATELY ONCE COMPLETE.

NOTES:
1. FOR GENERAL NOTES REFER TO DRG Nos. GNH-CN03-RW01-DRG-0031 AND 0032. FOR LEGEND REFER TO DRG Nos. GNH-CN03-RW01-DRG-0041 AND 0042.
2. FOR PLANTING SCHEDULE REFER TO DRG No. GNH-CN03-RW01-DRG-5201.



Mix 6 Area 36 (m²)=964. Table with columns: No., Plant Code. Rows include Hak liss, Cor cal, Euc acc, Euc mar, Euc rud, Euc wan, Aca pul, Gre ves, Mel ham, Mel rha, Mel vim, Nuy flo.

Mix 5 Area 26 (m²)=96900. Table with columns: No., Plant Code. Rows include Cal san, Aca pul, Ere pau, Gre obt, Lep eru, Aca las, Mel lat, All hum.

Mix 6 Area 38 (m²)=1585. Table with columns: No., Plant Code. Rows include Hak liss, Cor cal, Euc acc, Euc mar, Euc rud, Euc wan, Aca pul, Gre ves, Mel ham, Mel rha, Mel vim, Nuy flo.

Mix 6 Area 41 (m²)=1102. Table with columns: No., Plant Code. Rows include Hak liss, Cor cal, Euc acc, Euc mar, Euc rud, Euc wan, Aca pul, Gre ves, Mel ham, Mel rha, Mel vim, Nuy flo.

Mix 6 Area 43 (m²)=1985. Table with columns: No., Plant Code. Rows include Hak liss, Cor cal, Euc acc, Euc mar, Euc rud, Euc wan, Aca pul, Gre ves, Mel ham, Mel rha, Mel vim, Nuy flo.

Mix 13 Area 16 (m²)=13080. Table with columns: No., Plant Code, Seed g/ha, Plant Code. Rows include Ani man, Gre bip, Gre dru, Gre obt, Ban pet, Har com, Iso div, Ort lax, Pat occ, Iso dub, Ade cun, Ani man, Pti exa, Con can, Ken pro, Neu alo, Rho chl R, Rho man, Ken coc, Har com, Gom tom, Bur con, Lec flo, Cho cor.

Mix 6 Area 37 (m²)=801. Table with columns: No., Plant Code. Rows include Hak liss, Cor cal, Euc acc, Euc mar, Euc rud, Euc wan, Gre ves, Mel ham, Mel rha, Mel vim, Nuy flo.

Mix 6 Area 39 (m²)=1597. Table with columns: No., Plant Code. Rows include Hak liss, Cor cal, Euc acc, Euc mar, Euc rud, Euc wan, Aca pul, Gre ves, Mel ham, Mel rha, Mel vim, Nuy flo.

Mix 5 Area 29 (m²)=33432. Table with columns: No., Plant Code. Rows include Cal san, Aca pul, Ere pau, Gre obt, Lep eru, Aca las, Mel lat, All hum.

Mix 13 Area 17 (m²)=3667. Table with columns: No., Plant Code, Seed g/ha, Plant Code. Rows include Ani man, Gre bip, Gre dru, Gre obt, Ban pet, Har com, Iso div, Ort lax, Pat occ, Iso dub, Ade cun, Ani man, Pti exa, Con can, Ken pro, Neu alo, Rho chl R, Rho man, Ken coc, Har com, Gom tom, Bur con, Lec flo, Cho cor.

Mix 6 Area 40 (m²)=673. Table with columns: No., Plant Code. Rows include Hak liss, Cor cal, Euc acc, Euc mar, Euc rud, Euc wan, Aca pul, Gre ves, Mel ham, Mel rha, Mel vim, Nuy flo.

Mix 6 Area 42 (m²)=1268. Table with columns: No., Plant Code. Rows include Hak liss, Cor cal, Euc acc, Euc mar, Euc rud, Euc wan, Aca pul, Gre ves, Mel ham, Mel rha, Mel vim, Nuy flo.

Mix 6 / Area 44 REFER TO DRG No. GNH-CN03-RW01-DRG-5616

ISSUED FOR CONSTRUCTION

NOTE: ALL DRAWINGS ARE CONSIDERED UNCONTROLLED UNLESS STAMPED 'CONTROLLED COPY' IN RED

METADATA table with columns: GROUND SURVEY STANDARD, DATE OF CAPTURE, MAPPING SURVEY STANDARD, DATE OF CAPTURE, MAIN ROADS PROJECT ZONE, HEIGHT DATUM.

Logos for GNH, ARUP, TRADING AS ASJV, JACOBS, and project information including Project Director B. Woods and Date 17.10.2018.

Logos for Mainroads Western Australia and Infrastructure Delivery Directorate, along with project location and date 17.10.2018.

Table with columns: PROJECT TITLE (201708-625-1), DRAWING TITLE (LANDSCAPING PLAN - MCS1 CHA. 48870 TO CHA. 49610), SHEET (15), DRAWING STATUS (CONSTRUCTION), and DRAWING No. (GNH-CN03-RW01-DRG-5615).

Scale: 1:1000 (A1) / 1:2000 (A3)

A 1

SHEET 1

LANDSCAPING CURRENTLY BEING COMPLETED. RED-LINE MARK-UPS TO BE ISSUED SEPARATELY ONCE COMPLETE.

NOTES:
 1. FOR GENERAL NOTES REFER TO DRG Nos. GNH-CN03-RW01-DRG-0031 AND 0032. FOR LEGEND REFER TO DRG Nos. GNH-CN03-RW01-DRG-0041 AND 0042.
 2. FOR PLANTING SCHEDULE REFER TO DRG No. GNH-CN03-RW01-DRG-5201.

Mix 6
Area 45 (m²)=622

No.	Plant Code
15	Hak liss
12	Cor cal
12	Euc acc
9	Euc mar
12	Euc rud
16	Euc wan
21	Aca pul
10	Gre ves
21	Mel ham
16	Mel rha
10	Mel vim
2	Nuy flo

Mix 6
Area 47 (m²)=959

No.	Plant Code
22	Hak liss
19	Cor cal
19	Euc acc
13	Euc mar
19	Euc rud
25	Euc wan
32	Aca pul
16	Gre ves
32	Mel ham
24	Mel rha
16	Mel vim
3	Nuy flo

Mix 6
Area 48 (m²)=660

No.	Plant Code
15	Hak liss
13	Cor cal
9	Euc acc
9	Euc mar
13	Euc rud
17	Euc wan
22	Aca pul
11	Gre ves
22	Mel ham
17	Mel rha
11	Mel vim
2	Nuy flo

Mix 6
Area 49 (m²)=354

No.	Plant Code
8	Hak liss
7	Cor cal
5	Euc acc
7	Euc mar
9	Euc rud
12	Aca pul
6	Gre ves
12	Mel ham
9	Mel rha
6	Mel vim
1	Nuy flo

Mix 6
Area 50 (m²)=636

No.	Plant Code
15	Hak liss
13	Cor cal
13	Euc acc
9	Euc mar
13	Euc rud
17	Euc wan
21	Aca pul
11	Gre ves
21	Mel ham
16	Mel rha
11	Mel vim
2	Nuy flo

Mix 6
Area 44 (m²)=1547

No.	Plant Code
36	Hak liss
31	Cor cal
31	Euc acc
22	Euc mar
31	Euc rud
40	Euc wan
52	Aca pul
26	Gre ves
52	Mel ham
39	Mel rha
26	Mel vim
5	Nuy flo

Mix 6
Area 46 (m²)=941

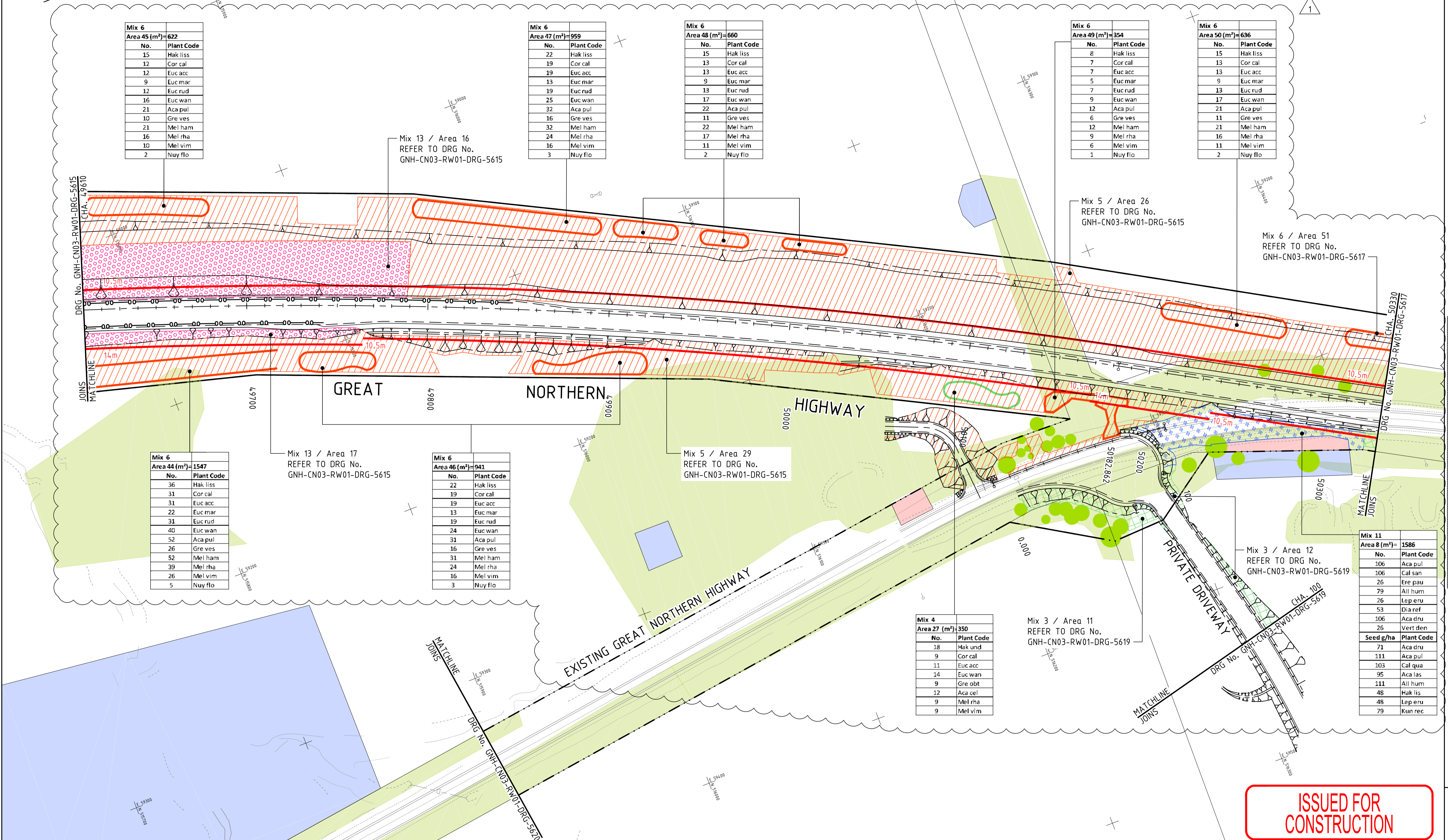
No.	Plant Code
22	Hak liss
19	Cor cal
19	Euc acc
13	Euc mar
19	Euc rud
24	Euc wan
31	Aca pul
16	Gre ves
31	Mel ham
24	Mel rha
16	Mel vim
3	Nuy flo

Mix 4
Area 27 (m²)=350

No.	Plant Code
18	Hak und
9	Cor cal
11	Euc acc
14	Euc wan
9	Gre obt
12	Aca cel
9	Mel rha
9	Mel vim

Mix 11
Area 8 (m²)=1586

No.	Plant Code
106	Aca pul
106	Cal san
26	Ere pau
79	All hum
26	Lep eru
53	Dia ref
106	Aca dru
26	Vert den
Seed g/ha	Plant Code
71	Aca dru
111	Aca pul
103	Cal qua
95	Aca las
111	All hum
48	Hak lis
48	Lep eru
79	Kun rec



ISSUED FOR CONSTRUCTION

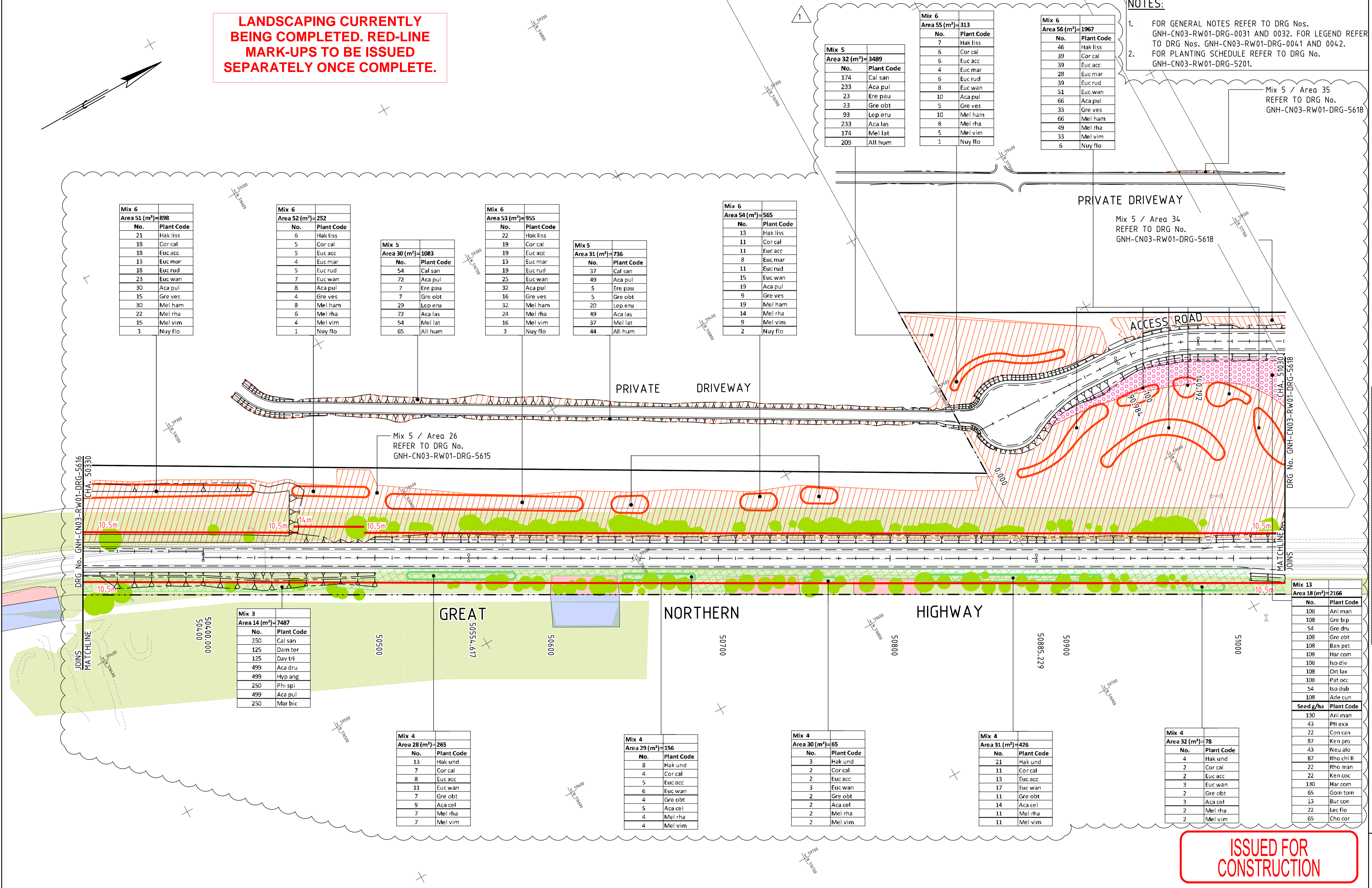
NOTE: ALL DRAWINGS ARE CONSIDERED UNCONTROLLED UNLESS STAMPED 'CONTROLLED COPY' IN RED

AMENDMENTS		METADATA		DRAWING INFORMATION		PROJECT INFORMATION	
No.	DESCRIPTION	APPROVED & DATE	No.	DESCRIPTION	APPROVED & DATE	PROJECT TITLE	PROJECT NO.
1	LANDSCAPING MIXES AMENDED	J.WEAR 20.11.19	67-08-43	GROUND SURVEY STANDARD:	T.SIMPSON	GREAT NORTHERN HIGHWAY (H006) - MUCHEA TO WUBIN STAGE 2	201708-626-1
0	ISSUED FOR CONSTRUCTION	J.WEAR 17.10.18	27.02.2012	DATE OF CAPTURE:	C.HICK	OLD GINGIN ROAD TO CHITTERING ROADHOUSE - SLK 38.6 TO SLK 51.1	GNH-CN03-RW01-DRG-5616
			67-08-44	MAPPING SURVEY STANDARD:	A. BRADFIELD	LANDSCAPING PLAN - MCS1 CHA. 49610 TO CHA. 50330	
			27.02.2012	DATE OF CAPTURE:	C.MADIGAN	SHEET 16	
				MAIN ROADS PROJECT ZONE:	J.WEAR		
				HEIGHT DATUM:	17.10.2018		
					B. WOODS		
					17.10.2018		
					N. FOX		
					17.10.2018		



LANDSCAPING CURRENTLY BEING COMPLETED. RED-LINE MARK-UPS TO BE ISSUED SEPARATELY ONCE COMPLETE.

NOTES:
 1. FOR GENERAL NOTES REFER TO DRG Nos. GNH-CN03-RW01-DRG-0031 AND 0032. FOR LEGEND REFER TO DRG Nos. GNH-CN03-RW01-DRG-0041 AND 0042.
 2. FOR PLANTING SCHEDULE REFER TO DRG No. GNH-CN03-RW01-DRG-5201.



ISSUED FOR CONSTRUCTION

NOTE: ALL DRAWINGS ARE CONSIDERED UNCONTROLLED UNLESS STAMPED 'CONTROLLED COPY' IN RED		METADATA		DRAWN: T.SIMPSON		LOCAL AUTHORITY: (502) SHIRE OF CHITTERING		MAIN ROADS RESPONSIBILITY AREA: WHEATBELT		HWA DRAWING NUMBER: 201708-627-1	
		GROUND SURVEY STANDARD: 67-08-43		DESIGNED: C.HICK		PROJECT DIRECTOR: B. WOODS		PROJECT DIRECTOR: N. FOX		PROJECT TITLE: GREAT NORTHERN HIGHWAY (H006) - MUCHEA TO WUBIN STAGE 2	
		DATE OF CAPTURE: 27.02.2012		CHECKED: A. BRADFIELD		DATE: 17.10.2018		DATE: 17.10.2018		DRAWING TITLE: OLD GINGIN ROAD TO CHITTERING ROADHOUSE - SLK 38.6 TO SLK 51.1	
		MAPPING SURVEY STANDARD: 67-08-44		CHECKED: C.MADIGAN		PROJECT DIRECTOR: B. WOODS		PROJECT DIRECTOR: N. FOX		LANDSCAPING PLAN - MCA5 CHA. 50330 TO CHA. 51030	
		DATE OF CAPTURE: 27.02.2012		APPROVED: J.WEAR		DATE: 17.10.2018		DATE: 17.10.2018		SHEET 17	
		MAIN ROADS PROJECT ZONE: MUCHEA94		DATE: 17.10.2018		DATE: 17.10.2018		DATE: 17.10.2018		DRAWING STATUS: CONSTRUCTION	
		HEIGHT DATUM: AHD		DATE: 17.10.2018		DATE: 17.10.2018		DATE: 17.10.2018		DRAWING No: GNH-CN03-RW01-DRG-5617	
AMENDMENTS										REV 1	
No.	DESCRIPTION	APPROVED & DATE	No.	DESCRIPTION	APPROVED & DATE						
1	LANDSCAPING MIXES AMENDED	J.WEAR 20.11.19									
0	ISSUED FOR CONSTRUCTION	J.WEAR 17.10.18									



INFRASTRUCTURE DELIVERY DIRECTORATE

Plot Date : 20 Nov 2019 5:36pm

FILENAME : C:\Users\hickwood\Desktop\Prints\2019-11-20\CN03\GNH-CN03-RW01-DRG-5618.dwg

Mix 5 / Area 26
REFER TO DRG No.
GNH-CN03-RW01-DRG-5615

Mix 6	
No.	Plant Code
Area 57 (m ²)=1930	
45	Hak liss
39	Cor cal
39	Euc acc
27	Euc mar
39	Euc rud
50	Euc wan
64	Aca pul
32	Gre ves
64	Mel ham
48	Mel rha
32	Mel vim
6	Nuy flo

Mix 13 / Area 18
REFER TO DRG No.
GNH-CN03-RW01-DRG-5617

Mix 5	
No.	Plant Code
Area 35 (m ²)=188	
9	Cal san
13	Aca pul
1	Ere pau
1	Gre obt
5	Lep eru
13	Aca las
9	Mel lat
11	All hum

Mix 6	
No.	Plant Code
Area 58 (m ²)=3603	
84	Hak liss
72	Cor cal
72	Euc acc
50	Euc mar
72	Euc rud
94	Euc wan
120	Aca pul
60	Gre ves
120	Mel ham
90	Mel rha
60	Mel vim
11	Nuy flo

Mix 5	
No.	Plant Code
Area 34 (m ²)=3350	
168	Cal san
223	Aca pul
22	Ere pau
22	Gre obt
89	Lep eru
223	Aca las
168	Mel lat
201	All hum

Mix 13	
No.	Plant Code
Area 19 (m ²)=1605	
80	Ani man
80	Gre bip
40	Gre dru
80	Gre obt
80	Ban pet
80	Har com
80	Iso div
80	Ort lax
80	Pat occ
40	Iso dub
80	Hak und
10	Cor cal
11	Euc acc
15	Euc wan
10	Gre obt
13	Aca cel
10	Mel rha
10	Mel vim

Mix 4	
No.	Plant Code
Area 34 (m ²)=382	
19	Hak und
10	Cor cal
11	Euc acc
15	Euc wan
10	Gre obt
13	Aca cel
10	Mel rha
10	Mel vim

Mix 5	
No.	Plant Code
Area 33 (m ²)=41481	
2074	Cal san
2765	Aca pul
277	Ere pau
277	Gre obt
1106	Lep eru
2765	Aca las
2074	Mel lat
2489	All hum

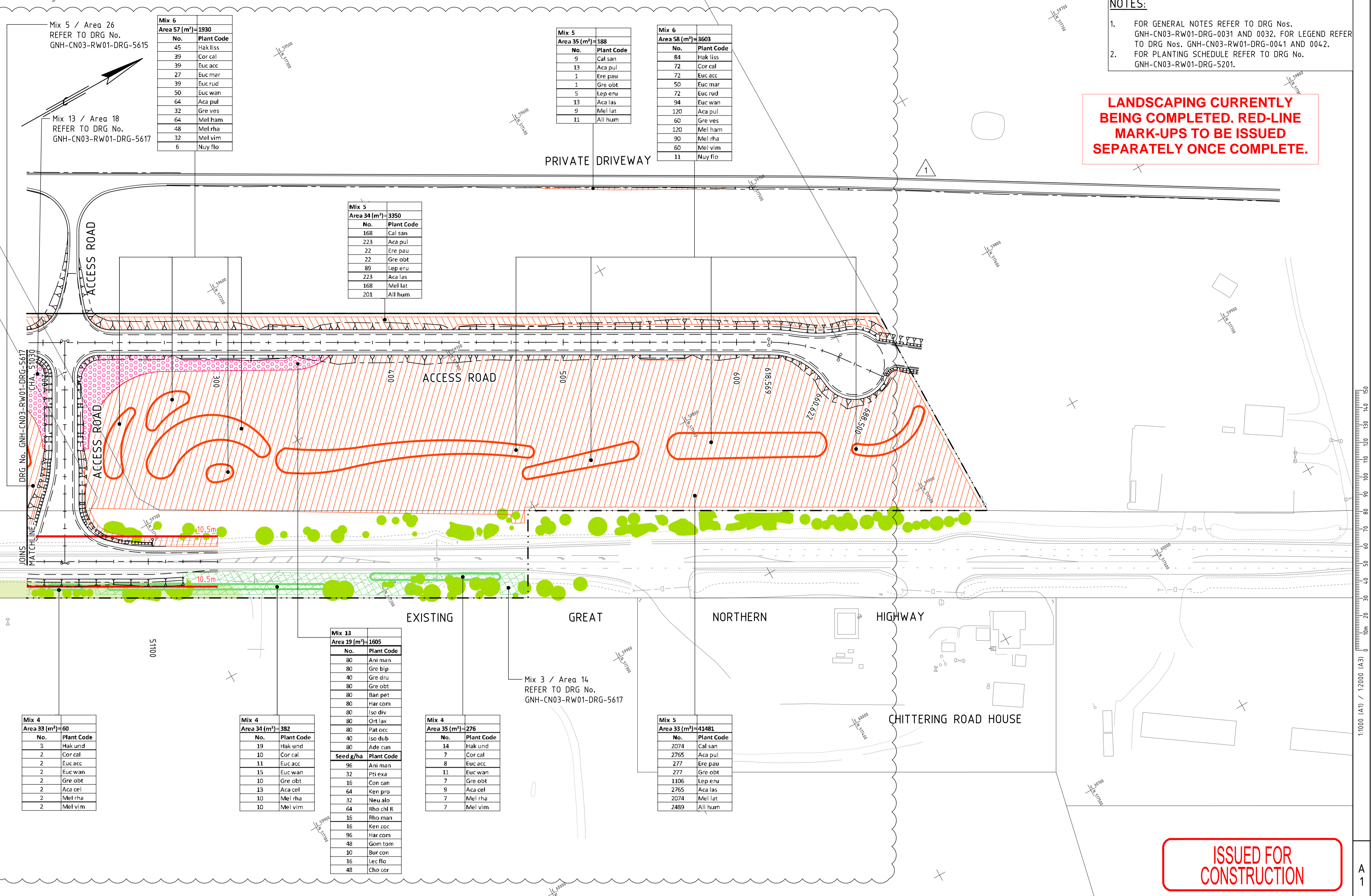
Mix 4	
No.	Plant Code
Area 33 (m ²)=60	
3	Hak und
2	Cor cal
2	Euc acc
2	Euc wan
2	Gre obt
2	Aca cel
2	Mel rha
2	Mel vim

Mix 4	
No.	Plant Code
Area 34 (m ²)=382	
19	Hak und
10	Cor cal
11	Euc acc
15	Euc wan
10	Gre obt
13	Aca cel
10	Mel rha
10	Mel vim

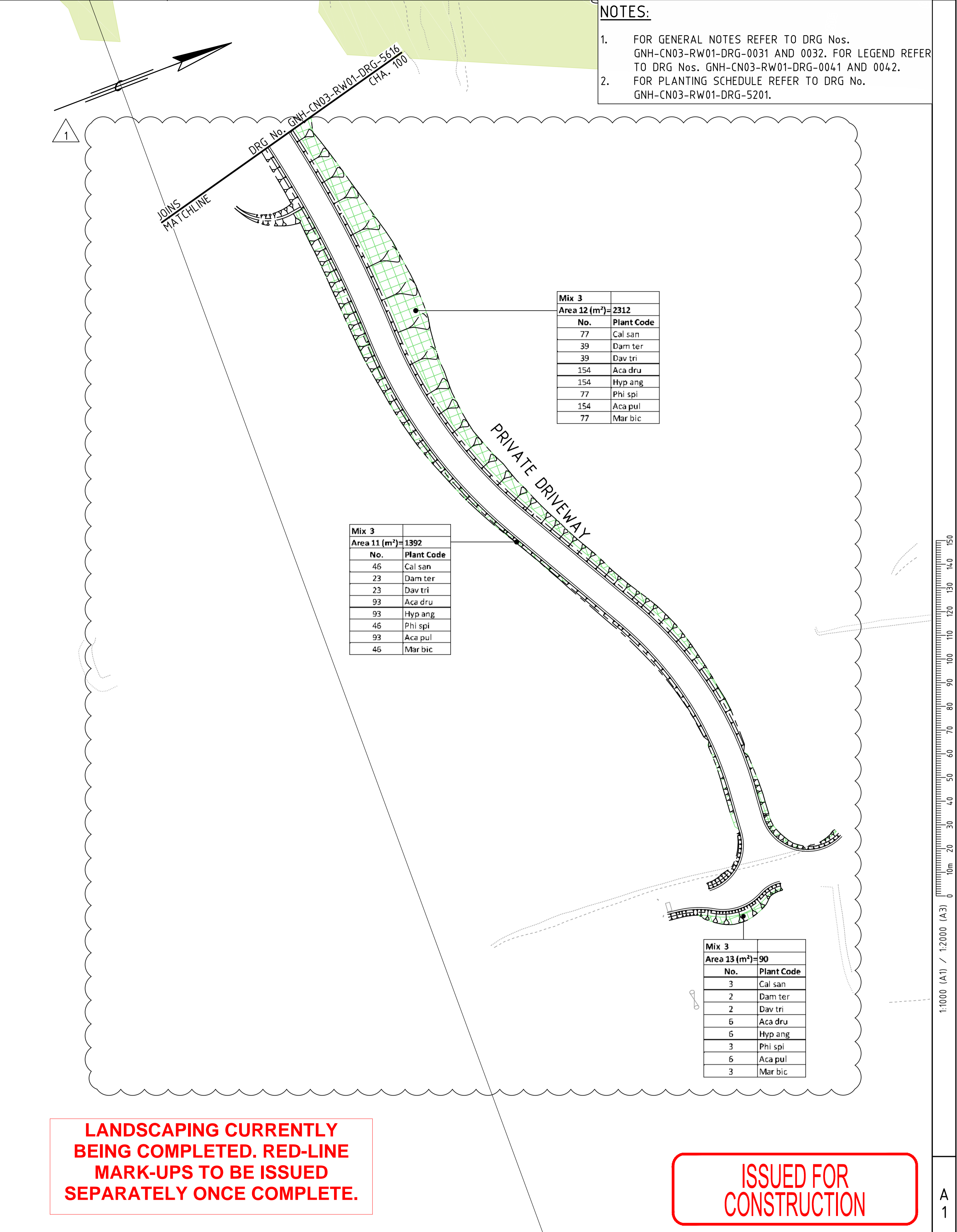
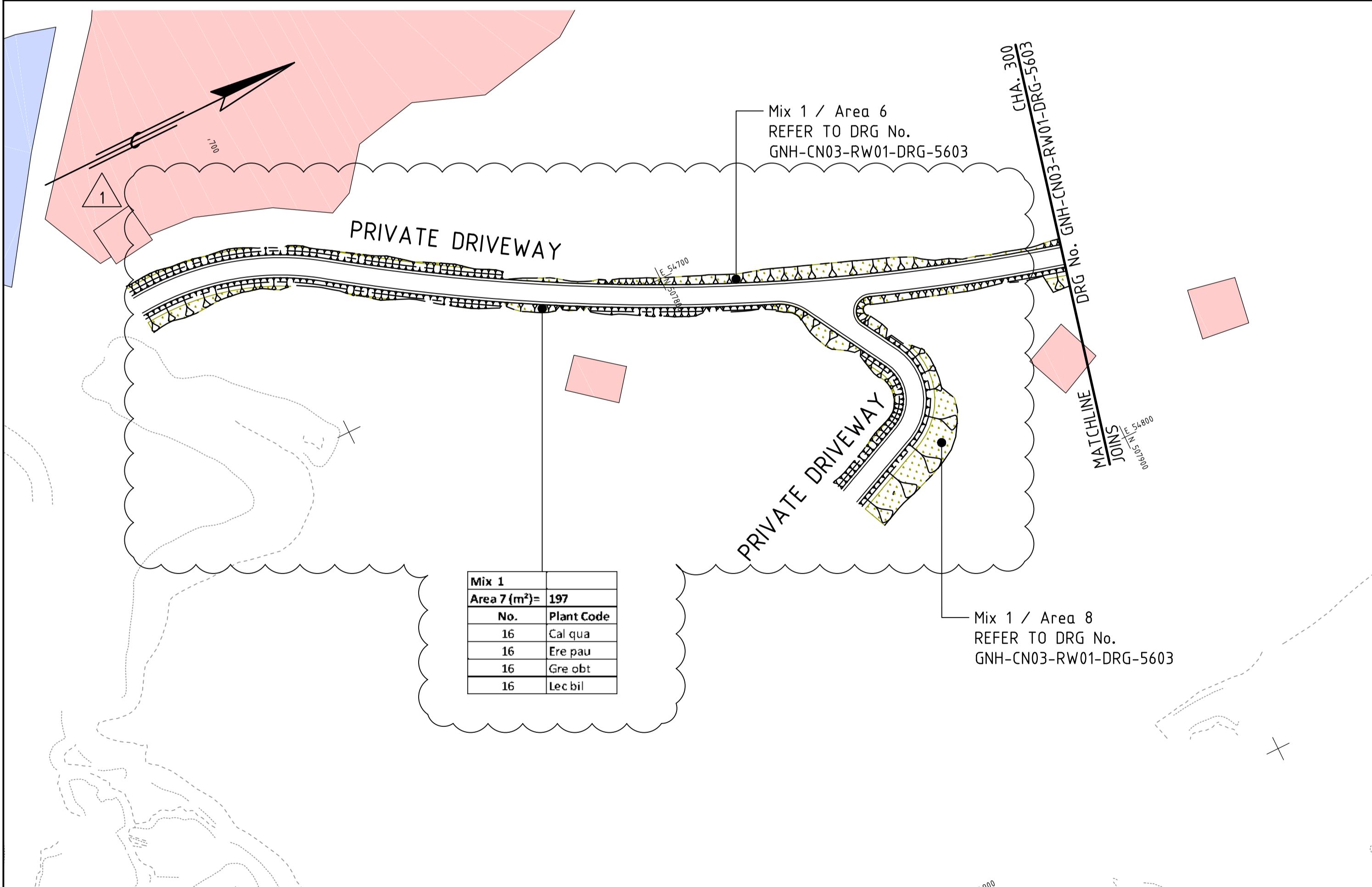
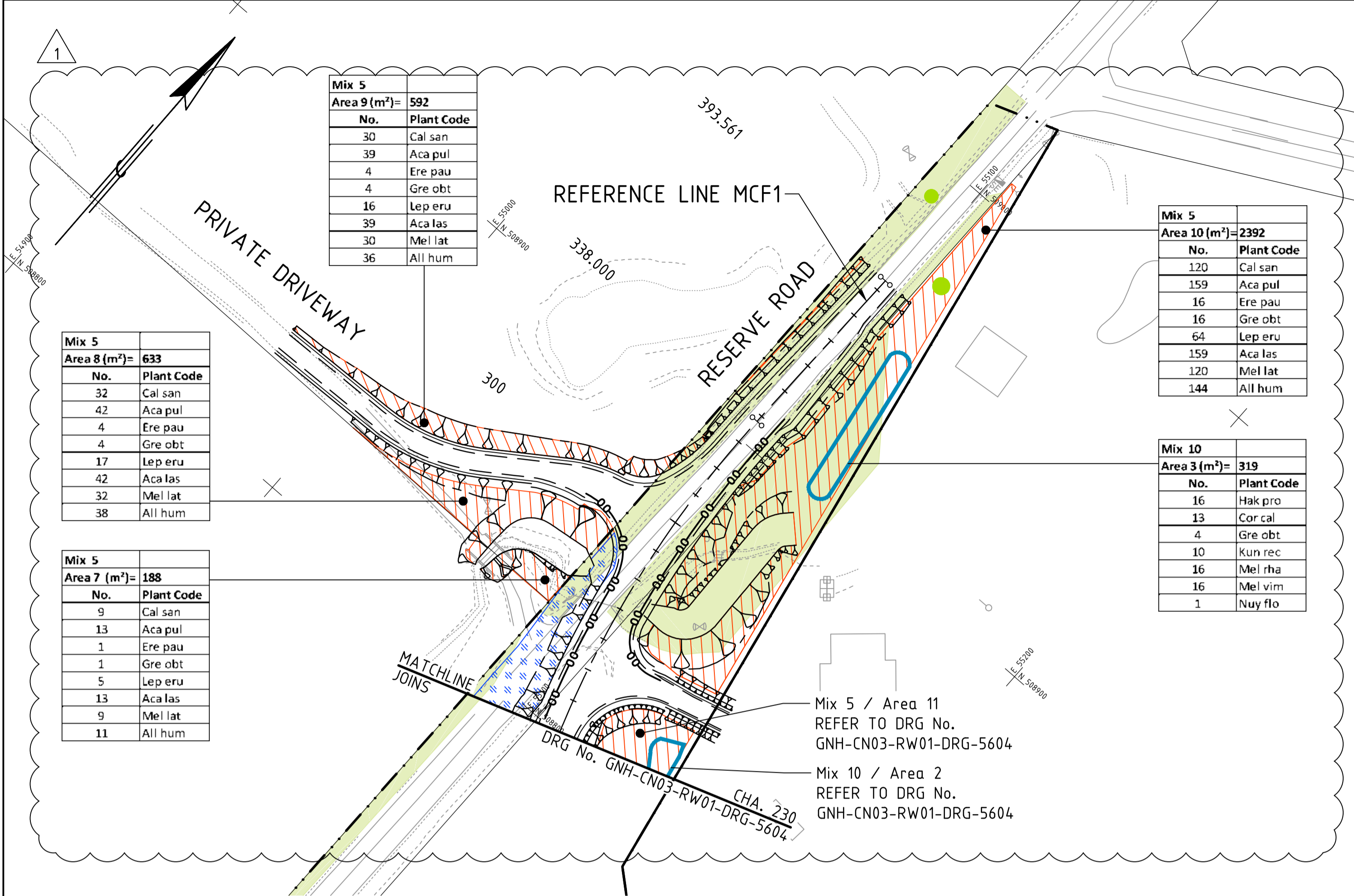
NOTES:
1. FOR GENERAL NOTES REFER TO DRG Nos. GNH-CN03-RW01-DRG-0031 AND 0032. FOR LEGEND REFER TO DRG Nos. GNH-CN03-RW01-DRG-0041 AND 0042.
2. FOR PLANTING SCHEDULE REFER TO DRG No. GNH-CN03-RW01-DRG-5201.

LANDSCAPING CURRENTLY BEING COMPLETED. RED-LINE MARK-UPS TO BE ISSUED SEPARATELY ONCE COMPLETE.

ISSUED FOR CONSTRUCTION



NOTE: ALL DRAWINGS ARE CONSIDERED UNCONTROLLED UNLESS STAMPED 'CONTROLLED COPY' IN RED		METADATA		DRAWN: T.SIMPSON CHECKED: C.HICK DESIGNED: A. BRADFIELD CHECKED: C.MADIGAN APPROVED: J.WEAR DATE: 17.10.2018	LOCAL AUTHORITY: (502) SHIRE OF CHITTINGING MAIN ROADS RESPONSIBILITY AREA: WHEATBELT PROJECT DIRECTOR: B. WOODS DATE: 17.10.2018	PROJECT TITLE: GREAT NORTHERN HIGHWAY (H006) - MUCHEA TO WUBIN STAGE 2 DRAWING TITLE: OLD GINGIN ROAD TO CHITTING ROADHOUSE - SLK 38.6 TO SLK 51.1 LANDSCAPING PLAN - MCA5 CHA. 51030 TO CHA. 51115 SHEET 18	HSWA DRAWING NUMBER: 201708-628-1 CONSTRUCTION GNH-CN03-RW01-DRG-5618
1 LANDSCAPING MIXES AMENDED 0 ISSUED FOR CONSTRUCTION	J.WEAR 20.11.19 J.WEAR 17.10.18	AMENDMENTS	GROUND SURVEY STANDARD: 67-08-43 DATE OF CAPTURE: 27.02.2012 MAPPING SURVEY STANDARD: 67-08-44 DATE OF CAPTURE: 27.02.2012 MAIN ROADS PROJECT ZONE: MUCHEA94 HEIGHT DATUM: AHD	PROJECT DIRECTOR: N. FOX DATE: 17.10.2018	SHEET 18	REV 1	



NOTES:

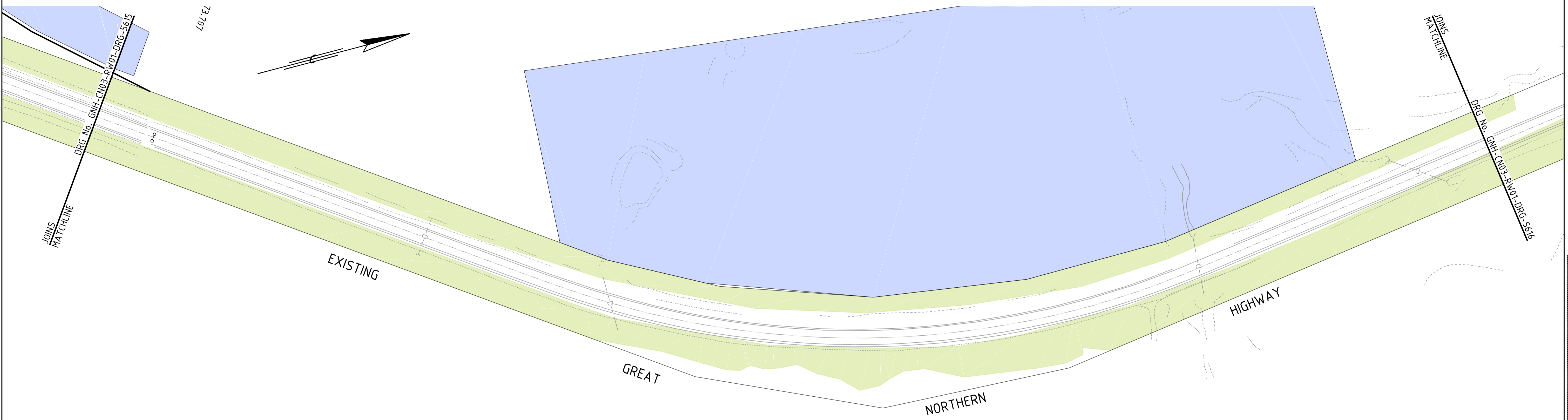
- FOR GENERAL NOTES REFER TO DRG Nos. GNH-CN03-RW01-DRG-0031 AND 0032. FOR LEGEND REFER TO DRG Nos. GNH-CN03-RW01-DRG-0041 AND 0042.
- FOR PLANTING SCHEDULE REFER TO DRG No. GNH-CN03-RW01-DRG-5201.

LANDSCAPING CURRENTLY BEING COMPLETED. RED-LINE MARK-UPS TO BE ISSUED SEPARATELY ONCE COMPLETE.

ISSUED FOR CONSTRUCTION

NOTE: ALL DRAWINGS ARE CONSIDERED UNCONTROLLED UNLESS STAMPED 'CONTROLLED COPY' IN RED		METADATA		DRAWN: T.SIMPSON CHECKED: C.HICK DESIGNED: A. BRADFIELD CHECKED: C.MADIGAN APPROVED: J.WEAR DATE: 17.10.2018	LOCAL AUTHORITY: (502) SHIRE OF CHITTERING MAIN ROADS RESPONSIBILITY AREA: WHEATBELT TRADING AS ASJV INFRASTRUCTURE DELIVERY DIRECTORATE	HSMA DRAWING NUMBER: 201708-629-1 PROJECT TITLE: GREAT NORTHERN HIGHWAY (H006) - MUCHEA TO WUBIN STAGE 2 DRAWING TITLE: OLD GINGIN ROAD TO CHITTERING ROADHOUSE - SLK 38.6 TO SLK 51.1 LANDSCAPING PLAN - MCF1 (RESERVE ROAD) CHA. 230 TO CHA. 393.561; PRIVATE DRIVEWAYS SHEET 19 DRAWING STATUS: CONSTRUCTION DRAWING No.: GNH-CN03-RW01-DRG-5619
1 LANDSCAPING MIXES AMENDED 0 ISSUED FOR CONSTRUCTION	J.WEAR 20.11.19 J.WEAR 17.10.18	AMENDMENTS	GROUND SURVEY STANDARD: 67-08-43 DATE OF CAPTURE: 27.02.2012 MAPPING SURVEY STANDARD: 67-08-44 DATE OF CAPTURE: 27.02.2012 MAIN ROADS PROJECT ZONE: MUCHEA94 HEIGHT DATUM: AHD	PROJECT DIRECTOR: B. WOODS DATE: 17.10.2018	PROJECT DIRECTOR: N. FOX DATE: 17.10.2018	SHEET: 1

NOTES:
 1. FOR GENERAL NOTES REFER TO DRG Nos. GNH-CN03-RW01-DRG-0031 AND 0032. FOR LEGEND REFER TO DRG Nos. GNH-CN03-RW01-DRG-0041 AND 0042.
 2. FOR PLANTING SCHEDULE REFER TO DRG No. GNH-CN03-RW01-DRG-5201.



LANDSCAPING CURRENTLY BEING COMPLETED. RED-LINE MARK-UPS TO BE ISSUED SEPARATELY ONCE COMPLETE.

ISSUED FOR CONSTRUCTION

NOTE: ALL DRAWINGS ARE CONSIDERED UNCONTROLLED UNLESS STAMPED "CONTROLLED COPY" IN RED				METADATA GROUND SURVEY STANDARD: 67-08-43 DATE OF CAPTURE: 27.02.2012 MAPPING SURVEY STANDARD: 67-08-44 DATE OF CAPTURE: 27.02.2012 MAIN ROADS PROJECT ZONE: MUCHEA94 HEIGHT DATUM: AHD		DRAWN: T.SIMPSON CHECKED: J. LACON DESIGNED: A. BRADFIELD CHECKED: C. MADIGAN APPROVED: J.WEAR DATE: 17.10.2018		LOCAL AUTHORITY: (502) SHIRE OF CHITTERING MAIN ROADS RESPONSIBILITY AREA: WHEATBELT INFRASTRUCTURE DELIVERY DIRECTORATE		HSWA DRAWING NUMBER: 201708-630 PROJECT TITLE: GREAT NORTHERN HIGHWAY (H006) - MUCHEA TO WUBIN STAGE 2 DRAWING TITLE: OLD GINGIN ROAD TO CHITTERING ROADHOUSE - SLK 38.6 TO SLK 51.1 LANDSCAPING PLAN PLAN - EXISTING GREAT NORTHERN HIGHWAY SHEET 20	
0 ISSUED FOR CONSTRUCTION J. WEAR 17.10.18		AMENDMENTS		PROJECT DIRECTOR: B. WOODS DATE: 17.10.2018		PROJECT DIRECTOR: N. FOX DATE: 17.10.2018		DRAWING STATUS: CONSTRUCTION DRAWING No: GNH-CN03-RW01-DRG-5620		SHEET: 0	

Attachment 7: Ministerial approval of the CEMP



Mr Norm Fox
Project Director
Main Roads
PO Box 6202
EAST PERTH WA 6892

Dear Mr Fox

**Great Northern Highway Muchea to Wubin Upgrade Stage 2, Muchea North, WA
(EPBC 2016/7656)**

Thank you for your email of 29 August 2018 to the Department seeking approval of the Construction Environmental Management Plan (Revision 3) (CEMP) in accordance with Condition 8 of the approval for EPBC 2016/7656 (the approval).

Officers of this Department have considered the CEMP and are satisfied that it meets the requirements of Condition 8. On this basis, and as a delegate of the Minister for the Environment and Energy, I have decided to approve the CEMP in accordance with Condition 8. This plan must now be implemented.

Condition 14 of the approval allows you (under certain circumstances) to implement revised plans without seeking the Minister's approval. If you require any advice on whether or not to submit a revised plan for approval, please contact the officer below. When submitting any revised plan to the Minister under Condition 14, please provide a 'tracked changes' version of the plan. I also attach a fact sheet providing guidance on 'new or increased impact' relating to changes to approved management plans under EPBC Act environmental approvals.

The Department has an active monitoring program which includes monitoring inspections, desk top document reviews and audits. Please ensure that you maintain accurate records of all activities associated with the conditions of approval, including implementation of approved plans, so that they can be made available to the Department on request.

Should you require any further information please contact David Loch on (02) 6275 9470 or by email to david.loch@environment.gov.au.

Yours sincerely

Gregory Manning
Assistant Secretary
Assessments (WA, SA, NT) & Post Approvals Branch

5 September 2018

Attachment 8: Notification to the Department of offset properties

From: BAETGE Marni (EO) <marni.baetge@mainroads.wa.gov.au>
Sent: Monday, 12 November 2018 1:35 PM
To: 'Post Approval'
Cc: 'epbcmonitoring@environment.gov.au'; Boulden, Lisa (Lisa.Boulden@jacobs.com); BRAID John (PEO) (john.braid@mainroads.wa.gov.au); Davies, Jonathan (Jonathan.Davies@jacobs.com); Jones, Grace (Grace.Jones@jacobs.com)
Subject: EPBC 2016/7656 Condition 9: Offset Property Details
Attachments: Outgoing Corres. DoEE EPBC2016-7656 Condition 9 Offset Details Nov18.pdf

Hello Post Approvals,

Please find attached correspondence to the Department summarising offset property details for Great Northern Highway Muchea North action (EPBC 2016/7656 Condition 9). The below file transfer link provides the documentation referred to in the correspondence (link expires in 7 days).

<https://we.tl/t-vNJJTABQ3s>

In accordance with EPBC 2016/7656 the following information has been provided:
Offset attributes table, Shapefile and map defining the location and boundary of the offset area
A textual description of the offset property including relevant figure and biological surveys.

Feel free to contact me if you have any concerns or queries.

Thanks.
Regards,
Marni

Marni Baetge
ENVIRONMENT OFFICER
Infrastructure Delivery Directorate
p: 08 9158 4318 | m: 0427474965 | e: marni.baetge@mainroads.wa.gov.au
w: www.mainroads.wa.gov.au





Enquiries: Marni Baetge (08) 9158 4318
Our Ref: 13/7463
Your Ref: EPBC 2016/7656

12 November 2018

Gregory Manning
Assistant Secretary
Assessments (WA, SA, NT) and Post Approvals Branch
Department of the Environment and Energy
GPO Box 787
Canberra ACT 2601

Dear Mr Manning

**Great Northern Highway Muchea North, WA
EPBC 2016/7656 Condition 9 – Offset Property Details**

Main Roads Western Australia (Main Roads) has commenced the Great Northern Highway Upgrade Muchea North (EPBC 2016/7656) action. EPBC 2016/7656 Condition 9 requires the following: *"To compensate for the loss of up to 52.5 hectares of foraging habitat, and 744 potential breeding trees for the Carnaby's Black Cockatoo the approval holder must, within one year after the commencement of the action, provide the Department with the offset attributes, shapefiles and textual descriptions and maps to clearly define the location and boundaries of the Ippolo Road Offset and Banovich Road Offset, that the approval holder has transferred to the DBCA."*

Please find enclosed the following information to satisfy EPBC 2016/7656 Condition 9:

- Offset attributes table, Shapefile and map defining the location and boundary of the offset area
- A textual description of the offset property including relevant figure and biological surveys (contained within the enclosed EPBC 2016/7656 Offset Proposal).

Main Roads trusts the information provided satisfies EPBC 2016/7656 Condition 9. If you require any further information please contact Marni Baetge on 9158 4318 or marni.baetge@mainroads.wa.gov.au.

Yours sincerely



Norm Fox
Director – Infrastructure Delivery Directorate

Enclosed as zip-file:

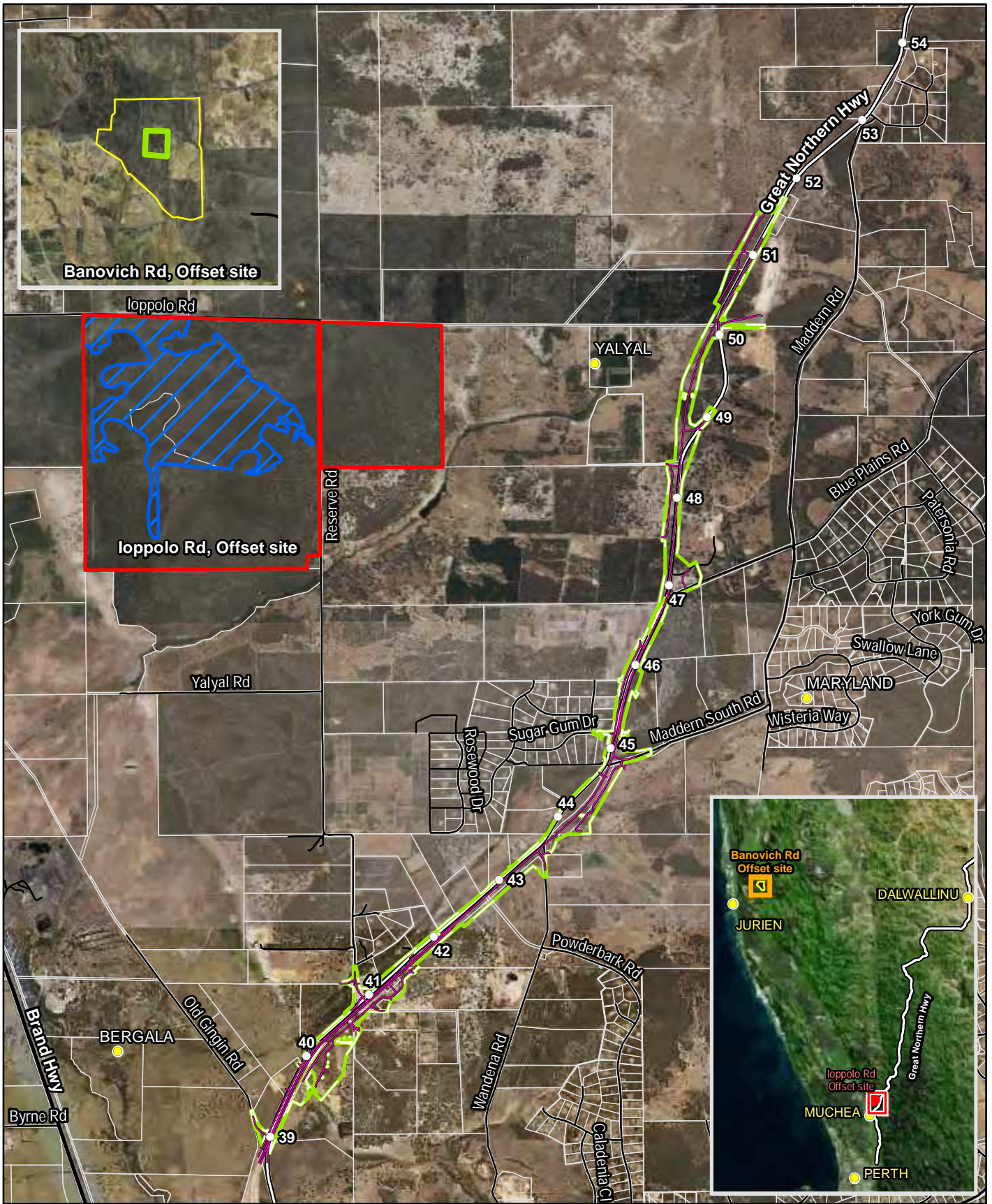
- EPBC2016-7656_OffsetSites_shapefile
- EPBC2016-7656_Figure 1
- EPBC2016-7656_OffsetAttributesTable
- EPBC2016-7656_MucheaNorth_OffsetProposal_Main Text
- EPBC2016-7656_MucheaNorth_OffsetProposal_AppendixA
- EPBC2016-7656_MucheaNorth_OffsetProposal_AppendixB
- EPBC2016-7656_MucheaNorth_OffsetProposal_AppendixC

**Note: The number of boundary coordinates has been simplified. The shape of the offset site is complex with over 900 coordinates. For an accurate boundary of the offset site please refer to the shapefile.*

Offset Site ID	EPBC Act Reference Number	Offset Property Address	Offset Property Size (ha)	Coordinates of boundary property (Decimal Degrees)		EPBC Act Protected Matters compensated for	Legal Mechanism for Conservation	Additional EPBC Act Protected Matters that may benefit
1	2016/7656	Lot M2091 Ioppolo Road, Chittering	259.7504	115.9828	-31.4759	Carnaby's Black Cockatoo foraging and potential breeding habitat	Crown Land Managed by DBCA as Conservation Estate	Banksia Woodlands of the Swan Coastal Plain <i>Chamaelucium</i> sp. Gingin (Gingin Wax) <i>Caladenia huegelii</i> (Grand Spider Orchid) <i>Grevillea curviloba</i> subsp. <i>curviloba</i> <i>Grevillea curviloba</i> subsp. <i>incurva</i> <i>Ptychosera pusillum</i> (Dwarf Pea) <i>Calyptorhynchus banksii naso</i> (Forest Red-tailed Black Cockatoo) <i>Dasyurus geoffroyi</i> (Western Quoll)
				115.9822	-31.4761			
				115.9819	-31.4757			
				115.9817	-31.4757			
				115.981	-31.4763			
				115.9802	-31.4763			
				115.9798	-31.4772			
				115.9816	-31.4781			
				115.9816	-31.4781			
				115.9835	-31.4777			
				115.9841	-31.4778			
				115.985	-31.4771			
				115.9864	-31.4767			
				115.9863	-31.4761			
				115.9866	-31.4759			
				115.9895	-31.4784			
				115.9891	-31.479			
				115.9896	-31.4793			
				115.9901	-31.4796			
				115.9906	-31.4807			
				115.9914	-31.481			
				115.9917	-31.4813			
				115.9921	-31.481			
				115.9924	-31.4813			
				115.993	-31.482			
				115.9935	-31.4821			
				115.994	-31.4824			
				115.9945	-31.4829			
				115.9954	-31.4833			
				115.9966	-31.4847			
				115.997	-31.4863			
				115.9976	-31.4866			
				115.9979	-31.4872			
				115.9979	-31.4874			
115.9972	-31.487							
115.9967	-31.4864							
115.9962	-31.486							
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115.996	-31.4867							
115.9957	-31.4869							
115.9957	-31.4866							
115.9962	-31.4856							
115.9961	-31.4853							
115.9953	-31.4852							
115.9945	-31.4844							
115.994	-31.4845							
115.994	-31.4848							
115.995	-31.4855							
115.9949	-31.4861							

115.9944	-31.4858
115.9941	-31.4859
115.9927	-31.4853
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115.994	-31.489
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115.993	-31.4896
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115.9913	-31.4903
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115.99	-31.4902
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115.9913	-31.4896
115.9914	-31.4894
115.9915	-31.4888
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115.9916	-31.4885
115.9913	-31.4882
115.9911	-31.488
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115.978	-31.4884
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115.9755	-31.485
115.9736	-31.4845
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115.9785	-31.4787
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115.9778	-31.4773
115.9775	-31.4766
115.9765	-31.4758
115.9758	-31.4755
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115.9739	-31.4757
115.9736	-31.476
115.9738	-31.4765
115.9735	-31.4769
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115.9726	-31.4776
115.9719	-31.4778
115.9713	-31.477
115.9706	-31.4771
115.9706	-31.4738
115.9834	-31.4743
115.9832	-31.4748
115.9829	-31.4754



- Legend**
- Town
 - Straight Line Kilometre Marker (1km)
 - Muechea North Alignment
 - Existing GNH Alignment
 - Freeway / Highway
 - Major Road
 - Minor Road
 - EPBC Approval Boundary
 - LOT M2091 Ioppolo Rd, Chittering
 - Lot 1 on Plan 62729, Banovich Rd
 - Cadastral Boundary

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Great Northern Highway
Muechea to Wubin Upgrade Stage 2

Figure 1: Location of Muechea North and Offset Sites

Drawing No GNH-CN03-EN01-GIS-0053	Issue A		
Task No GNH-1358	Drawing Status / Other Current as of 30/05/2018		
Date 30/05/2018	By BG	Chkd LB	Appd TJ

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Great Northern Highway Muchea to Wubin Upgrade - Stage 2

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**Muchea North - SLK 38.6 - 51.4 |
EPBC 2016/7656 | Environmental Offset Proposal**

Document Number :	GNH-CN03-EN01-RPT-0011
Revision :	6
Phase :	Stage 2
Date :	30 / 05 / 2018
Contract Number :	CN03-EN01
Client Contract Number :	187/15



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Document Control

Document description	
Project :	Great Northern Highway - Muceha to Wubin Upgrade - Stage 2
Document Title :	Muceha North - SLK 38.6 - 51.4 EPBC 2016/7656 Environmental Offset Proposal
Document No. :	GNH-CN03-EN01-RPT-0011
Contract Number :	CN03-EN01
Client Contract Number :	187/15

Current Issue

Revision	Date
5	30 May 2018

Prepared by	Reviewed by	Reviewed by	Approved by
Document Owner	Contract Lead	Peer Reviewer	Project Director
Lisa Boulden	Todd Jess	N/A	Beth Woods

Issue summary

Revision	Date	Issue description	Distribution
1	01-03-2017	Draft	Cross Discipline Review / Technical Review / PAG
2	13-03-2017	Final	Issued to DoEE
3	12-06-2017	Revised Draft	PAG review
4	28-06-2017	Revised Final	Issued to DoEE
5	29-05-2018	Updated Draft	PAG review
6	30-05-2018	Updated Final	Issued to DoEE



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 - 1.2 Proposal Description 2
- 2. Predicted Impacts 6**
- 3. Proposed Environmental Offset 7**
 - 3.1 Foraging Habitat and Potential Breeding Trees 7
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Appendices

Appendix A. Flora, Vegetation and Fauna Assessments

Appendix B. Carnaby's Black Cockatoo Investigations

Appendix C. Completed EPBC Offset Guide

Glossary

Abbreviation	Description
ASJV	Arup Jacobs Joint Venture
CN	Contract Number
CNOX	Contract XX – [Contract Name]
DoEE	Department of the Environment and Energy
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
FVC	Focused Vision Consulting
GNH	Great Northern Highway
ha	Hectare
IBA	Important Bird Area
IBRA	Interim Biogeographic Regionalisation of Australia
km	Kilometre
m	Metre
Main Roads	Main Roads Western Australia
mm	Millimetre
MoU	Memorandum of Understanding
M2W	Muceha to Wubin
M2W team	Muceha to Wubin Integrated Project Team, comprising Main Roads and industry partners Jacobs and Arup
DBCA	Department of Biodiversity, Conservation and Attractions
PDNH	Perth to Darwin National Highway
Phoenix	Phoenix Environmental Sciences
WA	Western Australia

1. Introduction

1.1 Project Background

In 2014 Main Roads Western Australia (Main Roads) established the Muchea to Wubin Integrated Project Team (M2W Team), comprising Main Roads and industry partners Arup and Jacobs (combining to form Arup Jacobs Joint Venture, ASJV) to conduct a comprehensive planning review of the full Muchea to Wubin link along the Great Northern Highway (GNH). This planning review is a critical component of the Great Northern Highway: Muchea to Wubin Upgrade Stage 2, which has been funded with \$384.8 million from the Federal and State Governments.

Among the improvements to be considered as part of the planning review were additional passing lanes, flattening crests and easing curves, safer roadsides, more rest stops and additional facilities for heavy vehicles.

The review examined the previous upgrade strategy developed in the 1990s and, having carefully considered current requirements for the movement of people and freight, delivered a revised upgrade strategy.

The M2W team has identified and prioritised construction packages to be delivered over the four-year period from 2015/16 to 2018/19. The construction programme includes the currently funded sections New Norcia Bypass (7 km), Miling Straight (22km), Miling Bypass (9km), Pithara (16km), Muchea North (13km), Dalwallinu to Wubin (33km) and Walebing (18km), and identifies additional priority packages to be constructed as funding becomes available.

1.2 Proposal Description

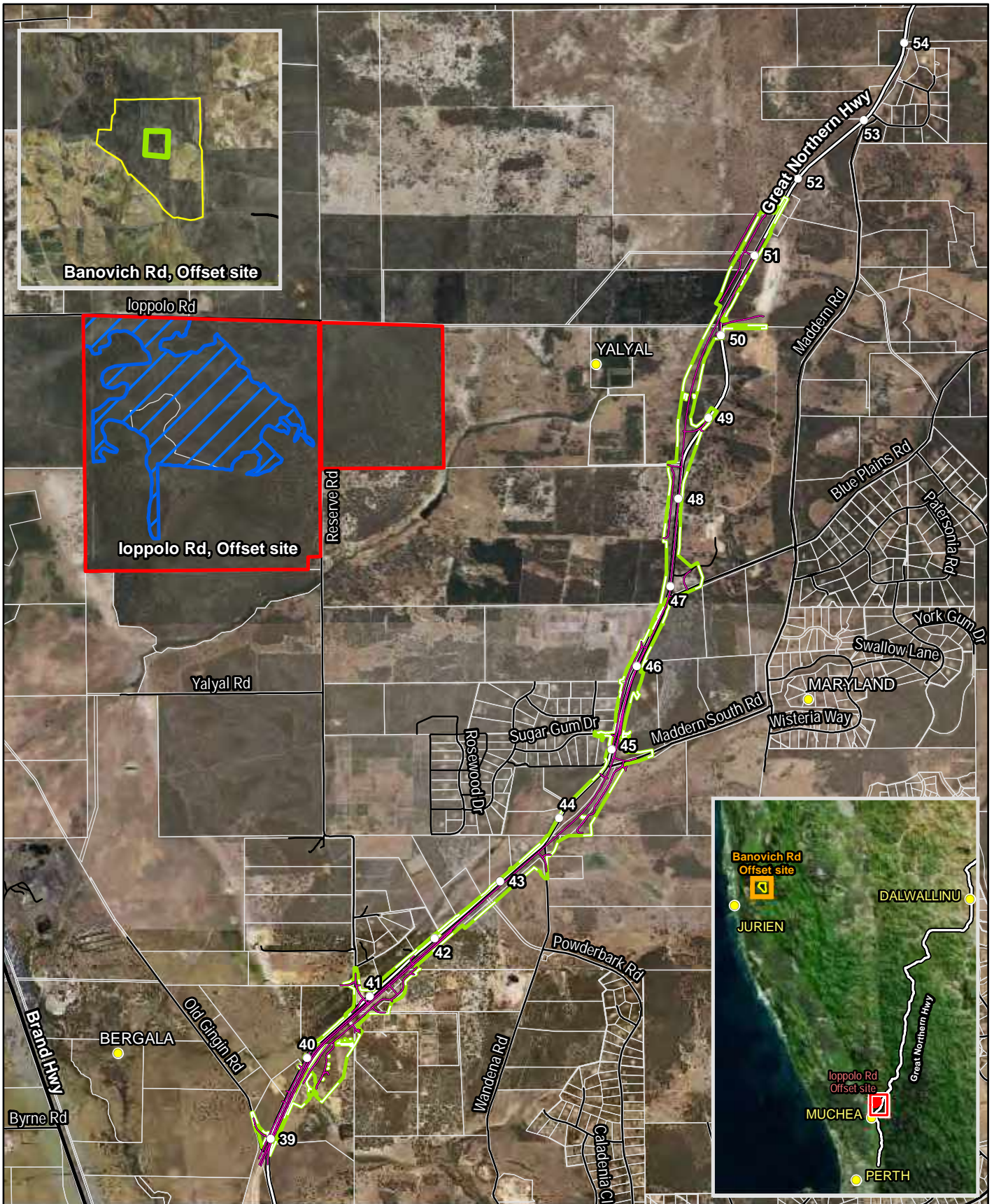
1.2.1 Purpose and Location

Main Roads proposes to upgrade and improve the GNH between Straight Line Kilometre (SLK) 38.6 and SLK 51.4 (referred to as Muchea North). Construction of the upgrade will require the clearing of 52.5 ha of foraging habitat for Carnaby's Black Cockatoo and up to six known nesting trees for the species. Impacts to known nesting trees will be managed through the installation of artificial hollows in proximity to the cleared trees and adjacent to adequate feeding areas. It is proposed to allocate a portion on Lot M2091, Ippolo Road, Chittering and an additional area at Lot 1 Banovich Road, Hill River (**Figure 1-1**), in order to offset the required clearing of foraging habitat at Muchea North.

1.2.2 Proposed Activities

In general, works will be undertaken to improve the horizontal and vertical geometry of the road, increase the seal and formation widths, and improve sight distances and clear zones. Construction activities will include:

- construction of approximately 3.7 km of dual carriageway from the end of the Perth – Darwin National Highway (Swan Valley Section) [also referred to as Northlink]. Each carriageway will be a 9.0 m wide seal on an 11.0 m wide formation;
- construction of approximately 5.7 km of single carriageway with a 10 m wide seal on a 12 m wide formation;
- construction of approximately 1.4 km of four lane carriageway with two 3.5 m wide northbound and southbound lanes, separated by a minimum 4.65 m median;
- widening of approximately 2 km of the existing GNH;
- realignment of the intersections at Old Gingin Road, Reserve Road, Wandena Road, Maddern Road and Sugar Gum Drive;
- construction of access roads with controlled access to the highway to service properties near Reserve Road, Sugar Gum Drive, at approximately SLK 48.8 and opposite the Chittering Roadhouse;



- Legend**
- Town
 - Straight Line Kilometre Marker (1km)
 - Muechea North Alignment
 - Existing GNH Alignment
 - Freeway / Highway
 - Major Road
 - Minor Road
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Client Project

**Great Northern Highway
Muechea to Wubin Upgrade Stage 2**

Figure 1-1: Location of Muechea North and Offset Sites

Drawing No GNH-CN03-EN01-GIS-0053	Issue A		
Task No GNH-1358	Drawing Status / Other Current as of 30/05/2018		
Date 30/05/2018	By BG	Chkd LB	Appd TJ

MXD Location: \\jacobs.com\PER\Projects\PB\FP\Projects\PB507321\Technical\GIS\Work\Environmental\CN03\GNH-EN01-GIS-0053-B.mxd

- provision of new intersections to link the existing GNH (retained as a local access road) to the new sections of the GNH;
- construction and realignment of private driveways;
- upgrade and installation of culverts;
- removal of redundant existing fence line and installation of new fence line;
- installation of signage and line markings and removal of redundant signage;
- installation of safety barriers where required; and
- relocation of utilities within the road reserve corridor (communications and power).

1.2.3 Legislative Approvals and Assessments

A referral under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) was submitted to the Department of the Environment and Energy (DoEE) on 1 March 2016 (EPBC 2016/7675). The referral was determined to be a controlled action with the controlling provisions being threatened species and communities and assessment via Preliminary Documentation. A request to vary the proposed action was submitted on 19 August 2016, and accepted on 19 October 2016.

1.2.4 Information Requested under EPBC 2016/7656

In a letter dated 4 November 2016, DoEE provided an additional information request for preliminary documentation as part of the assessment of EPBC 2016/7656. The information requested in relation to offsets and how this has been addressed in this document is provided in **Table 1-1**.

Table 1-1 : Offset Information Requested under EPBC 2016/7656

Information Requested	Response
In the event that impacts cannot be avoided or mitigated, please provide further information on offsets to compensate for any significant residual impacts on black cockatoos and for any additional listed threatened species identified within the project area, including the:	
a) type of offsets proposed	Direct offset.
b) extent to which the proposed offset actions correlate to, and adequately compensate for, the significant residual impacts of the proposed action on the protected matter	The EPBC Offset Guide has been used to calculate offsets required for the proposal. Offsets have been developed in accordance with the Offset Principles and calculated based on the total extent of clearing required for the protected matter. Landscaping and rehabilitation will reduce the final (residual) impact; however, as landscape designs have not been finalised for all contract packages, a conservative approach has been adopted and the total clearing amount has been used to calculate the proposed offsets. Using this conservative approach, it is considered that the proposed offsets will correlate to the impacted environmental values and adequately compensate the final residual impact for the relevant protected matters.

Information Requested	Response
c) suitability of the location of any proposed offset site for the protected matter.	There are two proposed offset sites: Lot M2091 Ippolo Road, Chittering, and Lot 1 Banovich Road, Hill River. The Ippolo Road site is located approximately 5 km west of Muchea North and consists of foraging habitat for Carnaby's Black Cockatoo together with some potential breeding habitat; the Banovich Road site contains known breeding trees for Carnaby's Black Cockatoo as well as breeding and foraging habitat for the species (Section 3).
d) conservation gain to be achieved by the offset i.e. positive management strategies that improve the site or averting the future loss, degradation or damage of the protected matter	The sites will be incorporated into the conservation estate and managed by the Department of Biodiversity, Conservation and Attractions (DBCA) for conservation. This will increase the area of Carnaby's Black Cockatoo present within the conservation estate and provide in perpetuity protection to the site.
e) time it will take to achieve the proposed conservation gain	The conservation gain will be achieved within a year as both of the sites have already been acquired by Main Roads, are vegetated and provide foraging and potential breeding habitat for Carnaby's Black Cockatoo.
f) level of certainty that the proposed offset will be successful	The land is vegetated and will be managed by DBCA. It is therefore considered that there is a low risk of the offset not succeeding.
g) current land tenure of any proposed offset and the method of securing and managing the offset for the life of the impact.	Land tenure prior to acquisition was private freehold. Upon acquisition the land becomes State (Crown) land. The sites will be transferred into the conservation estate with DBCA the land manager. This provides in perpetuity protection and management of the site.

2. Predicted Impacts

This offset proposal has been based on the total extent of clearing required for the proposed action. While many areas cleared during construction will be landscaped and revegetated, the extent of revegetation with species suitable for recreating habitat for Carnaby’s Black Cockatoo will be dependent on the final landscape plan. As these plans have not yet been developed, the residual impact cannot be accurately calculated and a conservative approach has been adopted by inputting the total clearing quantity in the offset calculator with no deduction related to landscaping and revegetation. **Table 2-1** details the maximum clearing required in relation to Carnaby’s Black Cockatoo.

Table 2-1 : Clearing Requirements – Carnaby’s Black Cockatoo

	Maximum Cleared	Mapped*
Known Nesting Trees	6	22
Trees with Suitable Hollows	7	32
Potential Breeding Trees	744	2,369
Foraging Habitat	52.5 ha	228.69 ha

* Mapped by Phoenix (2015; 2017a)

3. Proposed Environmental Offset

3.1 Foraging Habitat and Potential Breeding Trees

Main Roads proposes to offset the predicted impact to Carnaby's Black Cockatoo foraging habitat through the provision of 259.74 ha of land at Lot M2091 Ippolo Road, Chittering and 121.26 ha of land at Lot 1 Banovich Road, Hill River. Lot M2091 Ippolo Road is within 6 km of the known breeding sites recorded along the Muchea North project area. As noted in the Recovery Plan for the species, foraging habitat within a 6 km radius of known breeding areas is considered to be critical habitat. Lot 1 Banovich Road contains known breeding trees for Carnaby's Black cockatoo as well as breeding and foraging habitat for the species.

During discussions between Main Roads and DBCA regarding potential environmental offsetting needs, Lot M2091 was identified by DBCA as a property they were interested in acquiring. The property has been included in the Perth and Peel Green Growth Plan for 3.5 million (Draft Action Plan H: Conservation Program) as an area to be acquired under the Phase 2 ongoing additions to the conservation reserve system (Department of Premier and Cabinet, 2015). The property has since been acquired by Main Roads and a portion of the land allocated to offsetting impacts from the Perth to Darwin National Highway (Swan Valley Section) and Tonkin Highway Grade Separation projects (EPBC 2013/7042 and EPBC 2014/7385 respectively) (**Figure 3-1**).

Lot 1 Banovich Road, Hill River was originally acquired as part of the Mitchell Freeway Extension Project (EPBC 2013/7091). A portion has been allocated to offsetting impacts from the Mitchell Freeway Extension Project and the Great Northern Highway: Walebing to Wubin Project (EPBC 2016/7761).

A Memorandum of Understanding (MoU) has been established between Main Roads and DBCA for the management of Lot M2091 Ippolo Road as a whole. A separate MoU has been established for Lot 1 Banovich Road. These agreements set out the funding arrangements, including amount and term of funding, responsibilities of both parties, and the requirements for an operational works plan to be developed, implemented and reported upon. Under the MoU, the following activities will be undertaken over the first five years of the MoU:

- closure of existing tracks (barriers, ripping/mounding and maintenance);
- removal of dumped rubbish (old machinery, scrap metal, etc.);
- feral pig and deer control;
- survey for and control of feral bees; and
- *Phytophthora cinnamomi* signage, survey and treatment.

DBCA advises that once these works have been completed Lot M2091 will be "left in a much-improved condition, where upon the DBCA District will be able to manage any ongoing issues".

3.1.1 Offset Site 1 – Lot M2091 Ippolo Road, Chittering

Lot M2091 sits within a corridor of vegetation which extends north past the town of Gingin and south towards the Swan Valley. The property is part of two local ecological linkages and one regional ecological linkage as defined by the Shire of Chittering's Local Biodiversity Strategy (Shire of Chittering, 2010). These linkages allow Black Cockatoos to move north and south through an extensive band of vegetation, as well as east and west between the jarrah forests of the Darling Scarp and the woodlands and heaths of the Swan Coastal Plain (**Figure 3-2**). The property is also partially within the Northern Swan Coastal Plain Important Bird Area (IBA). This IBA is of particular significance for Carnaby's Black Cockatoo, as it supports a substantial proportion of the non-breeding population of the species as well as containing a number of breeding areas.



- Legend**
- Lot M2091 Ippolo Rd, Chittering
 - Important Bird & Biodiversity Areas
 - Carnaby's Black Cockatoo Foraging Habitat
 - Shire of Chittering Biodiversity Strategy Regional Linkages
 - Shire of Chittering Biodiversity Strategy Local Linkages
 - Straight Line Kilometre Marker (10km)
 - Existing Great Northern Hwy
 - Highway
 - Major Road
 - Minor Road
 - Water Line / Drainage

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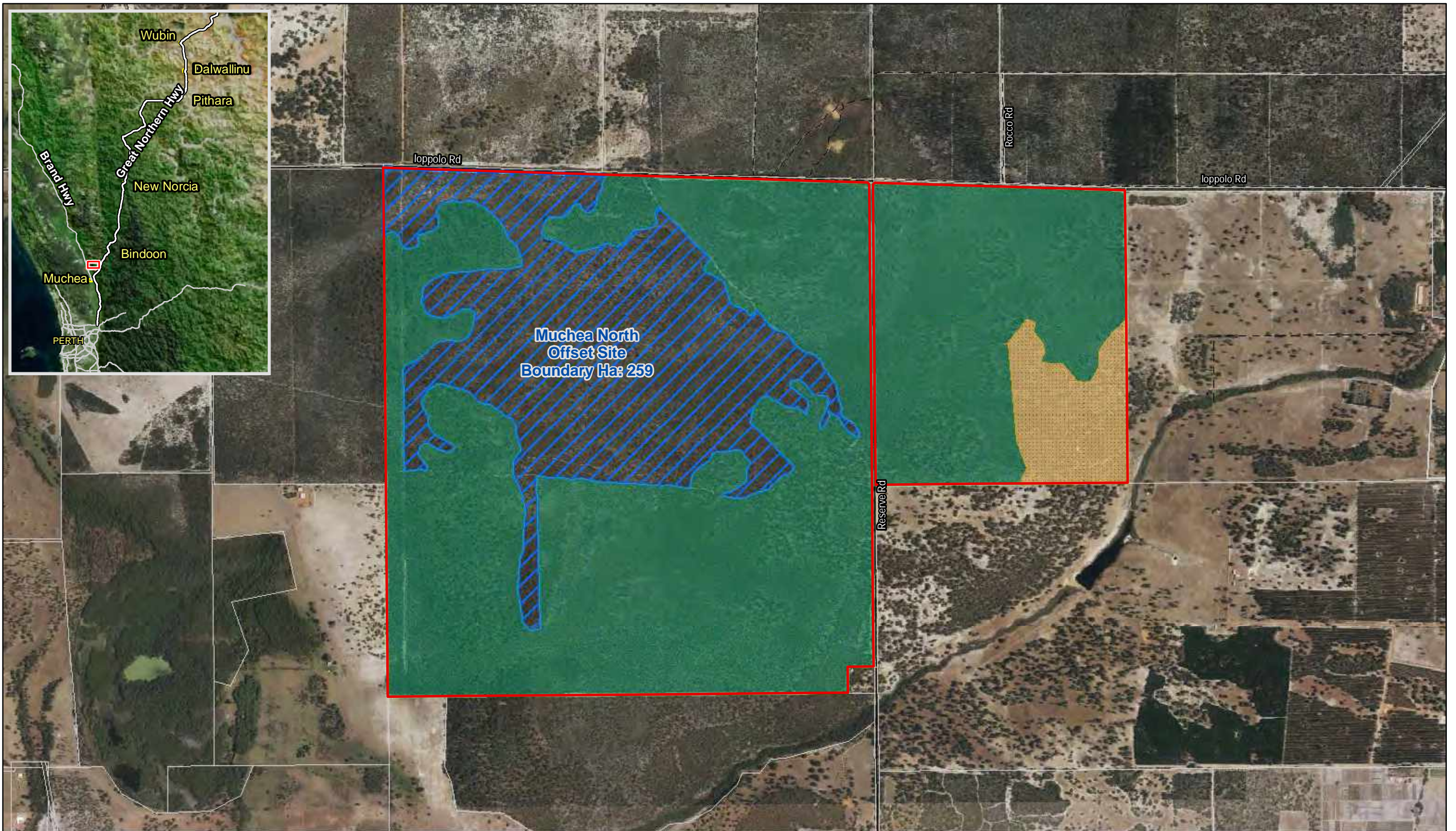
**Great Northern Highway
Mucchea to Wubin Upgrade Stage 2**

**Figure 3-1
Lot M2091 Ippolo Road
Regional Context**

Drawing No GNH-CN03-EN01-GIS-0073		Issue B	
Task No GNH-1541	Drawing Status / Other Draft / Other Info		
Date 16/06/2017	By BS	Chkd LB	Appd TJ




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
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Muchea North
Offset Site
Boundary Ha: 259

Legend

-  LOT M2091 Ippolo Rd, Chittering
-  Muchea North Offset Site Boundary (259 Ha)
-  PDNH Offset Site Boundary

-  Tonkin Grade Separation Offset Site Boundary
-  Cadastral Boundary
-  Minor Road

Data Source: Main Roads WA, Landgate

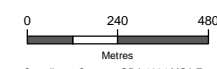


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**Figure 3-2: Lot M2091
Ippolo Road, Chittering**

Drawing No: **GNH-CN03-EN01-GIS-0050** Issue: **B**

Task No: **GNH-1358** Drawing Status / Other: **Current as of 30/05/2018**

Date	By	Chkd	Appd
30/05/2018	BG	LB	TJ

The entirety of Lot M2091 was surveyed by Coffey Environments in June and July 2014 (**Appendix A**). The key findings of the survey were (Coffey Environments, 2015):

- Vegetation condition was mapped as Very Good to Excellent with Excellent areas generally towards the middle of the property;
- A dieback assessment was undertaken and the property mapped as “Uninfested”;
- Sixteen vegetation units were mapped across the property;
- One Threatened flora species (*Chamelaucium* sp. Gingin, Gingin Wax) was recorded from the north western corner of the property, in the vicinity of the known location provided by DBCA;
- Six weeds were recorded across the property, none are Weeds of National Significance while one (*Zantedeschia aethiopica*, Arum Lily) is a Declared Plant;
- Three fauna habitats were mapped – Banksia Woodland, Eucalypt Woodland and a Dampland; and
- A black cockatoo habitat assessment was undertaken with the Eucalypt Woodland identified as high value habitat, the Banksia Woodland as moderate value and the Dampland and low value habitat. The Banksia woodlands contain key foraging species for Black Cockatoos.

A reconnaissance survey of Lot M2091 was undertaken by Phoenix Environmental Sciences (Phoenix) in May 2017 (**Appendix B**). Foraging evidence was recorded at a number of locations, showing that the site is used by Carnaby’s Black Cockatoo (Phoenix, 2017b). There are also several records of the species close to Lot M2091 including three records from the adjacent Chandala Nature Reserve and three records within 2.5 km of Lot M2091 to the east and south east.

In May 2018 an additional survey was undertaken by Phoenix to quantify the number of potential breeding trees, those with a diameter at breast height greater than 500 mm, within the offset site. This survey located 85 potential breeding trees (Phoenix, 2018).

The 259.74 ha portion of Lot M2091 to be assigned to the Muchea North Project is all considered to be foraging habitat, with 24 ha also considered potential breeding habitat. The offset site is shown on **Figure 3-3** and includes:

- 9.44 ha of *Banksia attenuata* and *Banksia menziesii* woodland over *Melaleuca preissiana* and/or *Adenanthos cygnorum* subsp. *cygnorum* shrubland (**foraging habitat** for Carnaby’s Black Cockatoo);
- 33.38 ha of *Banksia attenuata*, *Banksia menziesii* and *Nuytsia floribunda* shrubland (**foraging habitat** for Carnaby’s Black Cockatoo);
- 11.43 ha of *Banksia attenuata* and *Banksia menziesii* low sparse woodland over *Adenanthos cygnorum* subsp. *Cygnorum* tall open shrubland (**foraging habitat** for Carnaby’s Black Cockatoo);
- 8.59 ha of *Corymbia calophylla* and *Eucalyptus marginata* woodland over *Banksia attenuata* and *Banksia menziesii* woodland (**foraging and potential breeding habitat** for Carnaby’s Black Cockatoo);
- 5.50 ha of *Corymbia calophylla* with occasional *Eucalyptus marginata* and *Nuytsia floribunda* mid sparse woodland over emergent patches of *Banksia sessilis* var. *sessilis* tall sparse shrubland (**foraging and breeding habitat** for Carnaby’s Black Cockatoo);
- 1.52 ha of *Eucalyptus marginata* woodland over *Banksia attenuata*, *Banksia menziesii* and *Adenanthos cygnorum* subsp. *cygnorum* shrubland (**foraging and potential breeding habitat** for Carnaby’s Black Cockatoo);
- 4.61 ha of *Eucalyptus marginata* mid woodland over *Banksia attenuata* and *B. menziesii* tall sparse shrubland (**foraging and breeding habitat** for Carnaby’s Black Cockatoo);
- 4.02 ha of *Eucalyptus marginata* with occasional *Corymbia calophylla* mid sparse woodland over *Xanthorrhoea preisii* mid sparse shrubland (**foraging and breeding habitat** for Carnaby’s Black Cockatoo);

- 52.17 ha of *Eucalyptus tottiana* mid sparse to mid-isolated mallee woodland with occasional *Nuytsia floribunda* low isolated trees over *Banksia attenuata*, *Banksia menziesii* and *Adenanthos cygnorum* subsp. *cygnorum* tall sparse shrubland (**foraging habitat** for Carnaby's Black Cockatoo); and
- 129.07 ha of *Eucalyptus tottiana* and *Nuytsia floribunda* mid sparse to mid-isolated mallee woodland over *Banksia attenuata*, *Banksia menziesii* and *Adenanthos cygnorum* subsp. *cygnorum* tall open to tall sparse shrubland (**foraging habitat** for Carnaby's Black Cockatoo).

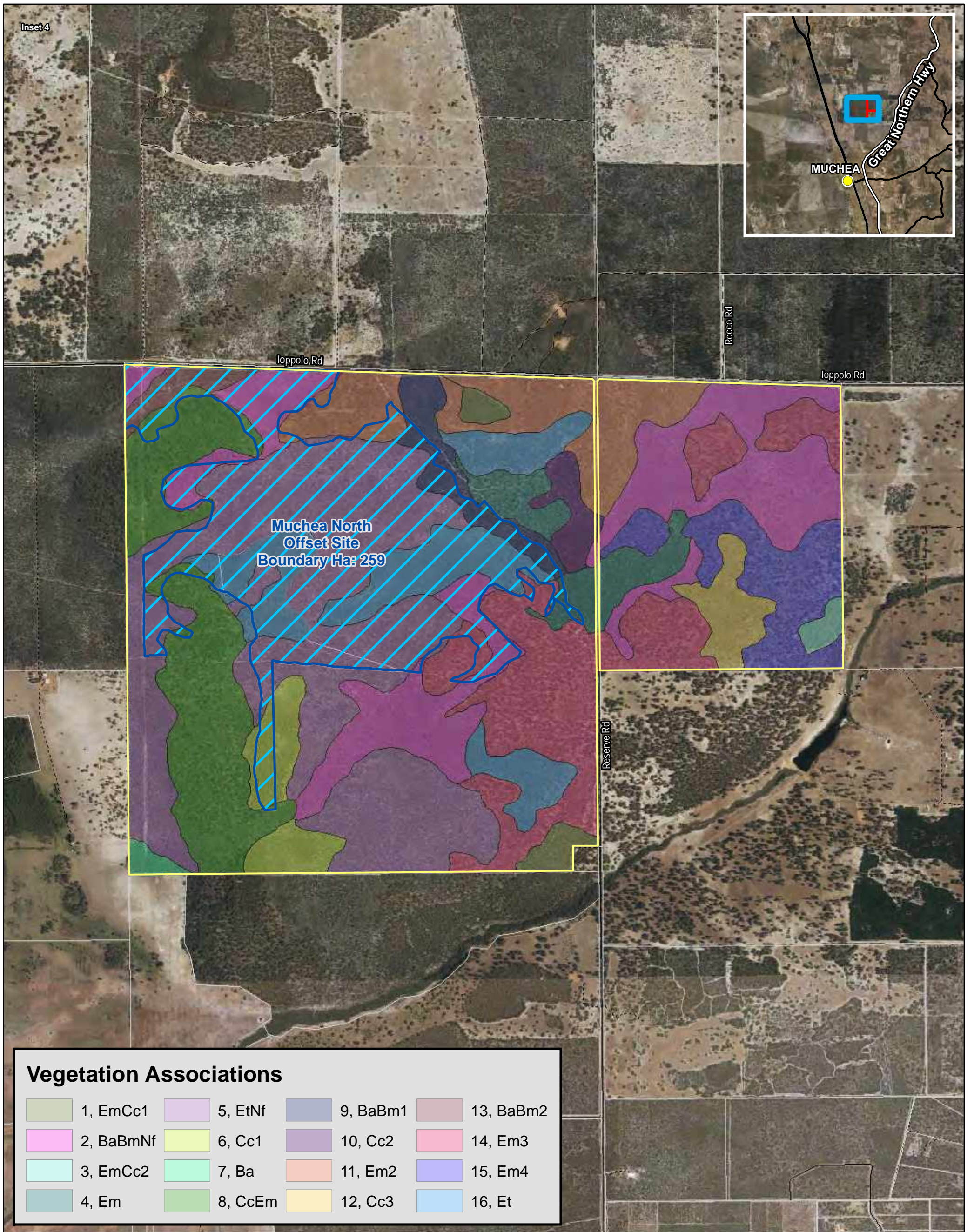
Given the foraging species present, the quality of the habitat and the regional context of the site as described above, there are not expected to be any barriers to the use of the offset site by Carnaby's Black Cockatoo. In addition, the site is close to water sources with a small dam located on the south east corner of the property, Lake Chandala less than 1 km west and Yalal Brook immediately to the south of the property. **Table 3-1** provides a breakdown of foraging habitat by vegetation quality for the offset site and the quality and quantity of foraging habitat to be cleared for the Muchea North Project.

Table 3-1 : Foraging Habitat Quantity and Quality – Impact Site and Ioppolo Road Offset Site

Vegetation Condition	Impact Site (Muchea North) (ha)	Offset Site (Lot M2091 Ioppolo Rd) (ha)
Degraded	10.0	0.00
Good	10.8	0.00
Very Good	18.9	9.23
Very Good – Excellent*	-	8.91
Excellent	10.8	241.60
Pristine	2.0	0.00
Total	52.5	259.74

* This condition type was not mapped at the impact site.

The offset site also encompasses the *Chamelaucium* sp. Gingin records from Coffey Environments (2015), representing at least 200 individuals.



Vegetation Associations

1, EmCc1	5, EtNf	9, BaBm1	13, BaBm2
2, BaBmNf	6, Cc1	10, Cc2	14, Em3
3, EmCc2	7, Ba	11, Em2	15, Em4
4, Em	8, CcEm	12, Cc3	16, Et

Legend

- Muchea North Offset Site Boundary
- LOT M2091 Ioppolo Rd, Chittering
- Cadastral Boundary
- Major Road
- Minor Road
- Track

Data Source: Main Roads WA, Landgate



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0 290 580 Scale at A3
Metres 1:20,000
Coordinate System: GDA 1994 MGA Zone 50



Main Roads Western Australia

Great Northern Highway
Muchea to Wubin Upgrade Stage 2

Figure 3-3 - Ioppolo Road Offset Site

Drawing No: GNH-CN03-EN01-GIS-0094 Issue: A

Task No: GNH-1786 Drawing Status / Other: Draft / Other Info

Date	By	Chkd	Appd
30/05/2018	BG	LB	TJ

3.1.2 Offset Site 2 - Lot 1 Banovich Road, Hill River

Lot 1 is situated between Coomaloo Nature Reserve to the south east and Lesueur National Park to the north west and connects these two conservation reserves. The property is 1995 ha in size and was originally acquired as part of the Mitchell Freeway Extension Project (EPBC 2013/7091).

The entirety of the property was surveyed by GHD from 1 to 5 August 2016 (**Appendix A**). The key findings of the survey were (GHD, 2016):

- Vegetation condition was mapped mainly Excellent to Pristine;
- fourteen vegetation units were mapped across the property including four resembling conservation significant ecological communities;
- nine conservation significant flora species were recorded by GHD (2016) including one Threatened flora species (*Hakea megalosperma*). An additional targeted survey by Phoenix in late September 2016 recorded the presence of the threatened orchid *Thelymitra stellata* (Phoenix, 2016; Appendix B);
- no Weeds of National Significance or Declared Plants were recorded;
- seven fauna habitats were mapped as follows:
 - ▶ Wandoo Woodlands;
 - ▶ Marri Woodlands;
 - ▶ *Eucalyptus todtiana*, *Banksia attenuata/menziesii* low Open Woodland;
 - ▶ minor drainage lines, seasonally inundated areas and dams;
 - ▶ heathlands on lateritic soils; and
 - ▶ scattered trees of Wandoo and Marri in paddock.
- the property contains foraging and breeding habitat for Carnaby's Black Cockatoo with 10 breeding events recorded during the GHD (2016) survey.

The 121.26 ha portion of Lot 1, 1395 Banovich Road, Hill River to be assigned to the Muchea North Project is shown on **Figure 3-4** and consists of:

- 3.31 ha of Vegetation Type (VT) 02 *Petrophile chrysantha* heathland (**foraging habitat** for Carnaby's Black Cockatoo);
- 12.20 ha of VT 05 *Eucalyptus todtiana*, *Banksia attenuata* and *B. menziesii* woodland (**foraging and breeding habitat** for Carnaby's Black Cockatoo);
- 16.56 ha of VT 06 *Xanthorrhoea* spp. and *Kingia australis* heathland (**foraging habitat** for Carnaby's Black Cockatoo);
- 11.61 ha of VT 09 *Corymbia calophylla* woodland (**foraging and breeding habitat** for Carnaby's Black Cockatoo);
- 59.33 ha of VT 10 *Eucalyptus wandoo* subsp. *pulverea* woodland (**foraging and breeding habitat** for Carnaby's Black Cockatoo);
- 16.68 ha of VT 12 mixed heath with isolated clumps of mallee (**foraging habitat** for Carnaby's Black Cockatoo); and
- 1.58 ha of VT 14 pasture with emergent trees (**foraging and breeding habitat** for Carnaby's Black Cockatoo).

In May 2018 an additional survey was undertaken by Focused Vision Consulting (FVC) to quantify the number of potential breeding trees, those with a diameter at breast height greater than 500 mm, within the offset site. This survey located 1,321 potential breeding trees and one known breeding tree (FVC, 2018).

Inset 4



Muchea North
offset area
121Ha

Vegetation Type (GHD Data)	
VT01 - <i>Allocasuarina microstachya</i> heathland	VT08 - <i>Ecdiocollea monostachya</i> heathland
VT02 - <i>Petrophile chrysantha</i> heathland	VT09 - <i>Corymbia calophylla</i> woodland
VT03 - <i>Melaleuca preissiana</i> open woodland	VT10 - <i>Eucalyptus wandoo</i> woodland
VT04 - <i>Melaleuca platycalyx</i> heathland and <i>Eucalyptus wandoo</i> woodland	VT11 - <i>Banksia attenuata</i> open heathland
VT05 - <i>Eucalyptus totiana</i> , <i>Banksia attenuata</i> and <i>B. menziesii</i> woodland	VT12 - Mixed heath with isolated clumps of mallee
VT06 - <i>Xanthorrhoea</i> and <i>Kingia</i> heathland	VT13 - <i>Melaleuca ?concreta</i> heathland
VT07 - <i>Melaleuca raphiophylla</i> woodland	VT14 - Pasture with emergent trees

Legend

CBC Potential Habitat Trees (FVC Data)

- Known Nesting Trees
- Potential Breeding Trees
- Muchea North Offset Area
- Lot 1 on Plan 62729, Banovich Rd, Hill River (1995.18ha)

- Freeway / Highway
- Major Road
- Minor Road
- Track
- Cadastral Boundary

Joint Venture Partners:

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Scale at A3

Coordinate System: GDA 1994 MGA Zone 50



Main Roads Western Australia

Great Northern Highway
Muchea to Wubin Upgrade Stage 2

Figure 3-3 Banovich Road Offset Site

Drawing No: GNH-CN03-EN01-GIS-0095 Issue: A

Task No: GNH-1786 Drawing Status / Other: Draft / Other Info

Date	By	Chkd	Appd
28/05/2018	BG	LB	TJ

Given the foraging species present, the quality of the habitat and the regional context of the site as described above, there are not expected to be any barriers to the use of the offset site by Carnaby's Black Cockatoo. In addition, the site is close to water sources with several dams located in the cleared portion of the property and in adjacent agricultural land. Table 3-2 provides a breakdown of foraging habitat by vegetation quality for the offset site and the quality and quantity of foraging habitat to be cleared for the Muchea North Project.

Table 3-2 : Foraging Habitat Quantity and Quality – Impact Site and Banovich Road Offset Site

Vegetation Condition	Impact Site (Muchea North) (ha)	Offset Site (Lot 1 Banovich Rd) (ha)
Degraded	10.0	1.58
Good	10.8	0.00
Very Good	18.9	6.36
Excellent	10.8	59.33
Pristine	2.0	53.86
Total	52.5	121.26

3.2 Nesting Hollows

Main Roads proposes to offset the clearing of six known nesting trees and seven trees with hollows suitable for Carnaby's Black Cockatoo through the installation of artificial hollows. A total of 39 artificial hollows are planned to be installed. Artificial hollows will be installed outside of the breeding season and prior to clearing of known nesting trees in order to maximise the number of hollows available at the commencement of the breeding season.

Main Roads is intending to procure and install artificial hollows known as Cockatubes® (**Figure 3-5**). These are constructed by Landcare SJ Inc. and the current design developed over a period of 10 years with the assistance of DBCA and the Western Australian Museum. They are used extensively throughout the south west of Western Australia and a number of Cockatubes® have been previously installed by Main Roads along the Great Northern Highway, including within the Muchea North project area. Cockatubes® have an expected lifespan of 50 years or more, provided they are regularly maintained, for example replacing the sacrificial wood chewing post as required. Those currently in place at Muchea North show evidence of use by Carnaby's Black Cockatoo.

Main Roads has engaged Tony Kirkby (a recognised Black Cockatoo expert) to assist with the identification of trees suitable for artificial hollow installation. A number of trees have already been identified for installation of artificial hollows both along the road reserve and within Lot M2091 Ioppolo Road (**Appendix B**). Additional trees will be identified taking into consideration the following parameters:

- Located in proximity to impacted nesting hollow or existing nesting hollow which will not be impacted.
- Located within or adjacent to foraging habitat.
- Located in proximity to water.
- Trees should be mature and well shaded.
- Trees should be accessible with a cherry picker, without requiring additional disturbance, to allow installation of the artificial hollows.
- Trees should be within the road reserve, but not adjacent to the road, or within other Crown lands (e.g. DBCA managed lands) to facilitate ease of access for monitoring and maintenance.

Main Roads will undertake regular monitoring and maintenance to demonstrate the artificial hollows are effective as an offset (i.e. they are used by Carnaby's Black Cockatoo).



Figure 3-5 : Example Cockatube® (photo credit Landcare SJ Inc.)

3.2.1 Monitoring and Maintenance

3.2.1.1 Pre-Impact Survey

Surveys at Muchea North (Phoenix 2015; 2017a) identified six hollows actively in use for breeding out of a total of 22 hollows which showed evidence of previous use by Carnaby's Black Cockatoo. This ratio of previously used versus active breeding hollows is in line with advice from Ron Johnstone (a recognised Black Cockatoo expert with the WA Museum) that breeding pairs will have a roster of three or four trees from which they chose for nesting in any particular breeding season.

To confirm the number of hollows actively in use for breeding at Muchea North, previously recorded hollows with evidence of use by Carnaby's Black Cockatoo will be surveyed in the breeding season prior to clearing occurring. This survey will be undertaken in September or October and the results used to guide any adaptive management requirements.

3.2.1.2 Post-Impact Monitoring Surveys

In order to determine that the installation of artificial hollows has been effective as an offset the installed artificial hollows will be surveyed annually in October. The survey will also include assessment of previously recorded natural hollows suitable for Carnaby's Black Cockatoo to allow for a comprehensive view of Carnaby's Black Cockatoo breeding activity. The October timing is expected to provide the greatest potential to identify if hollows (natural and artificial) are in use for that particular breeding season. The first survey will occur during the breeding season following the clearing of suitable hollows.

Surveys are to be undertaken by a suitably qualified person. Hollows will initially be inspected from the ground using binoculars to check for signs of use (chew marks or birds entering/exiting the hollow) or factors which may prohibit nesting by Carnaby's Black Cockatoo such as invasion of the hollow by feral bees. A drone or remotely operated camera on a pole of sufficient length may also be used to look directly into the hollow. Surveys will identify:

- if hollows are currently in use or show evidence of previous use;

- maintenance requirements for artificial hollows (such as replacement of the sacrificial wooden post or removal of feral bees); and
- if hollows are no longer able to be used by Carnaby's Black Cockatoo, for example they have been invaded by feral bees, the hollow has been damaged or the limb has fallen.

The results of monitoring surveys will be provided to DBCA in order to contribute to broader research into the species. This information will also be available to other research organisations and individuals upon request.

Maintenance of artificial hollows will be scheduled for between March and June so as to occur outside of the breeding season.

3.2.2 Adaptive Management

As noted above, Carnaby's Black Cockatoo are known to have a "roster" of hollows (typically three) that they will choose from to use for nesting in any particular breeding season (*pers com.* Ron Johnstone). When the bird flies out of the hollow after the breeding season, another bird may inhabit the hollow, bees may inhabit the hollow or the tree may fall over. Where this occurs, black cockatoos will either use one of the other hollows previously used, or will search for a new hollow. (*pers com.* Ron Johnstone). As such, it is unlikely that all installed hollows will be used every year and it may be a number of years before a particular hollow is selected for nesting.

To determine that the installation of artificial hollows meets the offset requirements, Main Roads will implement an adaptive management approach. The aim of the adaptive management will be to maximise the likelihood, and eventually prove, that the artificial hollows are being used by Carnaby's Black Cockatoo in line with the pre-impact usage of natural hollows. The adaptive management approach is outlined in **Figure 3-6**. It is proposed that this adaptive management approach will be used until such a time that monitoring shows breeding by Carnaby's Black Cockatoo along the Muchea North section of the GNH is at least equivalent to that recorded during pre-impact surveys (refer to **Section 3.2.1.1**).

The offset will be deemed to be effective and adaptive management will cease when the following criterion has been achieved:

- At least six¹ artificial hollows are in use for three consecutive years post-impact.

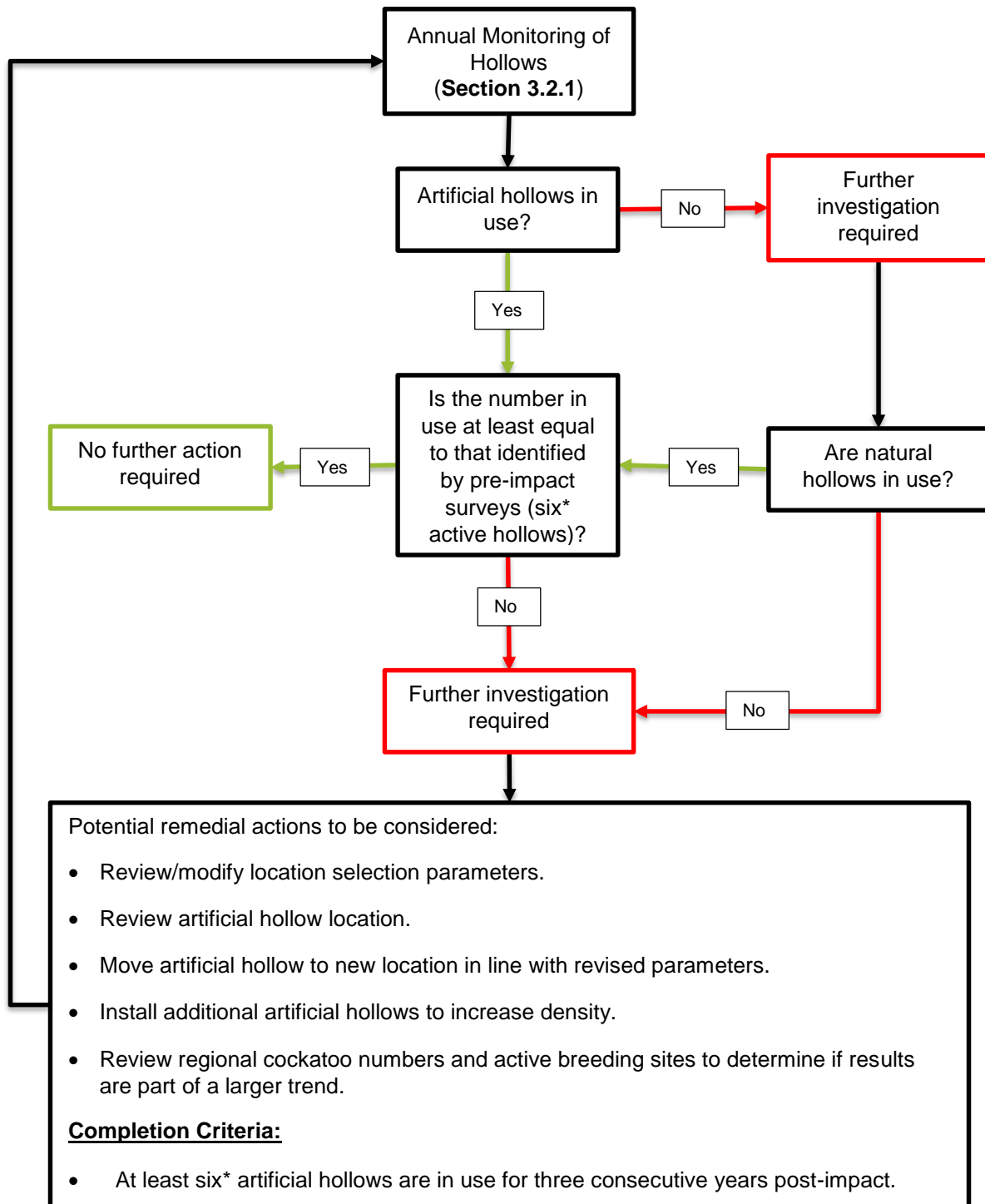
3.2.3 Record Keeping

The following information will be recorded and kept on file:

- each Cockatube® will be assigned a unique identifier;
- locations of installed Cockatubes® will be recorded using a GPS;
- date of installation for each Cockatube®;
- photographs of Cockatubes® following installation;
- results of annual monitoring including condition of the hollow, if the hollow is/has been in use and photographs;
- maintenance required and date undertaken; and
- outcomes of any investigations undertaken and additional actions put in place.

This information will be made available to other government organisations and third parties for research into the species.

¹ This number may change, depending on the results of the pre-impact survey.



* This number may change, depending on the results of the pre-impact survey.

Figure 3-6 : Adaptive Management Decision Tree

4. Offset Guide Inputs and Justification

Table 4-1 provides the inputs used in the EPBC Offset Guide and the justifications for these. As Lot M2091 also provides direct offset for the Perth to Darwin Nation Highway (Swan Valley Section) and Tonkin Highway Grade Separation projects, the same input values have been used for the start quality, future quality with and without offset and risk of loss with and without offset. The purpose of this is to provide consistency between the offset proposals for the three projects. The completed EPBC Offset Guide is provided in **Appendix B**.

Table 4-1 : Offsets Guide Inputs and Justifications – Carnaby’s Black Cockatoo Foraging Habitat

Offset Guide Item	Input Value	Justification
EPBC Act Status	Endangered	Current EPBC Act listing
Impact Area	52.5 ha	Total amount of clearing required for the proposal. This area is larger than the ultimate residual impact as some of this area will be landscaped and revegetated. As landscape designs have not been finalized a conservative approach to offsets has been adopted and the total clearing amount has been used to calculate the offset required.
Quality of Impact Area	9	The quality of the impact area has been determined based on the value of the habitat as mapped by Phoenix (2015; 2017a). The vegetation to be cleared includes vegetation identified as “Quality” foraging habitat as well as areas identified as “Low Value” foraging habitat. The majority (80%) of the foraging habitat to be cleared has been mapped as “Quality”. The presence of known nesting trees in the area to be cleared increases the Quality rating of the impact area and a corresponding Quality rating of 9 has been selected.
Time over which Loss is averted	20 years	The transfer of the offset site to Park and Wildlife will provide protection and management in perpetuity.
Time until ecological benefit	1 year	As the acquired land is vegetated and has been incorporated into the conservation estate to be managed by DBCA, the ecological benefit will be realised within 1 year.
Start Area	380 ha	This area achieves 100% direct offset, based on the other inputs used

Offset Guide Item	Input Value	Justification
Start Quality	7	Mapping undertaken by Coffey Environments (2015) shows that the vegetation present at Lot M2091 is in Very Good to Excellent condition, which is expected to equate to “Quality” or “High Value” foraging habitat for Carnaby’s Black Cockatoo. Mapping undertaken by GHD (2016) shows that the vegetation present at Lot 1 Banovich Road is in Excellent to Pristine condition, which is expected to equate to “High Value” foraging and breeding habitat for Carnaby’s Black Cockatoo. Evidence of foraging by Carnaby’s Black Cockatoo has been recorded within both sites. Lot M2091 is within 6 km of known breeding areas and is therefore considered to be critical habitat and is in proximity to water with Lake Chandala less than 1 km west, Yalal Brook is immediately south and a private dam immediately east of the property. Lot 1 contains known breeding sites for Carnaby’s Black Cockatoo and is close to water sources with several dams located in the cleared portion of the property. It is therefore considered critical habitat for the species. Considering all of the above, a Quality rating of 7 has been applied.
Future Quality without offset	6	If the offset site was to remain private freehold land there is a risk of degradation to the site. This may be through illegal dumping of rubbish, grazing of the site by stock or clearing of vegetation for economic purposes such as farming or housing.
Future Quality with offset	7	The quality of the vegetation will, at a minimum, be maintained through management of the offset site by DBCA.
Risk of Loss (%) without offset	15%	If the offset sites were to remain private freehold land, there is a risk of degradation to the sites. This may be through grazing of the site by stock or clearing of vegetation for economic purposes such as farming or housing. This risk input is consistent with that used for offset proposals associated with the Perth to Darwin Nation Highway (Swan Valley Section) and Tonkin Highway Grade Separation projects.
Risk of Loss (%) with offset	5%	As the offset sites will be transferred to DBCA for management and incorporation into the conservation estate, there is a 95% confidence level that the environmental values being offset will not be lost (i.e. a 5% risk that the values will be lost).
Confidence in result (averted risk)	90%	As the offset sites will be transferred to DBCA for management and incorporated into the conservation estate, there is a high level of confidence that the averted risk will be realised.
Confidence in result (Change in habitat quality)	90%	As the sites will be incorporated into the conservation estate, there is a high level of confidence that the change in the quality score will be realised.

The EPBC Offset Guide has also been used to calculate the number of artificial hollows that should be installed to mitigate and compensate for the impact of clearing known nesting trees. The use of artificial hollows is

considered to be a management and mitigation action, rather than an offset. **Table 4-2** provides the inputs used and justification for these.

Table 4-2 : Offsets Guide Inputs and Justifications – Clearing of Known Nesting Trees

Offset Guide Item	Input Value	Justification
EPBC Act Status	Endangered	Current EPBC Act listing
Number of Features (Total Quantum of Impact)	13	Six known nesting trees and seven trees with suitable but unused hollows to be cleared.
Time Horizon (years)	1	Artificial hollows will be installed prior to the breeding season and prior to clearing of suitable hollows. Recent studies show artificial hollows may be used in the first year following installation (Groom, 2010)
Start Value	1	There is an existing artificial hollow at Muceha North. This will require relocation as the tree to which it is attached is within the clearing footprint.
Future Value Without Offset	1	No additional artificial hollows installed
Future Value with Offset	39	This achieves 100% direct offset, based on the other inputs used
Confidence in result	35%	<p>Recent studies show that Carnaby's Black Cockatoo will readily nest in artificial hollows with a strong correlation between the use of artificial hollows and their proximity to currently used natural hollows (Groom, 2010; BirdLife Australia, 2017). Additionally, the artificial hollow currently installed at Muceha North has been used in previous seasons by Carnaby's Black Cockatoo.</p> <p>The artificial hollows will be installed in proximity to the cleared trees, or in proximity to known breeding areas, and adjacent to adequate foraging areas. Hollows will be positioned such that they are not visible from the GNH in order to reduce the risk of poaching of eggs, chicks or birds.</p> <p>While Main Roads is confident that the use of artificial hollows will effectively offset the residual impact from the project, a confidence of 35% has been selected to reflect the difference in lifespan between natural and artificial hollows and the remaining uncertainty within the scientific literature in relation to the use of artificial hollows in all circumstances.</p>

5. Conclusions

Main Roads proposes to offset impacts to Carnaby's Black Cockatoo through the provision of 259.74 ha at Lot M2091, Ippolo Road, Chittering and 121.26 ha at Lot 1 Banovich Road, Hill River.

The Ippolo Road offset site encompasses 259.74 ha of foraging habitat, including 24 ha of potential breeding habitat and 85 potential breeding trees. Lot M2091 is located within 6 km of known breeding sites, is in close proximity to water sources, and is therefore considered critical habitat for the species. The Banovich Road offset site encompasses 121.26 ha of foraging habitat, including 84.72 ha of breeding habitat, 1,321 potential breeding trees and one known nesting tree. Lot 1 is located adjacent to known breeding sites, is in close proximity to water sources, and is therefore considered critical habitat for the species.

The offset proposed will provide adequate and commensurate offsetting of the impacted protected matter (Carnaby's Black Cockatoo). A conservative approach has been adopted in calculating the offset required by using the total amount of clearing to be undertaken, rather than the residual impact following landscaping and revegetation activities. This is likely to provide a net gain in the overall conservation outcome.

The EPBC Offset Guide has also been used to calculate the total number of artificial hollows to be installed (39) to appropriately mitigate the impact of clearing up to six known nesting trees and seven trees with suitable, but unused, hollows. To assess that the installation of artificial hollows is effective as an offset, the installed hollows will be monitored and an adaptive management approach implemented, should monitoring show the installed hollows are not being used by Carnaby's Black Cockatoo.

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Appendix A. Flora, Vegetation and Fauna Assessments

Appendix B. Carnaby's Black Cockatoo Investigations



Appendix C. Completed EPBC Offset Guide

Appendix A. Flora, Vegetation and Fauna Assessments

NorthLinkWA

Perth-Darwin National Highway



Flora, Vegetation and Fauna Assessment

Lot M2091 Ippolo Road, Chittering

DOC NO / NLWA-00-EN-RP-0009

REV / 0

DATE / 15 April 2015

coffey 



EXECUTIVE SUMMARY

Main Roads Western Australia (MRWA) commissioned Coffey Environments Australia Pty Ltd (Coffey) to complete a Level 1 flora, vegetation and fauna and Black Cockatoo assessment, at Lot M2019 Ippolo Road, Chittering (the study area), located approximately 50 kilometres (km) north of Perth in the Swan Coastal Plain bioregion of Western Australia.


The purpose of the study was to undertake an assessment of the ecological values of the study area. The outcome of the assessment will be used to determine the suitability of the land as an offset for values to be impacted by the NorthLink WA project. The study area is 986 hectare (ha) and is adjacent to a C Class Nature Reserve to the west, which is 163 ha.

The survey was conducted over four days 8 to 10 June and 17 June 2014. The key findings of the desktop assessment are:

- Twenty Threatened (Declared Rare-extant) flora listed under the *Wildlife Conservation Act 1950* and the *Environment Protection and Biodiversity Conservation Act 1999* were identified as potentially occurring within close proximity to the study area.
- Thirty four Priority listed flora recognised by the Department of Parks and Wildlife were identified as potentially occurring within close proximity to the study area. Ten taxa are considered Likely to occur; 15 as Possible; and 30 as Unlikely to occur in the study area.
- Seven ecological communities listed as conservation significant, including four Threatened Ecological Communities and three Priority Ecological Communities were identified for the study area.
- 221 fauna species have been previously recorded in the vicinity of the study area; these include 12 amphibians, 47 reptiles, 134 birds and 28 mammals.
- 14 conservation significant fauna species were identified as potentially occurring within close proximity to the study area, of these one species is considered Likely to occur, three as Possible and four species as Unlikely to occur in the study area.

The key findings of the field survey are:

- The vegetation condition of the study area was considered to be Good to Pristine as per Bush Forever (Government of Western Australia, 2000 and Keighery, 1994) vegetation condition scale.
- The areas of vegetation considered to be pristine were generally located within the middle of the study area where introduced taxa and human visitation is low or non-existent.
- Dieback in the study was considered uninfested and presents a low risk of spreading the disease into other areas.
- Dieback risk assessment allocated 87.6 ha as Low risk vegetation, with 12.2 ha as moderate and 19.4 ha as high risk.
- Sixteen vegetation units were described, four are considered to be representative of Priority 2 Ecological Community Banksia Yellow-Orange Sands and two Threatened Ecological Communities.
- A total of 154 vascular taxa were recorded from the study area.
- One Threatened taxa *Chamelaucium* sp. Gingin (N.G. Marchant 6) and One Priority taxa *Hypolaena robusta* (P4) were recorded in the study area.

- 
- Six introduced taxa were recorded from the study area. None of them are considered to be Weeds of National Significance.
 - **Zantedeschia aethiopica* is registered as a Declared Pest under the *Biosecurity and Agriculture Management Act 2007* and three species, **Zantedeschia aethiopica*, **Lupinus* sp. and **Brassica tournefortii*, have a High rating under the Environmental Weed Strategy for Western Australia.
 - Three fauna habitats were recorded in the study area: Banksia Woodland, Eucalypt Woodland and a Dampland.
 - The Black Cockatoo Habitat assessed Eucalypt Woodland (315 ha) as high value Black Cockatoo habitat, Banksia Woodland (663 ha) as being moderate and Dampland (3 ha) as low value Black Cockatoo habitat.
 - All habitat types contained multiple foraging resources for Black cockatoos which equates to approximately 981 ha of foraging habitat.
 - Thirty nine fauna species were recorded during the survey including one species of amphibian, three species of reptile, 32 species of bird and three species of mammal.
 - The Western Brush Wallaby (*Macropus irma*) listed as Priority 4 under Department of Parks and Wildlife's Priority listing was the only conservation significant fauna species recorded during the survey.
 - Black-eared Cuckoo (*Chrysococcyx osculans*) was recorded during the survey this record is considered to occur just outside of the southerly distribution of this otherwise common species.

The study area is considered to be of high conservation value comprising habitat for a high number of threatened flora and fauna species. The vegetation is representative of a number of Threatened and Priority Ecological Communities, some of these are likely to be impacted by the NorthLink WA Project. The addition of the study area to the conservation estate will substantially increase the estate with the adjacent Class C Reserve and provide protection of an important ecological linkage.



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ABBREVIATIONS AND UNITS

Term	Definition
°C	decimal degrees
%	percentage
ANZECC	Australian and New Zealand Environment and Conservation Council
BAM Act	<i>Biosecurity and Agriculture Management Act 2007</i>
BOM	Bureau of Meteorology
CALM	Conservation and Land Management
CCW	conservation category wetland
Coffey	Coffey Environments Australia Pty Ltd
Cwlth	Commonwealth
DBH	diameter at breast height
DEC	Department of Environment and Conservation
DOE	Department of the Environment
DOW	Department of Water
DPAW	Department of Parks and Wildlife
DSEWPAC	Department of Sustainability, Environment, Water, Population and Communities
EP Act	<i>Environmental Protection Act 1986</i>
EPA	Environmental Protection Authority
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
EWSWA	Environmental Weed Strategy for Western Australia
FCT	Floristic Community Type
GPS	global positioning system
ha	hectare
IBRA	Interim Biogeographic Regionalisation for Australia
IUCN	International Union for Conservation of Nature
km	kilometres
m	metres
mm	millimetres
MNES	Matters of National Environmental Significance
MRWA	Main Roads Western Australia



Term	Definition
MUW	multiple use wetland
NVIS	National Vegetation Information System
PEC	Priority Ecological Community
REW	resource enhancement wetland
SCP	Swan Coastal Plain
TEC	Threatened Ecological Community
UFI	unique feature identifier
WC Act	<i>Wildlife Conservation Act 1950</i>
WA	Western Australia
WALGA	Western Australian Local Government Association
WAPC	Western Australian Planning Commission



1 INTRODUCTION

MRWA has purchased an area of land (986 ha) in the Chittering area for the purpose of offsetting impacts of the NorthLink WA Project (including this Perth–Darwin National highway and the Tonkin Grade Separations projects). Both projects have been deemed a ‘controlled action’ by the Commonwealth Department of the Environment (DOE) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) given their impacts to Matter of National Environmental Significance (MNES), specifically Black Cockatoos. These projects are also being assessed under the *Environmental Protection Act 1986* (EP Act).

To determine the suitability of this land as an offset site for these projects, MRWA commissioned the NorthLink WA Consultancy Services Team to complete an environmental survey of the study area.

1.1 Location and Tenure

The study area is Lot M2091 Ippolo Road (Certificate of Title 1169-601), Chittering, located approximately 50 kilometres (km) north of Perth within the Swan Coastal Plain bioregion of Western Australia (Figure 1). The study area is approximately 986 ha (Figure 2) in size and is bordered by a C Class Nature Reserve managed by the Department of Parks and Wildlife to the west, private land bordering Ippolo Road to the north, private land to the southwest, south and east.

The study area is currently zoned “Agriculture Resource” under the Shire of Chittering Town Planning Scheme No. 6. MRWA have purchased the study area for the purpose of conservation management by the Department of Parks and Wildlife. The addition of the study area to the existing C Class Nature Reserve to the west will increase the size of the Nature Reserve from 163 ha to 1146 ha.

1.2 Objective

The objectives of the environmental assessment were to identify the existing environmental values of the study area to determine the suitability of the site as an offset for the project. The environmental assessment included a Level 1 flora and vegetation survey and a Level 1 fauna survey and Black Cockatoo habitat assessment.

The objective of the Level 1 flora and vegetation survey was to:

- Compile an inventory of vascular plants.
- Identify and map the extent of vegetation communities.
- Record the occurrence of introduced plant species.
- Identify and record conservation significant species and ecological communities.
- Locate the presences of wetlands, including rivers, creeks and floodways.

The objective of the Level 1 fauna survey and Black Cockatoo habitat assessment was to:

- Identify the fauna values of the habitats present in the study area.
- Determine the significance of the habitats to support Black Cockatoos.
- Identify conservation significant fauna occurring or likely to occur in the study area.
- Assess the regional and local significance of the study area.


1.3 Scope

The scope of works for the Level 1 flora and vegetation survey included:

- A desktop literature review of databases and previous surveys completed in the vicinity of the study area, including:
 - A search of the Commonwealth’s DOTE protected matters search tool for MNES.
 - Department of Parks and Wildlife’s (DPAW’s) Threatened and Priority flora database.
 - DPAW’s Threatened and Priority ecological communities’ database.
 - DPAW’s combined biological database NatureMap.
 - Environmentally Sensitive Area’s listed under the EP Act.
 - Previous flora and vegetation surveys undertaken in close proximity to the study area.
 - A search of DPAW’s *Geomorphic Wetlands of the Swan Coastal Plain* dataset.
- A Level 1 flora and vegetation survey, which included:
 - Mapping and description of the plant communities according to a broad floristic formation level and a vegetation association level, using a combination of recent aerial photography and field surveys to ground-truth.
 - Mapping of vegetation condition using the vegetation condition rating scale developed by Keighery (1994) and published in Government of Western Australia (2000).
 - Compiling a list of native and non-native plant species occurring within the study area as recorded from relevé sampling, opportunistic collections and observations.
 - Identifying, locating (GPS point) and mapping any significant plant species or ecological communities recorded on the DPAW Threatened species, Priority species, Threatened Ecological Community (TEC) and Priority Ecological Community (PEC) databases.
 - A targeted search, involving a site walk-over, for conservation-significant species potentially occurring within the study area.

The fauna assessment included:

- A desktop literature review of databases and previous surveys completed in the vicinity, which included:
 - The online DPAW NatureMap database to identify potential vertebrate fauna within the study area based on previous fauna surveys conducted in the region.
 - DPAW’s Threatened and priority species database.
 - Commonwealth Government’s database of fauna MNES to identify species potentially occurring within the area that are protected under the EPBC Act or international migratory bird agreements.
 - Previous fauna surveys conducted in the area.
- A level 1 fauna survey, to:
 - Identify the major fauna habitats present within the study area.
 - Record opportunistic fauna sightings, including conservation significant fauna.

- 
- Map the major fauna habitats present surrounding the study area to assess the regional significance of the study area and the importance of ecological linkages.
 - Assess the likely presence of conservation significant fauna.
 - Identify significant features or habitat for conservation significant fauna species.
 - A Black Cockatoo habitat assessment, comprising:
 - A site walkover to search for signs of evidence that Black Cockatoo utilise the study area.
 - The determination of the density of Black Cockatoo breeding habitat.
 - The identification of Black Cockatoo feeding habitat.

2 ENVIRONMENTAL LEGISLATION AND POLICY

2.1 Environmental Legislation

The assessment of native vegetation within the study area was undertaken in accordance with the requirements of the following key environmental legislation and regulations:

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (Cwlth).
- *Environmental Protection Act 1986* (EP Act) (WA).
- *Wildlife Conservation Act 1950* (WC Act) (WA).
- *Biosecurity and Agriculture Management Act 2007* (BAM Act) (WA).
- State Planning Policy 2.8 Bushland Policy for the Perth Metropolitan Region.

2.2 Environmental Policies

The EPA has produced a number of policy statements, guidelines and technical guides, which provide guidelines and advice regarding the EPA's position. Position statements, guidelines and technical guides relevant to fauna, flora and vegetation, including:

- Guidance for the Assessment of Environmental Factors No. 51: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia (EPA, 2004a).
- Guidance for Assessment of Environmental Factors No. 56 – Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia (EPA, 2004b).
- Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA/DEC, 2010).
- Guidance for the Assessment of Environmental Factors No. 6 Rehabilitation of Terrestrial Ecosystems (EPA, 2006).
- Position Statement No. 2 Environmental Protection of Native Vegetation in Western Australia (EPA, 2000).
- Position Statement No. 3 Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA, 2002).
- Position Statement No. 7 Principles of Environmental Protection (EPA, 2004c).
- Western Australia Environmental Offset Guidelines (EPA, 2014) and WA Environmental Offsets Policy (EPA, 2011).

3 EXISTING ENVIRONMENT

3.1 Climate

Pearce RAAF Airbase in Bullsbrook is the nearest reliable Bureau of Meteorology (BOM) weather station to the study area approximately 20 km south. The climate of the Chittering region is described typically as Mediterranean with dry summers and wet winters. The average maximum temperature reaches 33.5°C in summer, while in winter the temperature drops to 8.1°C. The region receives an average annual rainfall of 680 mm, with the majority of this falling in the winter months (1937-2014) (BOM, 2014).

The three months prior to the survey commencing (April to June 2014), RAAF Airbase received 234.5 mm, or 7% below the long-term average rainfall of 253.2 mm (1937-2014) for the same period. The 12 months before the survey the rainfall was 683.8 mm (July 2013 to Jun 2014), which is 0.5% above the long term average of 680.0 mm (1939-2014) for the same period (Figure 3).

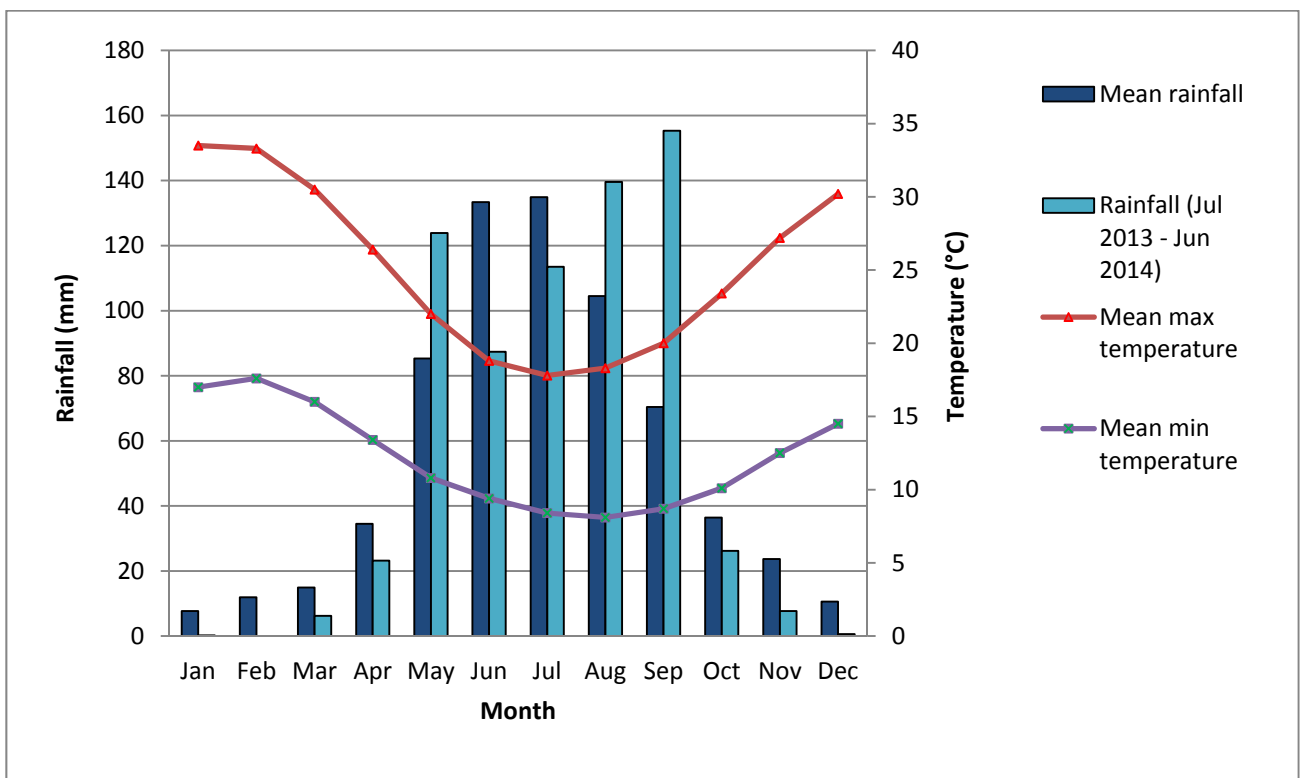


Figure 3 Climate

3.2 Topography and Landforms

The study area is situated on a consolidated sand dune consisting of hill rises, lateritic slopes and plains. A seasonally inundated depression (basin) in the southwest corner of the study area can be associated with Chandala Brook. The soil profile is medium to coarse-grained sand, therefore surface water would infiltrate readily through the porous nature of the soil.



3.3 Geology and Soils

The study area is located on the Swan Coastal Plain bioregion, which in the Perth Region is 34 km wide in the north and 23 km wide in the south and is bounded by the Gingin and Darling Fault Scarps, which rise to over 200 m above sea level (Davidson, 1995). The Swan Coastal Plain consists of a series of distinct landforms (McArthur and Bettenay 1974), roughly parallel to the coast. The distinct landforms, from east to west include the Ridge Hill Shelf, the Pinjarra Plain, the Bassendean Dune system, the Spearwood dune system and the Quindalup dune system (Davidson, 1995).

The study area is located on the Ridge Hill Shelf and the Pinjarra Plain, directly west of the Gingin Scarp and the Dandaragan Plateau. The Ridge Hill Shelf and the Pinjarra Plain are described as:

- Ridge Hill Shelf – comprises the colluvial slopes which form the foothills of the Darling and Dandaragan Plateaus and which represent dissected remnants of a sand covered, wave cut platform.
- Pinjarra Plain – a piedmont and valley-flat alluvial plain consisting predominantly of clayey alluvium that has been transported by rivers and streams from the Darling and Dandaragan Plateaus. The plain is generally about 5 km wide west of the colluvial slopes.

Churchward and McArthur (1978) mapped the soil landforms of the System Six region. According to the mapping by Churchward and McArthur (1978), the study area occurs in association five soil landforms.

- Yanga – Poorly drained plain with grey sandy benches and intervening swamps; also in areas of bog iron ore, marl or solonchic soils.
- Coonambidgee – Gently sloping fringe to the Dandaragan Plateau; deep grey sands.
- Reagan – Gently sloping scarp dominated by yellow or grey sands; some duricrust and gravels present.
- Mogumber – Gently undulating landscapes; duricrust and gravels on crests and grey sands in broad shallow depressions.
- Moondah – Valleys with deep red and yellow brown sands; occasional swamps.

3.4 Hydrology and Wetlands

According to the Department of Water's (DOWs) Hydrogeological Atlas, there are four aquifers occurring in close proximity to the study area. The four aquifers occur at three levels, with two unconfined aquifers, the Mirrabooka and Surficial, occurring at Level 1 (DOW, 2014). The Leederville-Parmelia confined aquifer occurs at Level 2, while the Perth-Yarragadee North confined aquifer is located at Level 3 and represents the bottom aquifer in relation to the study area (DOW, 2014).

According to drainage and contour mapping viewed on the Shared Land Information Platform, a small drainage line passes through the northwest corner of the study area and an additional drainage line, Chandala Brook, runs in a northeast to southwest direction just outside the southern boundary of the study area. The drainage contour in the northwest of the study area is considered to be minor and is unnamed. It does not have a formal channel, but more a flowline between two small rises.

The surface hydrology of the study area flows into the two drainage contours located in close proximity to the study area before discharging into Chandala Lake and other larger creek systems or floodplains in the vicinity of the study area.

DPAW's Geomorphic Wetlands Swan Coastal Plain dataset displays the location, boundary, geomorphic classification (wetland type) and management category of wetlands on the Swan Coastal Plain. The

information contained within this dataset was originally digitised from the Wetlands of the Swan Coastal Plain Volume 2B Wetland mapping, Classification and Evaluation: Wetland Atlas, which was captured at a scale of 1:25, 000 (Hill et al., 1996).

Wetlands on the Swan Coastal Plain have been classified using a geomorphic wetland classification system based on the characteristics of landform and water permanence. Table 1 below details the geomorphic classification of wetlands the DPAW (2014a) have adopted for the Swan Coastal Plain, which have been identified by Semeniuk and Semeniuk (1995).

Table 1 Geomorphic wetland classification types

Hydroperiod	Landform				
	Basin	Channel	Flat	Slope	Highland
Permanent inundation	Lake	River	-	-	-
Seasonal inundation	Sumpland	Creek	Floodplain	-	-
Intermittent inundation	Playa	Wadi	Barlkarra	-	-
Seasonal waterlogging	Dampland	Trough	Palusplain	Paluslope	Palusmont


DPAW has assigned wetland management categories based on their ecological, hydrological and geomorphological significance, and took into account the degree of disturbance that had occurred. The three Wetland Management Categories on the Swan Coastal Plain can be summarised as follows:

1. Conservation Category (CCW) – wetlands that support a high level of ecological attributes and functions (generally having intact vegetation and natural hydrological processes), or that have a reasonable level of functionality and are representative of wetland types that are rare or poorly protected.
2. Resource Enhancement (REW) – wetlands that have been modified (degraded) but still support substantial ecological attributes (wetland dependant vegetation covering more than 10%) and functions (hydrological properties that support wetland dependent vegetation and associated fauna), and have some potential to be restored to the Conservation management category. Typically, such wetlands still support some elements of the original native vegetation, and hydrological function.
3. Multiple Use (MUW) – wetlands that are assessed as possessing few remaining ecological attributes and functions. While such wetlands can still play an important role in regional or landscape ecosystem management, including water management, they are considered to have low intrinsic ecological value. Typically, they have very little or no native vegetation remaining (less than 10%).

According to DPAW's *Geomorphic Wetlands Swan Coastal Plain Dataset*, one MUW (UFI 15732; Palusplain) occurs in the extreme southwest of the study area. An additional four CCWs occur in close proximity to the study area. The four CCWs occur approximately 500 m to 1,200 m to the west of the southwest corner and are associated with Chandala Lake within Chandala Nature Reserve.

3.5 Biological Context of Study Area

The Interim Biogeographic Regionalisation for Australia (IBRA) divides Australia into 89 bioregions based on major biological and geographical attributes. The bioregions have been further divided into 419 subregions. The study area is located in the Swan Coastal Plain (SCP) bioregion, subregion Dandaragan Plateau (SWA01) and a small portion in the southwest of the study area in the Perth subregion (SWA02).



The Dandaragan Plateau (SWA1) subregion consists of cretaceous marine sediments with sand and lateritic mantle. It is bordered by the Derby and Dandaragan Faults. The vegetation includes scrub-heaths on laterite pavement and gravelly sandplains, Jarrah and Marri woodlands and *Banksia* low woodlands. Dominant land use is mainly dry-land agriculture and areas of conservation.

The Perth (SWA2) subregion is a low lying coastal plain which consists of colluvial and Aeolian sands, alluvial river flats and coastal limestone. In the east it rises to duricrusted Mesozoic sediments while to the south there are widespread outwash plains. A complex series of seasonal wetlands and swamps extend north to south. The vegetation includes heath and/or Tuart woodlands on limestone, *Banksia* and Jarrah- *Banksia* woodlands on Quaternary marine dunes of various ages, Marri on colluvial and alluvial soils *Casuarina obesa* on out wash plains and paperbark (*Melaleuca* sp.) in wetland areas (Mitchell et al., 2002.)

3.6 Regional Vegetation

Heddle et al. (1980) have described and mapped vegetation complexes of the Darling System at a floristic scale of 1:250,000 (as recognised by Diels, 1906; and Gardner, 1942). The vegetation complex mapping is based on data collected from the literature, ground surveys, road traverses and aerial photographs and is related to the landforms, soils and climatic conditions.

Based on the mapping undertaken by Heddle et al. (1980) the study area is considered to be representative of five vegetation complexes (Figure 4). The five vegetation complexes have been described as:

- Coonambidgee complex: consists of vegetation ranging from a low open forest and low woodland of Pricklybark (*Eucalyptus todtiana*) and *Banksia* species (*Banksia attenuata*, *Banksia menziesii* and *Banksia ilicifolia*) with local admixtures of *Banksia prionotes*, to open woodland of Marri (*Corymbia calophylla*) and *Banksias* (*Banksia* spp.). The Coonambidgee complex is located on the fluvial deposits of the Swan Coastal Plain.
- Karamal complex-south: is dominated by an open forest of Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*) with a definite second storey of *Banksia grandis* on the gravelly soils and *Banksia attenuata* and *Banksia menziesii* on the sandier soils. The Karamal complex-south is located on the lateritic uplands of the Dandaragan Plateau.
- Mogumber complex-south: dominated by an open woodland of Marri (*Corymbia calophylla*) with a well-defined second storey of Pricklybark (*Eucalyptus todtiana*) and *Banksia* species (*Banksia attenuata*, *Banksia menziesii* and *Banksia ilicifolia*). The Mogumber complex-south is located on the lateritic uplands of the Dandaragan Plateau.
- Moondah complex: supports predominantly a low closed to low open forest of *Banksia attenuata*, *Banksia menziesii*, *Banksia prionotes* and *Eucalyptus todtiana* on the slopes and an open woodland of Marri (*Corymbia calophylla*) and *Banksia* (*Banksia* spp.) in the valleys. The Moondah complex is located in the valleys of the Dandaragan Plateau.
- Reagan complex: supports vegetation ranging from low open woodland of *Banksia attenuata*, *Banksia menziesii* and *Eucalyptus todtiana* to closed heath, depending on the depth of soil. The Reagan complex is located on the scarps of the Dandaragan Plateau.

The extent of each vegetation complex located within the study area is presented in Table 2 below.



Table 2 **Vegetation complex extent**

Land unit	Extent within the study area (ha)	Extent within the study area (%)
Coonambidgee complex	8.7	0.9
Karamal complex-south	181.3	18.4
Mogumber complex-south	424.9	43.1
Moondah complex	105.2	10.7
Reagan complex	266.3	27.0

4 METHODS

4.1 Flora and Vegetation

4.1.1 Desktop Assessment

In accordance with the EPA's Guidance Statement No. 51 for a Level 1 flora and vegetation survey, a desktop assessment was undertaken prior to the field survey component of the assessment. The desktop assessment involved a review of existing environmental or biological data available for the study area and lands adjacent to the study area. The desktop assessment involved the review of State and Federal databases, regional and local contextual data for the northern Swan Coastal Plain and existing biological surveys undertaken on the Swan Coastal Plain. The results of the desktop assessment are detailed in Section 5.

4.1.1.1 Databases

A request for searches of DPAW's threatened flora and ecological community's database was submitted on 30 May 2014 for a central coordinate (-31.487441°S; 115.985779°E) within the study area with a 5 km buffer for Threatened and Priority listed flora and a 10 km buffer for Threatened and Priority listed ecological communities (Appendix A). The search was undertaken for:

- The Department's Threatened (Declared Rare) and Priority Flora database.
- The Western Australian Herbarium Specimen database for Priority species opportunistically collected in the area of interest.
- The Department's Threatened and Priority Flora List, which contains species that are declared rare (Conservation Code T or X for those presumed to be extinct), poorly known (Conservation Codes 1, 2 or 3), or require monitoring (Conservation Code 4).
- The Department's Threatened and Priority Ecological Communities database.

A search of DOTE (2014a) online publicly available database for MNES was undertaken for the study area. A central point (-31.48843S; 115.98843E) with a 10 km buffer was undertaken for the study area (Appendix B).

4.1.1.2 Regional Perspective

A review of regional and local contextual data, with reference to flora and vegetation, was completed prior to the field survey component of the assessment. The review was undertaken to identify the flora and plant communities considered to be significant from a regional and local context. The review also concentrated on broad scale mapping of plant communities and floristic units. The documents that have been reviewed include:

- Vegetation complexes of the Darling System Western Australia (Hedde et al., 1980).
- Floristic Survey of the Southern Swan Coastal Plain (Gibson et al., 1994).
- The Bush Forever Strategy: Volume 1 (Government of Western Australia, 2000a) and Volume 2 (Government of Western Australia, 2000).
- Plant Life of Western Australia (Beard, 1990).

- Local Government Biodiversity Planning Guidelines for the Perth Metropolitan Region (WALGA, 2004).
- The Darling System – System 6, Part I: General Principles and Recommendations (DCE, 1983).
- Native Vegetation in Western Australia: Technical Report 249 (Shepherd et al., 2002).

4.1.1.3 Existing Biological Surveys

Several biological surveys have been undertaken within the study area and in close proximity to the study area. These reports were reviewed to identify the known plant communities occurring within and adjacent to the study area. The review also identified the condition of the vegetation and the location of known conservation significant flora and ecological communities occurring within and adjacent to the study area. The existing biological surveys reviewed, included:

- Perth–Darwin National Highway – Tonkin Highway Link Alignment Definition Study: Environmental Impact Assessment and Biological Survey (GHD, 2013a).
- Swan Valley Bypass, Perth–Darwin National Highway: Level 2 Flora and Vegetation Survey (360 Environmental, 2014).
- A flora and vegetation survey of Lots 46 and 47 Maralla Road and Lexia Avenue, Ellenbrook (M.E. Trudgen & Associates, 1999).
- East Landsdale Flora and Fauna Assessment – Lots 50 and 51 (Ecoscape, 2009a).
- East Landsdale Flora and Fauna Assessment – Lot 154 (Ecoscape, 2009b).
- Level 2 Flora and Vegetation Survey, North Ellenbrook (360 Environmental, 2012).
- Level 1 flora and fauna assessment of Gaston Road, Muchea (GHD, 2009).
- Flora and fauna assessment, Mitchell Freeway Extension (Burns Beach Road to Romeo Road) (GHD, 2013b).
- Level 2 flora and vegetation survey of Lot 5 Mornington Drive, Mariginuiup (Monocot-Dicot Botanical Research, 2010).
- Flora and vegetation assessment, M70/138 Hopkins Road, Nowergup (Coffey Environments, 2010).

4.1.2 Field Survey

A Level 1 flora and vegetation survey, consistent with the EPA’s Guidance for the Assessment of Environmental Factors No. 51 (EPA, 2004a), was conducted of the study area. The survey was completed from 8 to 10 June and 17 June 2014.

The field survey component of the assessment was led by Mr Clinton van den Bergh, assisted by Ms Lucy Dadour and Ms Michelle Holliday. Clinton has over 8 years’ experience conducting flora and vegetation surveys in Western Australia with relevant experience on the Swan Coastal Plain.

The survey was conducted under a Licence to take flora for scientific or other prescribed purposes (licence number SL010743) and a Permit to take Declared Rare Flora (permit number 73–1314) from DPAW. All flora specimens were collected during the survey under these licences and permits, in accordance with the conditions required under each licence/permit.

4.1.2.1 Flora and Vegetation Assessment

A total of 30 relevés were sampled within the study area. Relevés are unmarked quadrats where a central point is marked with a Global Positioning System (GPS) and an approximate radius is sampled around this



point for the purpose of recording vegetation structure, species composition, dominance and compiling a species inventory. For the purpose of this assessment a radius of approximately 20 m was sampled. Flora sampling quadrats on the Swan Coastal Plain are 100 m² in size, therefore the size of the relevé was sufficient to sample the flora and vegetation within the study area.

Information recorded at each relevé included landform features, soil colour and texture, leaf litter cover, rock size and type, vegetation structure, vegetation condition and fire age. Structural information on the dominant species (species with a cover higher than 1%) including height and percentage cover were recorded for each relevé.

Common species that were well known to the survey botanists were identified in the field, while remaining species unknown to the survey botanist were collected during the field survey and assigned a unique number to facilitate tracking. The specimens were pressed during that day, following recommendations provided by the Western Australia Herbarium. The specimens were then sufficiently dried prior to submitting to a consultant taxonomist, Mr Malcolm Trudgen, for identification.

The broad floristic formations and vegetation associations were described based on the floristic data recorded from the relevés and from visual observations while traversing the study area, utilising the standardised terminology for vegetation structural classes detailed in the Australian Vegetation Attribute Manual (ESCAVI, 2003). The vegetation structural terminology of the National Vegetation Information System (NVIS) was adapted from Specht (1970), Specht et al. (1974), and Walker and Hopkins (1990) (ESCAVI, 2003).

The vegetation recorded from the study area has been described to a NVIS hierarchical level III (Broad Floristic Formation) and V (Vegetation Association). Hierarchical level III requires the dominant growth form, cover, height and dominant land cover genus for the upper most or the ecologically or structurally dominant stratum. Hierarchical level V requires the dominant growth form, cover, height and dominant species (three for each stratum) for each of the three traditional strata (i.e. upper, mid and ground). The hierarchical structure and the vegetation structural terminology are described in Table 3 and Table 4, while the NVIS height class definition is provided in Table 5.

Table 3 NVIS hierarchical structure

Hierarchical level	Description	NVIS structural/floristic component required
I	Class	Dominant growth form for the ecologically or structurally dominant stratum.
II	Structural Formation	Dominant growth form, cover and height for the ecologically or structurally dominant stratum.
III	Broad Floristic Formation	Dominant growth form, cover, height and dominant land cover genus for the upper most or the ecologically or structurally dominant stratum.
IV	Sub-formation	Dominant growth form, cover, height and dominant genus for each of the three traditional strata (i.e. Upper, Mid and Ground).
V	Association	Dominant growth form, height, cover and species (3 species) for each of the three traditional strata (i.e. Upper, Mid, Ground).
VI	Sub-Association	Dominant growth form, height, cover and species (5 species) for all layers/sub-strata.

Source: Table 1 from ESCAVI (2003).



Table 4 NVIS structural terminology

Stratum	Growth form	Height ranges (m) ¹	Structural formation classes (% cover)					
			80–100	50–80	20–50	0.25–20	0–0.25	Unknown
U	Tree, palm	<10 = low 10-30 = mid >30 = tall	Closed forest	Open forest	Woodland	Sparse woodland	Isolated trees	Isolated clumps of trees
	Tree mallee	<3 = low <10 = mid 10-30 = tall	Closed mallee forest	Open mallee forest	Mallee woodland	Sparse mallee woodland	Isolated mallee trees	Isolated clumps of tree mallees
M	Shrub, cycad, tree-fern	<1 = low 1-2 = mid >2 = tall	Closed shrubland	Shrubland	Open shrubland	Sparse shrubland	Isolated shrubs	Isolated clumps of shrubs
	Mallee shrub	<3 = low <10 = mid 10-30 = tall	Closed mallee shrubland	Mallee shrubland	Open mallee shrubland	Sparse mallee shrubland	Isolated mallee shrubs	Isolated clumps of mallee shrubs
	Heath shrub	<1 = low 1-2 = mid >2 = tall	Closed heath shrubland	Heath shrubland	Open heath shrubland	Sparse heath shrubland	Isolated heath shrubs	Isolated clumps of heath shrubs
	Chenopod shrub	<1 = low 1-2 = mid >2 = tall	Closed chenopod shrubland	Chenopod shrubland	Open chenopod shrubland	Sparse chenopod shrubland	Isolated chenopod shrubs	Isolated clumps of chenopod shrubs
	Samphire shrub	<0.5 = low >0.5 = mid	Closed samphire shrubland	Samphire shrubland	Open samphire shrubland	Sparse samphire shrubland	Isolated samphire shrubs	Isolated clumps of samphire shrubs
G	Hummock grass	<2 = low >2 = mid	Closed hummock grassland	Hummock grassland	Open hummock grassland	Sparse hummock grassland	Isolated hummock grasses	Isolated clumps of hummock grasses
	Tussock grass	<0.5 = low >0.5 = mid	Closed tussock grassland	Tussock grassland	Open tussock grassland	Sparse tussock grassland	Isolated tussock grasses	Isolated clumps of tussock grasses
	Other grass	<0.5 = low >0.5 = mid	Closed grassland	Grassland	Open grassland	Sparse grassland	Isolated grasses	Isolated clumps of grasses
	Sedge	<0.5 = low >0.5 = mid	Closed sedgeland	Sedgeland	Open sedgeland	Sparse sedgeland	Isolated sedges	Isolated clumps of sedges



Stratum	Growth form	Height ranges (m) ¹	Structural formation classes (% cover)					
			80–100	50–80	20–50	0.25–20	0–0.25	Unknown
	Rush	<0.5 = low >0.5 = mid	Closed rushland	Rushland	Open rushland	Sparse rushland	Isolated rushes	Isolated clumps of rushes
	Vine	<10 = low 10-30 = mid >30 = tall	Closed vineland	Vineland	Open vineland	Sparse vineland	Isolated vines	Isolated clumps of vines
	Herbs	<0.5 = low >0.5 = mid	Closed herbland	Herbland	Open herbland	Sparse herbland	Isolated herbs	Isolated clumps of herbs

Source: ESCAVI (2003). Note growth forms that do not occur or were not sampled within the study area were omitted (i.e. seagrass bed).
 1. Refer to Table 5 for height range information.

Table 5 NVIS height class definition

Height class	Height range (m)	Growth forms			
		Tree, palm, vine	Shrub, heath shrub, chenopod, samphire shrub, tree-fern	Tree mallee, mallee shrub	Hummock grass, tussock grass, other grass, sedge, rush, herb
8	>30	Tall			
7	10-30	Mid		Tall	
6	<10	Low		Mid	
5	<3			Low	
4	>2		Tall		Tall
3	1-2		Mid		Tall
2	0.5-1		Low		Mid
1	<0.5		Low		Low

Source: ESCAVI (2003).

The condition of the vegetation recorded within the study area was described based on the condition rating scale developed by Keighery (1994) and published in the Bush Forever Strategy (Government of Western Australia, 2000b) (Table 6).



Table 6 Vegetation condition rating scale

Condition code	Definition
P Pristine	Pristine or nearly so, no obvious signs of disturbance.
Ex Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are nonaggressive 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 disturbances. 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 area is completely or almost completely without native species. These areas are often referred to as parkland cleared with the flora composing weed or crop species with isolated native trees or shrubs.

Source: Bush Forever (Government of Western Australia, 2000), originally developed by Keighery (1994).

4.1.2.2 Targeted Searches

Sections of the study area were traversed on foot, with known locations of conservation significant flora or habitat likely to support conservation significant flora targeted during the searches. For populations of potential or known significant flora, a specimen, GPS location, photo, estimated population size and description of vegetation was documented. Further opportunistic collections of taxa not recorded in the relevés and introduced flora were also recorded. The focus of the targeted introduced flora surveys were:

- Weeds of National Significance listed under the EPBC Act.
- Declared Pests under Section 22 of the BAM Act.
- Environmental weed species with a “High” rating as listed by DPAW.

4.1.3 Limitations of Survey

The field survey component of the assessment was not undertaken at the most appropriate time for conducting flora and vegetation surveys on the Swan Coastal Plain. The survey was undertaken in winter, while the optimal time is spring. However, this is not considered to be a major limiting factor, as only a Level 1 flora and vegetation survey was required to identify the dominant vegetation structures.

No numerical analysis of the floristic data collected from the field survey was undertaken. Fungi and non-vascular flora (e.g. bryophytes, mosses etc.) were not collected or recorded during the field survey. The collection of fungi and non-vascular flora was outside the scope of this survey.

Table 7 below details the botanical survey limitations associated with the flora and vegetation assessment of the Study area.



Table 7 Botanical survey limitations

Limitation	Constraint and significance*	Comments
Competency/experience of the scientist conducting the survey	No	The survey and reporting was executed by Senior Botanist Clinton Van Den Bergh and Environmental Ecologist Lucy Dadour. A specialist consultant taxonomist, Malcolm Trudgen, undertook the specimen identifications.
Level of survey	No	A single phase Level 1 flora and vegetation survey was completed in accordance with the EPA's Guidance Statement 51 (EPA, 2004a).
Sources of information	No	The Swan Coastal Plain has been comprehensively surveyed in the past as a result of urban development. The sources of information were reviewed prior to, during and after the survey.
Scope	No	The entire scope was met.
Proportion of: a) Flora collected and identified. b) Task achieved and further work that may be required.	a) Yes; low b) No	a) It is estimated that between 70 and 80% of the potential flora occurring in the study area has been recorded. b) All tasks were achieved.
Completeness	No	The study area was adequately sampled and traversed.
Mapping reliability	No	The study area was traversed on foot and was easily accessible. The upper stratum of the plant communities were fairly homogenous over the entire study area. As a result the mapping reliability from a broad floristic formation is considered to be high. The mapping reliability at the vegetation association level is considered to be moderate to high.
Timing/weather/season/cycle	Yes	The survey was undertaken in winter so does not constitute a comprehensive inventory of annual and ephemeral species.
Disturbances which affected the results of the survey	No	The study area was considered to be in excellent condition with very minor disturbances. In some sections, the Banksia species were dying as a result of the drought or poor rainfall in the years preceding the survey.
Intensity of the survey	No	The survey was undertaken at an intensity which is in accordance with the EPA guidance (EPA, 2004a).
Completeness	No	The study area was adequately traversed on foot or via vehicle.
Resources	No	Adequate resources were assigned to the field surveys, specimen identifications and reporting components of the assessment.
Remoteness and/or access problems	No	Several unmade roads and informal tracks were located across the study area. These were accessed during the field survey component of the assessment.
Availability of contextual information	No	The greater Swan Coastal Plain region has been extensively surveyed, therefore a large amount of contextual information is available for the study area.

* Indicates whether the limitation is a constraint (yes/no) and, if yes, the significance of the constraint (low/moderate/high).

4.2 Fauna

4.2.1 Desktop Assessment

In accordance with the EPA's Guidance Statement No. 56 for a Level 1 fauna survey, a desktop assessment was undertaken prior to the field survey component of the assessment. The desktop assessment involved a review of existing environmental or biological data available for the study area and lands adjacent to the study area. The desktop assessment involved the review of State and Federal databases, regional and local contextual data for the northern Swan Coastal Plain and existing biological surveys undertaken on the Swan Coastal Plain. The results of the desktop assessment are detailed in Section 5.

4.2.1.1 State and Federal Government Databases

State and federal database searches were undertaken using:

- DPAW NatureMap online database (DPAW, 2014a). The search area was a 15 km circle around the coordinates 31°29'12"S 115°59'05"E.
- DPAW list of Threatened and Priority fauna (DPAW, 2014b). The search area was a 15 km circle around the coordinates 31°29'12"S 115°59'05"E.
- The Protected Matters Search Tool maintained by the DOTE bounded by a 10 km buffer area for the coordinates -31.486074°S, 115.989609°E (DOTE, 2014a).

4.2.1.2 Regional and Local Contextual Data

A review of regional and local contextual data, with reference to fauna, was completed prior to the field survey component of the assessment. The documents that have been reviewed include:


- Birds Australia Birddata (Birddata, 2014). The search area was a one degree square containing the point -31.41522 °S, 115.9935 °E.
- General texts to provide supplementary information including Tyler and Doughty (2009) for frogs; Storr et al., (1983, 1990, 1999, 2002), Bush et al. (2010), Bush et al. (2007) and Wilson and Swan (2010) for reptiles; Johnstone and Storr (1998; 2004), Simpson and Day (2010) and Johnstone and Storr (1998; 2004) for birds; and Menkhorst and Knight (2011) and van Dyck and Strahan (2008) for mammals; Churchill (2008) for bats.

4.2.1.3 Existing Biological Surveys

Several biological surveys have been undertaken within the study area and in close proximity to the study area. These reports were reviewed to identify the fauna assemblages occurring within and adjacent to the study area. The review also identified the location of known conservation significant fauna occurring within and adjacent to the study area. The existing biological surveys reviewed, included:

- Egerton Fauna Survey (Tingay and Associates, 1994).
- A Biological Survey of Boonaring Nature Reserve (Burbidge et al., 1996).
- Flora, Vegetation and Vertebrate Fauna Assessment Neerabup Industrial Area (ATA, 2007).
- Neerabup Road Extension Level 2 Fauna Survey (GHD, 2014).

Collectively these sources of information were used to create lists of species expected to utilise the study area. It should be noted that these lists include historic records of species that have since become locally extinct and species that have been recorded in the general region, but are vagrants, and are generally not found in the area because of a lack of suitable habitat. Many previously recorded fauna have specific habitat requirements that may be present in the general area but not located in the study area (e.g. marine



species). As such, erroneous records and species that have habitat specificity to habitats not present in the study area (wetland and marine species) have been omitted from the list of species expected to occur.

4.2.2 Field Survey

The field survey was conducted on 8 to 11 July by John Trainer and Michelle Holliday. The survey included an inspection of the major fauna habitats, Black Cockatoo habitat assessment and opportunistic fauna observations. The site was traversed by foot and a list of fauna recorded during the survey was assembled. The presence or evidence of any conservation significant fauna had its details recorded (GPS location, sex, habitat and picture taken if possible).

4.2.2.1 Fauna Habitat

Fauna habitats were classified according to vegetation and landform types and then mapped using a combination of aerial photography and ground-truthing. Fauna habitat assessments were conducted to record the habitat features and habitat values across the site. Fauna habitats were assessed on the microhabitats they provide to the expected faunal assemblage, habitat/vegetation condition and also the number of conservation significant fauna they potentially support.

4.2.2.2 Black Cockatoo Habitat Assessment

The vegetation of the study area was assessed on its ability to provide habitat to the three threatened species of Black Cockatoo. Based upon the current distribution maps in the EPBC Act referral guidelines for three threatened Black Cockatoo species (herein referred to as the Cockatoo referral guidelines) the study area is located in the known range of two of the three species: the Carnaby's Cockatoo and on the extreme northern range of the Forest Red-tailed Black Cockatoo (DSEWPAC, 2012). The methodology used to conduct the Black Cockatoo habitat assessment is consistent with that specified in the Cockatoo referral guidelines.

Habitats were mapped as High, Moderate or Low value for Black Cockatoos based on the level of suitable habitat they provide. High value habitats provide breeding, foraging and roosting habitat. Moderate value habitats provide quality foraging habitat or quality foraging habitat and roosting habitat. Low value habitats provide limited foraging habitat.

Foraging Assessment

The site was examined for evidence of current and historic foraging by Black Cockatoos, with particular focus upon the species of plant that are known foraging resources of these species (Valentine and Stock, 2008, Johnstone et al., 2008 and Chapman, 2007). Evidence in the form of chewed Marri or Jarrah nuts/fruits, chewed/broken Banksia seed pods and stripped tree bark are usually located on the ground underneath foraging resources. Due to the differing beak morphology of each of the Black Cockatoo species, characteristic chew marks are created upon Marri nuts which can be used to provide species identification (Fleming, 2011). Foraging habitat is mapped according to the presence of foraging resources.

Roosting Assessment

According to the Cockatoo referral guidelines roosting habitat is classified as a group of tall trees that are located close to riparian environments or other permanent water sources, usually close to or within foraging habitat (DSEWPAC, 2012). Trees or stands of trees that match this description were examined for evidence of recent use as a roost site (feathers and droppings) and a database searches was conducted for known roost sites in the vicinity of the site. Any stand of tall trees was classified and mapped as potential roosting habitat due to the study areas close proximity to riparian environments and permanent water sources.

Breeding Assessment

All three species of Black Cockatoo breed in large tree hollows which are found in trees usually more than 200 years old (DSEWPAC, 2012). The size of a tree is measured by its diameter at breast height (DBH) in millimetres (mm) and is used to establish its hollow bearing potential. Trees with a DBH of 500 mm or above (300 mm DBH for Salmon Gum and Wandoo) are classified as providing breeding habitat.

Due to the large size of the study area (988 ha) a tree density survey was deemed the most appropriate method to establish the level of breeding habitat present. Within each large stand of tree in the Eucalypt Woodland, a one hectare quadrat (100 m x 100 m) was conducted in an area of representative tree density. The number of trees with a DBH over 500 mm per quadrat and their details (species, height and presence of hollows) was recorded per site. This information was used to provide breeding tree density for each Eucalypt Woodland stand (number of trees/hectare) and extrapolated based on habitat mapping to give a total estimate of the number of breeding trees in the study area. In the stands of trees where multiple tree density surveys were completed an average of total tree density was used.

Additionally, the details (GPS location, species, height and size of hollows) of trees with suitable breeding hollows were opportunistically recorded while traversing the study area.

4.2.3 Limitations of Survey

As this survey was a level 1 survey with no trapping program, small ground dwelling fauna such as skinks, snakes and small mammals are unlikely to be recorded. However, the lack of conservation significant fauna that fall into this category and the high number of previous surveys completed in the vicinity should not impact upon this assessments ability to identify them as part of the wider fauna assemblage.

Both field participants (Mr John Trainer and Ms Michelle Holliday) are experienced in conducting fauna assessments in the South West.

As numerous terrestrial fauna surveys have been conducted in the region, fauna assemblages are well characterised. As such, there is sufficient quantitative terrestrial fauna data collected from study area to allow for comparison to regional data.

Weather was cold and intermittently wet during the assessment with maximum ambient temperatures between 15.7 and 17.2°C and minimum ambient temperatures down to 2.4°C (BOM, 2014). With 11 mm recorded over the survey period. The survey was conducted out of season (EPA, 2004b and EPA/DEC, 2010), which deem that late spring/early summer is the most appropriate time to conduct fauna surveys in the South West. However, as this was a Level 1 survey with no trapping program, the focus of the survey was on habitat assessments rather than recording the faunal assemblage and is considered a low value constraint. The cold weather experienced during the survey would have impacted the number of opportunistic fauna records obtained during the survey, in particular observations of reptiles.

There were no access issues throughout the study area and the entire area was adequately surveyed. A statement of the fauna survey limitations for the project is provided in Table 8.

Table 8 Fauna survey limitations

Limitation	Constraint and significance*	Comments
Competency/experience of the scientist conducting the survey	No	An experienced zoologist undertook the field survey and the reporting.
Level of survey	No	A Level 1 fauna survey was considered appropriate to identify the habitat and conservation significant fauna values of the study area.



Limitation	Constraint and significance*	Comments
Sources of information	No	The Swan Coastal Plain region has been extensively surveyed with several comprehensive fauna surveys undertaken in within comparable habitats to those found in the study area.
Scope	No	The entire scope was met.
Proportion of: a) Fauna identified, recorded and/or collected; and b) Task achieved and further work that may be required	a) Yes; low b) No	a) The lack of pit fall traps reduces the number of small reptiles and mammals identified. However, the lack of conservation significant fauna that fall into this category and the high number of previous surveys completed in the region should not impact upon this assessments ability to identify them as part of the wider fauna assemblage. b) No further work is considered necessary to meet the current objectives and scope.
Completeness	No	The study area was adequately sampled and traversed.
Mapping reliability	No	The mapping reliability is considered to be high due to the homogenous nature of the study area and the quadrat sampling undertaken across the study area.
Timing/weather/season/cycle	Low	The survey was conducted out of season (EPA, 2004b and EPA/DEC, 2010), which deem that late spring/early summer is the most appropriate time to conduct fauna surveys in the South West. However, as this was a Level 1 survey with no trapping program, the focus of the survey was on habitat assessments rather than recording the faunal assemblage and is considered a low value constraint.
Disturbances which affected the results of the survey	No	There were no disturbances that affected the results of the survey.
Intensity of the survey	No	The intensity of the survey is sufficient to identify the presence of conservation significant fauna within the study area and to conduct a Black Cockatoo habitat assessment.
Completeness	No	The study area was adequately traversed on foot or via vehicle.
Resources	No	Adequate resources were assigned to the field survey and the reporting associated with the project.
Remoteness and/or access problems	No	The study area was adequately traversed on foot or via vehicle.
Availability of contextual information	No	The Swan Coastal Plain has been extensively surveyed, with all contextual information accessed prior, during and after the field survey (refer to Section 4.2.1).

* Indicates whether the limitation is a constraint (yes/no) and, if yes, the significance of the constraint (low/moderate/high).



4.3 Dieback

Phytophthora Dieback (Dieback) is a soil borne pathogen. In the southwest of Western Australia there is a number of plant hosts, including the Ericaceae, Fabaceae, Myrtaceae, Proteaceae, and Xanthorrhoeaceae families. While not all plants are susceptible to the disease, the ones that are affected by the pathogen generally results in chlorosis, dieback and often death (Terratree, 2014).

A linear dieback assessment of the main access tracks (approximately 119 ha) was conducted for the study area (Terratree, 2014 Appendix C). The following categorisation for vegetation was applied to determine the risk of dieback:

- High Risk: Areas where *Phytophthora cinnamomi* has been recovered from samples and disease symptoms are consistent with the presence of Dieback.
- Moderate Risk: Areas exhibiting past or current disturbances (logging, grazing, dumping etc.) which has altered vegetation structure and composition and areas downslope of confirmed infestations, or vegetation exhibiting disease symptoms but have not returned positive results for *P. cinnamomi*.
- Low Risk: Areas of protectable uninfested vegetation (as determined by a registered Dieback interpreter), which exhibit multiple healthy indicator species, vegetation in Pristine to Very Good condition, no disease pattern or chronology, and no significant risks from disease vectors or current land use.

5 RESULTS

5.1 Flora and Vegetation

5.1.1 Desktop Assessment

The desktop review and database searches yielded a total of 55 conservation significant taxa occurring or potentially occurring within the proximity of the study area (Appendix D). The 55 conservation significant taxa occurring or potentially occurring in the study area included 20 Threatened (declared rare-extant) taxa, three Priority 1 taxa, eight Priority 2 taxa, seventeen Priority 3 taxa and six Priority 4 taxa.

The desktop review identified one Threatened, *Chamelaucium* sp. Gingin (D. Marchant 6), and six Priority taxa (*Acacia cummingiana* (P3); *Caustis* sp. Gigas (A.S. George 9318) (P2); *Hypolaena robusta* (P4); *Schoenus griffinianus* (P3); *Verticordia rutilastra* (P3); and *Verticordia serrata* var. *linearis* (P3)) as occurring within the study area (Figure 5). The likelihood of the remaining 19 Threatened and 29 Priority listed taxa is detailed in Appendix D and is based on the following criteria:

- **Likely:** suitable habitat present and records within or less than 2 km from the study area.
- **Possible:** suitable habitat present, with records within 2-10 km from the study area.
- **Unlikely:** lacks of suitable habitat present, and/or there are no records closer than 10 km from the study area.

Based on the assessment of likelihood of occurrence, ten conservation significant taxa are known to occur or expected to occur within the study area, and a further 15 conservation significant taxa may potentially occur within the study area based on known locations and habitat preferences. The remaining 30 conservation significant taxa are not expected to occur within the study area based on habitat preferences and the current known locations (Appendix D).

Of the ten conservation significant taxa known to occur or expected to occur within the study area, only *Chamelaucium* sp. Gingin (N.G. Marchant 6) is listed as Threatened taxa under the WC Act and the EPBC Act. The remaining nine conservation significant taxa are listed as Priority taxa by DPAW.

Seven ecological communities listed as conservation significant, including four Threatened Ecological Communities and three Priority Ecological Communities are known to occur. Of the four TECs, three are listed as TECs under the EPBC Act. The list of TECs and PECs known to occur or potentially occur in the study area are presented in Table 9. The TEC SCP20c and the PECs SCP23b and Banksia yellow-orange sands, occur within the study area (see Figure 5), while the buffer for the Wooded waterbird wetlands PEC occurs across the southwest corner of the study area. The remainder of the TECs occur between 7 and 10 km of the study area.

Table 9 Threatened and Priority Ecological Communities occurring within close proximity to the study area

Community name	Community description	Federal listing ¹	State listing ¹
NTHIRON	Perth to Gingin Ironstone Association.	Endangered	Critically Endangered
Mound Springs SCP	Communities of Tumulus Springs (Organic Mound Springs, Swan Coastal Plain).	Endangered	Critically Endangered
Muchea Limestone	Shrublands and woodlands on Muchea Limestone.	Endangered	Endangered
SCP20c	<i>Banksia attenuata</i> woodland over species rich dense shrublands.		Endangered
Banksia yellow-orange sands	<i>Banksia</i> woodland of the Gingin area restricted to soils dominated by yellow to orange sands.		Priority 2
Wooded waterbird wetlands	Wooded wetlands which support colonial waterbird nesting areas.		Priority 2
SCP23b	Swan Coastal Plain <i>Banksia attenuata</i> – <i>Banksia menziesii</i> woodlands.		Priority 3

1. See Appendix E for the definitions of Federal and State listing categories.

5.1.2 Vegetation Condition

The condition of the vegetation recorded within the study area ranged from Good to Pristine (Figure 6) according to the vegetation condition rating scale in Table 6. The majority (84%) of the vegetation was in excellent condition due to the intact vegetation structure, minimal anthropogenic disturbances and minimal signs of disturbance as a result of pathogens, diseases and overgrazing from native and non-native fauna.

The sections of vegetation in good condition were generally located in areas of higher visitation from humans and non-native fauna. These areas were located in the southwest corner, the eastern and northern boundaries of the study area and along the unmade Reserve Road that goes through the centre of the study area. Old car bodies and higher concentrations of introduced taxa were located along the eastern boundary, associated with a gate in the fence that allowed stock to graze within the study area and uncontrolled movement from the paddocks.

In addition to the areas of the study area that were considered to have a lower condition rating, there were several areas that were considered to have a higher condition rating. The areas of vegetation considered to be pristine were generally located within the middle of the study area where introduced taxa and human visitation is low to non-existent.

5.1.3 Dieback

The majority of the study area (87.6 ha) is categorised as Low risk vegetation, with 12.2 ha rated as moderate and 19.4 ha assessed as high risk. Most of the study area is uninfested and presents a low risk of spreading the disease into other areas (Terratree, 2014; Appendix C).

5.1.4 Vegetation Units

The vegetation units recorded from the study area can be broadly categorised into four broad floristic formations. The broad floristic formations have been mapped on Figure 7 and are described below:

- *Corymbia* woodland – The *Corymbia* woodland broad floristic formation occurred as a dominant and as a co-dominant with *Eucalyptus* species along the higher landforms of the study area and generally in association with lateritic soils. The dominant upper stratum species was *Corymbia calophylla*. The extent of *Corymbia* woodland covers 17% of the study area.
- *Eucalyptus* woodland – The *Eucalyptus* woodland broad floristic formation occurred across the study area and occurred as either the dominant upper stratum or as a co-dominant with *Corymbia calophylla*. The *Eucalyptus* woodland occurred on lateritic soils and deep sands higher in the landscape. The dominant species in the upper stratum was *Eucalyptus marginata*. The extent of *Eucalyptus* woodland covers 56% of the study area.
- *Banksia* woodland – The *Banksia* woodland occurred in small isolated patches and has been identified as a separate formation compared to the *Banksia* shrubland due to the height of woodland (over 10 m) and the lack of *Eucalyptus* or *Corymbia* species. The dominant *Banksia* species were *Banksia attenuata* and *Banksia menziesii*. The extent of *Banksia* woodland covers 10% of the study area.
- *Banksia* shrubland – The *Banksia* shrubland is distinct from the *Banksia* woodland due to the isolated or sparse presence of *Eucalyptus tottiana* in the upper stratum. The *Banksia* species (commonly *Banksia attenuata* and *Banksia menziesii*) were generally lower than 10 m in height. The *Banksia* shrubland broad floristic formation was the dominant formation across the study area. The extent of *Banksia* shrubland covers 17% of the study area.

A total of 16 vegetation units were identified from the study area (Table 10). The vegetation units have been described to a vegetation association level (Hierarchical Level V) and have been divided further from the four broad floristic formations. The vegetation association units have been mapped on Figure 8, while the floristic data collected from the 30 relevés sampled within the study area are provided in Appendix F.



5.1.5 Vegetation Significance



5.1.5.1 Boregional and Subregional Protection



The bioregions and subregions are the reporting unit for assessing the status of native ecosystems and their level of protection in the National Reserve System. In this way, IBRA is used as a dynamic tool for monitoring progress towards building a comprehensive, adequate and representative (CAR) reserve system (DOTE, 2014b). Such information assists governments to decide how to best prioritise funding to meet national protection targets.



The study area is located within the Swan Coastal Plain bioregion and the Perth subregion. According to the National Reserve System, the Swan Coastal Plain bioregion is not considered to be a bioregion with less than 10% protection. Both the Swan Coastal Plain bioregion and the Perth subregion have between 10-15% of their current area protected within International Union for Conservation of Nature (IUCN) Class I-IV Reserves (i.e. National Parks, Nature Reserves).



Table 10 **Vegetation units recorded**



Unit code	Quadrats	Broad floristic formation and site preference	Vegetation description	Area of study area	Photograph
EmCc ¹	COR01 & COR09	<i>Eucalyptus</i> woodland Lateritic slopes and rises	<i>Eucalyptus marginata</i> and occasional <i>Corymbia calophylla</i> mid sparse woodland over <i>Xanthorrhoea preissii</i> and <i>Allocasuarina humilis</i> mid open to mid sparse shrubland over <i>Hibbertia hypericoides</i> , <i>Conostephium pendulum</i> and occasional <i>Hakea stenocarpa</i> low open shrubland over <i>Lepidosperma pubisquamum</i> (flat form) and <i>Mesomelaena tetragona</i> and <i>Mesomelaena pseudostygia</i> low sparse sedgeland on lateritic coarse black, brown sandy loam on lateritic rises and slopes.	1.2% / 11.5 ha	
BaBmNf	COR03, COR11, COR18, COR26 & COR27	<i>Banksia</i> shrubland Consolidated dunes and plains	<i>Banksia attenuata</i> , <i>Banksia menziesii</i> and <i>Nuytsia floribunda</i> tall sparse to tall open shrubland over <i>Allocasuarina humilis</i> , <i>Xanthorrhoea preissii</i> and <i>Daviesia divaricata</i> subsp. <i>divaricata</i> mid sparse to mid open shrubland over <i>Eremaea pauciflora</i> var. <i>pauciflora</i> , <i>Melaleuca systema</i> and <i>Leucopogon conostephioides</i> low open shrubland over <i>Mesomelaena pseudostygia</i> and <i>Schoenus efoliatus</i> low sparse sedgeland on yellow, grey-brown coarse grained sand on consolidated dunes.	15.0% / 147.9 ha	



Unit code	Quadrats	Broad floristic formation and site preference	Vegetation description	Area of study area	Photograph
EmCc ²	COR05	<i>Eucalyptus</i> woodland Lateritic slopes	<i>Eucalyptus marginata</i> and <i>Corymbia calophylla</i> mid woodland over <i>Xanthorrhoea preissii</i> mid sparse shrubland over <i>Hibbertia hypericoides</i> low open shrubland over <i>Mesomelaena tetragona</i> low sparse sedgeland on a lateritic slope with brown coarse grained sandy loam with a laterite subsurface on lateritic slopes.	0.5% / 4.8 ha	
Em ¹	COR06	<i>Eucalyptus</i> woodland Consolidated plains	<i>Eucalyptus marginata</i> low sparse woodland over <i>Banksia attenuata</i> , <i>Banksia menziesii</i> and <i>Adenanthos cygnorum</i> subsp. <i>cygnorum</i> tall open shrubland over <i>Jacksonia floribunda</i> mid isolated shrubs over <i>Hibbertia hypericoides</i> and <i>Stirlingia latifolia</i> low open shrubland over <i>Hypolaena exsulca</i> , <i>Lyginia imberbis</i> and <i>Alexgeorgea nitens</i> low sparse rushland on a plain with grey brown coarse grained sand on consolidated plain.	3.6% / 35.9 ha	



Unit code	Quadrats	Broad floristic formation and site preference	Vegetation description	Area of study area	Photograph
EtNf	COR10 & COR24	<i>Eucalyptus</i> woodland Consolidated dunes	<i>Eucalyptus tottiana</i> and <i>Nuytsia floribunda</i> mid sparse to mid isolated mallee woodland over <i>Banksia attenuata</i> , <i>Banksia menziesii</i> and <i>Adenanthos cygnorum</i> subsp. <i>cygnorum</i> tall open to tall sparse shrubland over <i>Beaufortia elegans</i> , <i>Xanthorrhoea preissii</i> and <i>Jacksonia floribunda</i> mid sparse shrubland over <i>Calothamnus sanguineus</i> , <i>Scholtzia involucreta</i> , and <i>Eremaea pauciflora</i> var. <i>pauciflora</i> low open to low sparse shrubland over <i>Mesomelaena pseudostygia</i> low isolated sedges over <i>Lyginia imberbis</i> low isolated rushes on grey coarse-grained sand on consolidated dunes.	25.0% / 246.3 ha	
Cc ¹	COR12 & COR13	<i>Corymbia</i> woodland Lateritic slopes and rises	<i>Corymbia calophylla</i> with occasional <i>Eucalyptus marginata</i> and <i>Nuytsia floribunda</i> mid sparse woodland over emergent patches of <i>Banksia sessilis</i> var. <i>sessilis</i> tall sparse shrubland over <i>Xanthorrhoea preissii</i> mid open shrubland over <i>Hibbertia hypericoides</i> , <i>Acacia celastrifolia</i> and <i>Calothamnus sanguineus</i> low open to low sparse shrubland on black, brown coarse-grained loamy, sand on lateritic rises and slopes.	3.0% / 29.3 ha	

Unit code	Quadrats	Broad floristic formation and site preference	Vegetation description	Area of study area	Photograph
Ba	COR14	<i>Banksia</i> woodland Seasonally waterlogged depressions	<i>Banksia attenuata</i> mid sparse woodland over <i>Kunzea glabrescens</i> and <i>Banksia menziesii</i> tall shrubland over <i>Macrozamia riedlei</i> and <i>Xanthorrhoea preissii</i> mid sparse shrubland over various sparse herbs with brown grey white coarse grained sand in a seasonally inundated depression.	0.4% / 4.2 ha	
CcEm	COR15 & COR17	<i>Corymbia</i> woodland Consolidated dunes with lateritic subsurface	<i>Corymbia calophylla</i> and <i>Eucalyptus marginata</i> mid sparse woodland over <i>Banksia attenuata</i> and <i>Banksia menziesii</i> low sparse to isolated woodland over <i>Xanthorrhoea preissii</i> and <i>Daviesia divaricata</i> subsp. <i>divaricata</i> tall sparse shrubland over <i>Hakea trifurcata</i> and <i>Macrozamia riedlei</i> mid sparse shrubland over <i>Hibbertia hypericoides</i> , <i>Conostephium pendulum</i> and <i>Stirlingia latifolia</i> low open shrubland over <i>Mesomelaena pseudostygia</i> low sparse sedgeland on grey, brown coarse-grained sand on consolidated dunes with lateritic subsurface.	11.0% / 108.6 ha	

Unit code	Quadrats	Broad floristic formation and site preference	Vegetation description	Area of study area	Photograph
BaBm ¹	COR19	<i>Banksia</i> shrubland Consolidated dunes	<i>Banksia attenuata</i> and <i>Banksia menziesii</i> low sparse woodland over <i>Adenanthos cygnorum</i> subsp. <i>cygnorum</i> tall open shrubland over <i>Xanthorrhoea preissii</i> and <i>Beaufortia elegans</i> mid sparse shrubland over <i>Hibbertia hypericoides</i> , <i>Scholtzia involucrata</i> and <i>Calothamnus sanguineus</i> low sparse shrubland over <i>Mesomelaena pseudostygia</i> low sparse sedgeland with grey brown coarse grained sandy loam on consolidated dunes.	2.4% / 23.7 ha	
Cc ²	COR20	<i>Corymbia</i> woodland Consolidated dunes	<i>Corymbia calophylla</i> with occasional <i>Eucalyptus marginata</i> mid isolated trees over <i>Banksia attenuata</i> tall sparse shrubland over <i>Allocasuarina humilis</i> and <i>Xanthorrhoea preissii</i> mid sparse shrubland over <i>Eremaea pauciflora</i> var. <i>pauciflora</i> , <i>Calothamnus sanguineus</i> and <i>Stirlingia latifolia</i> low open shrubland over <i>Mesomelaena pseudostygia</i> low sparse sedgeland with yellow brown coarse grained sand on consolidated dunes.	1.3% / 12.5 ha	

Unit code	Quadrats	Broad floristic formation and site preference	Vegetation description	Area of study area	Photograph
Em ²	COR25	<i>Eucalyptus</i> woodland Consolidated dunes	<i>Eucalyptus marginata</i> mid woodland over <i>Banksia attenuata</i> and <i>Banksia menziesii</i> tall sparse shrubland over <i>Eremaea pauciflora</i> var. <i>pauciflora</i> , <i>Hibbertia hypericoides</i> and <i>Daviesia triflora</i> low open shrubland over <i>Mesomelaena pseudostygia</i> low isolated sedges over <i>Lyginia imberbis</i> low isolated rushes with grey white coarse grained sand on consolidated dunes.	7.1% / 70.1 ha	
Cc ³	COR28	<i>Corymbia</i> woodland Consolidated dunes	<i>Corymbia calophylla</i> mid isolated trees over <i>Eucalyptus todtiana</i> mid isolated mallee trees over <i>Banksia attenuata</i> , <i>Banksia menziesii</i> and <i>Daviesia divaricata</i> subsp. <i>divaricata</i> tall sparse shrubland over <i>Eremaea pauciflora</i> var. <i>pauciflora</i> , <i>Calothamnus sanguineus</i> and <i>Hibbertia hypericoides</i> low sparse heath shrubland over <i>Mesomelaena pseudostygia</i> low sparse sedgeland with yellow brown coarse grained sand on consolidated dunes.	2.0% / 19.2 ha	

Unit code	Quadrats	Broad floristic formation and site preference	Vegetation description	Area of study area	Photograph
BaBm ²	COR30	<i>Banksia</i> woodland Seasonally waterlogged swale	<i>Banksia attenuata</i> and <i>Banksia menziesii</i> low woodland over <i>Melaleuca preissiana</i> and <i>Adenanthos cygnorum</i> subsp. <i>cygnorum</i> tall sparse shrubland over <i>Calytrix angulata</i> and <i>Xanthorrhoea preissii</i> mid sparse shrubland over <i>Leucopogon conostephioides</i> and <i>Hibbertia subvaginata</i> low sparse shrubland with grey brown coarse grained sand in a swale.	1.0% / 9.7 ha	
Em ³	COR02, COR07 & COR21	<i>Eucalyptus</i> woodland Consolidated dunes	<i>Eucalyptus marginata</i> with occasional <i>Corymbia calophylla</i> mid sparse woodland over <i>Xanthorrhoea preissii</i> mid sparse shrubland over <i>Hibbertia hypericoides</i> , <i>Calothamnus sanguineus</i> and <i>Conostephium pendulum</i> low heath shrubland over <i>Mesomelaena pseudostygia</i> and <i>Lepidosperma pubisquameum</i> (flat form) low sparse sedgeland over <i>Lyginia imberbis</i> low isolated rushes on grey, yellow, white coarse-grained sand on consolidated dunes.	12.7% / 125.5 ha	

Unit code	Quadrats	Broad floristic formation and site preference	Vegetation description	Area of study area	Photograph
Em ⁴	COR04	<i>Eucalyptus</i> woodland Consolidated dunes	<i>Eucalyptus marginata</i> mid sparse woodland over <i>Banksia attenuata</i> , <i>Banksia grandis</i> and <i>Nuytsia floribunda</i> tall sparse shrubland over <i>Jacksonia floribunda</i> and <i>Adenanthos cygnorum</i> subsp. <i>cygnorum</i> mid open shrubland over <i>Eremaea pauciflora</i> var. <i>pauciflora</i> , <i>Hibbertia hypericoides</i> and <i>Melaleuca systema</i> low heath shrubland over <i>Mesomelaena pseudostygia</i> low sparse sedgeland with white brown coarse grained sand on consolidated dune rises.	5.1% / 50.6 ha	
Et	COR08, COR16, COR22, COR23 & COR29	<i>Eucalyptus</i> woodland Consolidated dunes	<i>Eucalyptus tottiana</i> mid sparse to mid isolated mallee woodland with occasional <i>Nuytsia floribunda</i> low isolated trees over <i>Banksia attenuata</i> , <i>Banksia menziesii</i> and <i>Adenanthos cygnorum</i> subsp. <i>cygnorum</i> tall sparse shrubland over <i>Allocasuarina humilis</i> , <i>Xanthorrhoea preissii</i> and <i>Jacksonia floribunda</i> mid open shrubland over <i>Eremaea pauciflora</i> var. <i>pauciflora</i> , <i>Hibbertia hypericoides</i> and <i>Calothamnus sanguineus</i> low open to low sparse shrubland over <i>Mesomelaena pseudostygia</i> low sparse sedgeland on yellow, brown coarse-grained sand on consolidated dunes.	8.7% / 86.3 ha	

5.1.5.2 Floristic Community Types

The floristic information collected from the 30 relevés was compared against the floristic data from 'A Floristic Survey of the southern Swan Coastal Plain' (Gibson *et al.*, 1994) to determine the nearest match to the Floristic Community Types (FCTs) known to occur on the Swan Coastal Plain.

The results of the presence/absence comparison between the 30 relevés and the floristic data collected by Gibson *et al.* (1994) are presented in Table 11.

Table 11 Inferred floristic community types

Relevé	Nearest matches (FCT)	Landform	Inferred match	Description
COR01	28; 1a; 20a; 20b; & 21a	Ridge Hill/ Pinjarra	20b	Eastern <i>Banksia attenuata</i> and/or <i>Eucalyptus marginate</i> .
COR02	28; 20a; 21a; 21b; & 23a	Spearwood	28	Spearwood <i>Banksia attenuata</i> or <i>Banksia attenuata-Eucalyptus marginata</i> woodlands.
COR03	28; 23b; 20a; 20b; & 21a	Spearwood/ Pinjarra	20a	<i>Banksia attenuata</i> woodlands over species rich dense shrublands.
COR04	28; 20a; 23a; 23b; & 21a	Bassendean	23b	Northern <i>Banksia attenuata-Banksia menziesii</i> woodlands.
COR05	28; 1a; 20b; 21a; & 3a	Ridge Hill/ Pinjarra	20b	Eastern <i>Banksia attenuata</i> and/or <i>Eucalyptus marginate</i> .
COR06	28; 21c; 23a; 23b; & 21a	Bassendean	23b	Northern <i>Banksia attenuata-Banksia menziesii</i> woodlands.
COR07	28; 21a; 1a; 21b; & 21c	Bassendean/ Spearwood	21a	Central <i>Banksia attenuata-Eucalyptus marginata</i> woodlands.
COR08	28; 20a; 21a; 23a ;& 23b	Spearwood/ Pinjarra	20a	<i>Banksia attenuata</i> woodlands over species rich dense shrublands.
COR09	28; 1a; 3b; 3b ;& 1b	Bassendean/ Spearwood	21a	Central <i>Banksia attenuata-Eucalyptus marginata</i> woodlands.
COR10	23a; 28; 23b; 21a; & 20a	Bassendean	23b	Northern <i>Banksia attenuata-Banksia menziesii</i> woodlands.
COR11	28; 23b; 20b; 20a; & 21a	Bassendean	23b	Northern <i>Banksia attenuata-Banksia menziesii</i> woodlands.
COR12	28; 1a; 21a; 3b; & 3b	Bassendean/ Spearwood	21a	Central <i>Banksia attenuata-Eucalyptus marginata</i> woodlands.
COR13	28; 1a; 21a; 1b; & 21b	Bassendean/ Spearwood	21a	Central <i>Banksia attenuata-Eucalyptus marginata</i> woodlands.
COR14	28; 21a; 24; 21c; & 23a	Bassendean	21c	Low lying <i>Banksia attenuata</i> woodlands or shrublands.
COR15	28; 21a; 23a; 24; & 26b	Bassendean/ Spearwood	21a	Central <i>Banksia attenuata-Eucalyptus marginata</i> woodlands.
COR16	28; 21a; 23a; 23b; & 20a	Bassendean/ Spearwood	21a	Central <i>Banksia attenuata-Eucalyptus marginata</i> woodlands.



Relevé	Nearest matches (FCT)	Landform	Inferred match	Description
COR17	28; 20b; 21a; 1a; & 21b	Ridge Hill/ Pinjarra	20b	Eastern <i>Banksia attenuata</i> and/or <i>Eucalyptus marginate</i> .
COR18	21a; 23b; 28; 23a; & 20a	Bassendean	23b	Northern <i>Banksia attenuata</i> - <i>Banksia menziesii</i> woodlands.
COR19	28; 23b; 23a; 20a; & 21c	Bassendean	23a	Central <i>Banksia attenuata</i> - <i>Banksia menziesii</i> woodlands.
COR20	28; 20a; 21b; 23a; & 20b	Spearwood/ Pinjarra	20a	<i>Banksia attenuata</i> woodlands over species rich dense shrublands.
COR21	28; 21a; 23a; 26b; & 26b	Bassendean	23b	Northern <i>Banksia attenuata</i> - <i>Banksia menziesii</i> woodlands.
COR22	28; 23b; 23a; 20a; & 21a	Bassendean	23a	Central <i>Banksia attenuata</i> - <i>Banksia menziesii</i> woodlands.
COR23	28; 20a; 23a; 23b; & 20b	Spearwood/ Pinjarra	20a	<i>Banksia attenuata</i> woodlands over species rich dense shrublands.
COR24	23b; 23a; 28; 21c; & 20a	Bassendean	23a	Central <i>Banksia attenuata</i> - <i>Banksia menziesii</i> woodlands.
COR25	28; 20a; 21a; 23a; & 23b	Spearwood/ Pinjarra	20a	<i>Banksia attenuata</i> woodlands over species rich dense shrublands.
COR26	28; 20a; 23b; 21a; & 23a	Bassendean	23b	Northern <i>Banksia attenuata</i> - <i>Banksia menziesii</i> woodlands.
COR27	28; 20a; 23b; 20b; & 21a	Bassendean	23b	Northern <i>Banksia attenuata</i> - <i>Banksia menziesii</i> woodlands.
COR28	28; 20a; 23b; 20b; & 21a	Bassendean	23b	Northern <i>Banksia attenuata</i> - <i>Banksia menziesii</i> woodlands.
COR29	28; 20a; 23b; 21a; & 23a	Bassendean	23b	Northern <i>Banksia attenuata</i> - <i>Banksia menziesii</i> woodlands.
COR30	21c; 23a; 23b; 28; & 20c	Bassendean	21c	Low lying <i>Banksia attenuata</i> woodlands or shrublands.

It must be noted that the determination of the FCTs from the floristic data collected from the 30 relevés is considered to be an inference. To accurately determine the FCTs, systematic sampling of quadrats located in representative vegetation associations and multivariate analysis against the floristic data collected by Gibson *et al.* (1994), is required.

According to the comparison (Table 11), the following FCTs potentially occur in the study area:

- FCT20a – *Banksia attenuata* woodlands over species rich dense shrublands.
- FCT20b – Eastern *Banksia attenuata* and/or *Eucalyptus marginate*.
- FCT21a – Central *Banksia attenuata*-*Eucalyptus marginata* woodlands.
- FCT21c – Low lying *Banksia attenuata* woodlands or shrublands.
- FCT23a – Central *Banksia attenuata*-*Banksia menziesii* woodlands.

- FCT23b – Northern *Banksia attenuata*-*Banksia menziesii* woodlands.
- FCT28 – Spearwood *Banksia attenuata* or *Banksia attenuata*-*Eucalyptus marginata* woodlands.

According to DPAW information on ecological communities on the Swan Coastal Plain, FCT20a (also known as SCP20a) and FCT20b (also known as SCP20b) are considered to be Threatened Ecological Communities. FCT21c and FCT23b, also known as SCP21c and SCP23b respectively, are considered to be Priority Ecological Communities.

The locations of the inferred TECs and PECs are provided in Figure 9 and discussed in more detail in Section 5.1.4.3.

5.1.5.3 Threatened and Priority Ecological Communities

The floristic information collected from the 30 relevés was compared against the floristic data collected from the Gibson *et al.* (1994) survey of the Southern Swan Coastal Plain and the descriptions available for the TECs and PECs from DPAW to infer the presence of any additional TECs and PECs.

The majority of the study area is considered to be representative of the P2 PEC *Banksia* Yellow-Orange Sands and the PEC SCP23b. Both PECs are known to occur extensively within and adjacent to the study area. The description for the PEC Yellow-Orange Sands is:


Species-rich *Banksia* woodlands on deep yellow-red sands that appears restricted to the western Dandaragan Plateau. The vegetation is described as scattered *Eucalyptus todtiana* and *Corymbia calophylla* over *Banksia menziesii* and *Banksia attenuata* low open woodland over *Jacksonia sternbergiana* and *Adenanthos cygnorum* high open shrubland over *Allocasuarina humilis* and *Chamaelucium* sp. Gingin (N.G. Marchant 6)(T) open shrubland over *Eremaea pauciflora* and *Astroloma xerophyllum* low shrubland over *Mesomelaena pseudostygia* open sedgeland.

Vegetation associations BaBm¹, BaBmNf, Et and EtNf are considered to be representative of the Priority 2 *Banksia* Yellow-Orange Sands. The four vegetation associations listed above consist of *Eucalyptus todtiana* over *Banksia* spp. with an understorey layer dominated by *Allocasuarina humilis* and *Eremaea pauciflora* var. *pauciflora* over a sedge layer consisting of *Mesomelaena pseudostygia* on coarse-grained deep yellow-brown sands. This is considered to be consistent with the description of the PEC.

In addition to the known locations of the TEC and the PECs, based on a comparison between the floristic data collected from the 30 relevés with Gibson *et al.* (1994), an additional two TECs (SCP20a, SCP20b) and one PEC (SCP21c) potentially occur within the study area. The comparison confirmed the presence of the PEC SCP23b, known to occur within the study area. The location of the TECs and the PECs are presented in Figure 9.

The descriptions as provided by DPAW, for the additional TECs and the PECs are detailed below:

- Threatened Ecological Communities:
 - SCP20a – *Banksia attenuata* woodland over species rich dense shrublands. The TEC SCP20a is classified as Endangered. SCP20a corresponded with relevés COR03, COR08, COR20, COR23 and COR25. These relevés correspond with vegetation associations BaBmNf, Et, Cc² and Em².
 - SCP20b – *Banksia attenuata* and/or *Eucalyptus marginata* woodlands of the eastern side of the Swan Coastal Plain. The TEC SCP20b is classified as Endangered. The TEC SCP20b corresponded with relevés COR01, COR05 and COR17, which corresponded with vegetation associations EmCc¹, EmCc² and CcEm.
 - SCP20c – Shrublands and woodlands of the eastern side of the Swan Coastal Plain. The TEC SCP20c is classified as Critically Endangered. According to DPAW data, the TEC SCP20c occurs



in the southeast of the study area. The exact location is difficult to determine based on the information provided by DPAW. The buffer associated with the TEC is 500 m which indicates that the TEC is located in association with vegetation association Em³ and relevé COR07. Relevé COR07 was inferred to represent FCT21a, which is not listed as a TEC or a PEC.

- Priority Ecological Communities:

- SCP21c – Low lying *Banksia attenuata* woodlands or shrublands. This P3 PEC occurs sporadically between Gingin and Bunbury, and is largely restricted to the Bassendean system. The PEC tends to occupy lower lying wetter sites and is variously dominated by *Melaleuca preissiana*, *Banksia attenuata*, *Banksia menziesii*, *Regelia ciliata*, *Eucalyptus marginata* or *Corymbia calophylla*. Structurally, this community type may be either a woodland or occasionally shrubland. The PEC SCP21c corresponded with relevés COR14 and COR30 and occurred in low lying areas with *Melaleuca preissiana* present. The vegetation associations that correspond with COR14 and COR30 are Ba and BaBm².
- SCP23b – Swan Coastal Plain *Banksia attenuata* - *Banksia menziesii* woodlands. These woodlands occur in the Bassendean system, from Melaleuca Park to Gingin. The P3 PEC occurs in reasonably extensive *Banksia* woodlands north of Perth. The PEC SCP23b is represented by relevés COR04, COR06, COR10, COR11, COR18, COR21, COR26, COR27, COR28 and COR29. These relevés corresponded with vegetation associations Em⁴, Em, EtNf, BaBmNf, Em³, Cc³ and Et.

There is significant overlap between the inferred TECs and PECs and the known TECs and PECs (according to DPAW data). To remove the overlap and accurately confirm the presence of TECs or PECs, a systematic quadrat sampling survey with multivariate analysis needs to be completed across the study area.

In the case of an overlap between the PEC *Banksia* Yellow-Orange Sands and the inferred TECs and PECs, the PEC *Banksia* Yellow-Orange Sands has been mapped. This is based on the accurate vegetation description provided by DPAW compared to the data available on the remaining TECs and PECs and the reliance on multivariate analysis.

DPAW also identify *Banksia* dominated woodlands on the Swan Coastal Plain bioregion as a Priority 3 ecological community. The main feature of these *Banksia* woodlands is the presence of *Banksia attenuata* and/or *Banksia menziesii* occurring on deep sands, with the species commonly co-occurring. The community occurs on the Quindalup, Spearwood and Bassendean dunes and rarely on the Pinjarra Plain landforms, which comprise the dominant landforms of the Swan Coastal Plain.

5.1.5.4 Vegetation Complexes

The study area is located across five vegetation complexes; the Mogumber complex-south, Reagan complex, Karamal complex-south, Coonambidgee complex and Moondah complex. The pre-European extent, extent remaining in 2013 and the pre-European extent remaining in formal protection is provided in Table 12. Formal protection includes native vegetation remaining in conservation estate, Bush Forever sites in conservation estate and Bush Forever sites in Regional Parks.

The National Objectives and Targets for Biodiversity Conservation 2001-2005 recognises that a retention of 30% or more of the pre-clearing extent of each ecological community is necessary if Australia's biological diversity is to be protected (ANZECC, 2000). In addition to the Australian and New Zealand Environment and Conservation Council (ANZECC) 30% retention target, the EPA has adopted a 10% level of pre-clearing extent as representing 'endangered' (EPA, 2000).

The pre-European extent remaining on the Swan Coastal Plain for each vegetation complex is greater than 30%; however, only the Coonambidgee (10%) and the Karamal Complex-South (27%) have greater than 10% of the pre-European extent remaining in formal protection.

Table 12 Native vegetation extent by vegetation complexes on the Swan Coastal Plain

Vegetation Complex	Pre-European extent (ha)	2013 extent (ha)	Pre-European extent remaining (%)	Formal protection ¹ (ha)	Pre-European extent with formal protection (%)	Extent within the study area	Inclusion of the study area (%)
Coonambidgee	6,272.3	2,859.5	45.6	647.7	10.3	8.7	10.5
Karamal (south)	24,016.7	15,225.9	63.4	6,513.5	27.1	181.3	27.9
Mogumber (south)	13,985.5	5,621.9	40.2	175.3	1.3	424.9	4.3
Moondah	17,858.8	7,279.8	40.8	1,742.8	9.8	105.2	10.4
Reagan	9,080.5	3,052.4	33.6	341.4	3.8	266.3	6.7

Source: Perth Biodiversity Program (WALGA 2013).

1: Formal protection includes DPAW conservation estates, Bush Forever on conservation estate and Bush Forever in Regional Parks.

The vesting of the study area as conservation estate will increase the formal protection of each of the vegetation complexes. However, the increase is not sufficient to increase the pre-European extents above the 30% threshold.

The inclusion of the study area into the conservation estate will not increase the pre-European extent within formal protection above the endangered 10% level for any of the vegetation complexes within the study area. However, the pre-European extent of the Moondah vegetation complex within formal protection will be increased above the 10% endangered level (an increase of 0.6% to 10.4%).

5.1.6 Ecological Corridors

The study area is located within the Perth subregion which has historically been cleared for urban development, industrial development and agriculture. As a result only 42% (or 473,176 ha) of the pre-European extent for the Perth subregion (1,117,757 ha) remains intact (DPAW, 2013a).

The study area is located within an ecological corridor linking Boonanarring Nature Reserve and Leda Nature Reserve. The corridor runs in a north to south alignment and is fragmented in sections and crosses the Great Northern Highway.

The study area is not located within an east-west ecological corridor. The east-west movement of flora and fauna is impeded by the historical clearing of native vegetation along both sides of the Brand Highway.

5.1.7 Taxa Recorded

A total of 154 vascular taxa were recorded from the study area during the site visit. This included 148 native taxa and six introduced taxa from 36 families and 88 genera. Two taxa were not identified to genus level, one was from the Orchidaceae family. The taxon was not identified to genus level because only the basal leaf was present. The remaining taxon that was not identified to genera level had inadequate material to make an accurate identification to genera.



An additional seven taxa, *Austrodanthonia* sp., *Haemodorum* sp., *Anigozanthos* sp., *Pimelea* sp. 1, *Pimelea* sp. 2, *Stylidium* sp. and **Lupinus* sp., were only identified to genus level. The taxa within the field were not flowering and/or fruiting at the time of the survey which is required to ensure a positive identification.

The dominant families recorded from the study area are listed in Table 13, while the dominant genera recorded from the study area is listed in Table 14. The entire list of vascular taxa recorded from the study area is provided in Appendix G.

Table 13 Dominant families recorded from the study area

Family name	Common name	Native taxa	Introduced taxa
Proteaceae	Banksia family	28	0
Fabaceae	Legume or Pea family	24	1
Myrtaceae	Myrtle family	19	0
Ericaceae	Heath family	12	0
Cyperaceae	Sedge family	8	0

Of the 36 families recorded from the study area, 18 families were only represented by one genera, while the vast majority of the taxa were members of four families, the Proteaceae, Fabaceae, Myrtaceae and Ericaceae, which constituted approximately 55% of the total number of taxa recorded.

Table 14 Dominant genera recorded from the study area

Genera	Common name	Native taxa	Introduced taxa
Acacia	Wattle	10	0
Banksia	Banksias	7	0
Hakea	Hakeas	7	0
Daviesia	Daviesias	6	0

Of the 88 genera recorded from the study area, 58 genera were only represented by one taxon. The dominant nine genera (*Acacia*, *Banksia*, *Hakea*, *Daviesia*, *Calytrix*, *Hibbertia*, *Lepidosperma*, *Lomandra* and *Petrophile*) represented approximately 33% of the total number of taxa recorded.

5.1.8 Taxa of Significance

One Threatened and six Priority listed taxa are known to occur in the study area. The known locations were traversed to locate the conservation significant taxa and to further refine the population size. The Threatened taxa, *Chamelaucium* sp. Gingin (N.G. Marchant 6), was located in the northwest of the study area. *Chamelaucium* sp. Gingin (N.G. Marchant 6) (Plates 1 to 3) is a Threatened taxon under the WC Act with a classification of Vulnerable and it is listed as Endangered under the Commonwealth EPBC Act (see Figure 9).

Chamelaucium sp. Gingin (N.G. Marchant 6) is endemic to Western Australia and is apparently confined to the Gingin/Chittering area where it is known from a range of only 3 km and six populations (Stack and English, 2003). The six known populations contain a total of approximately 4700 adult plants and 1800 juveniles. This species occurs on white/yellow sand supporting open low woodland with *Eucalyptus todtiana*, *Banksia attenuata* and *Hibbertia* species.



Plate 1 *Chamelaucium* sp. Gingin (N.G. Marchant 6) growing along fence line between offset site and nature reserve



Plate 2 *Chamelaucium* sp. Gingin (N.G. Marchant 6), close-up of buds before flowering



Plate 3 *Chamelaucium* sp. Gingin (N.G. Marchant 6), close-up of flowers



Plate 4 *Hypolaena robusta* (Priority 4)*



Plate 5 Arum Lily (**Zantedeschia aethiopica*)

* Photography by A.D. Crawford. Image used with the permission of the Western Australian Herbarium, Department of Parks and Wildlife (<http://florabase.dpaw.wa.gov.au/help/copyright>). Accessed on Tuesday, 26 August 2014.



Chamelaucium sp. Gingin (N.G. Marchant 6) is an open straggly shrub growing to a height of 1 to 2 m tall and has many slender stiff branches that bear numerous long axillary shoots. Its erect, glandular, bright green leaves are 5.4-11.5 mm long by 1.2-1.4 mm wide, and are scattered along the main branches, but are mostly crowded on numerous short axillary shoots. The inflorescence is composed of a small head on short axillary shoots or sometimes a larger flower head at the end of main branches. The flowers occur in groups of two to nine in small heads on axillary shoots. Up to 20 flowers are held in clusters at the end of main branches. The flowers are pale pinkish-white, and the buds are tinged a deeper pink (adapted from Stack and English, 2003).

Critical habitat is defined as habitat that is identified as being critical to the survival of the threatened taxon. The critical habitat for *Chamelaucium* sp. Gingin (N.G. Marchant 6) comprises:

- The area of occupancy of known populations.
- Areas of similar habitat within 200 m of known populations, i.e. white/yellow sand supporting open low woodland over open scrub (these provide potential habitat for natural range extensions).
- Corridors of remnant vegetation that link populations (these are necessary to allow pollinators to move between populations and are usually road and rail verges).
- Additional occurrences of similar habitat that do not currently contain the species but may have done so in the past (these represent possible translocation sites).

The study area represents critical habitat for *Chamelaucium* sp. Gingin (N.G. Marchant 6) for the existing population and areas of similar habitat within 200 m and providing a vegetated corridor linking populations.

Of the six Priority listed taxa recorded from the study area, only one was re-recorded, *Hypolaena robusta* (P4). The remaining five Priority listed taxa were not identified during the July 2014 site visit. No other Priority listed taxa were recorded from the study area.

Hypolaena robusta is listed a Priority 4 taxon and is a member of the Restionaceae or rush family. *Hypolaena robusta* (see Plate 4) is described as a tall stout, dioecious rhizomatous, perennial rush with well-spaced culms on thick rhizomes (Meney and Pate, 1999; DPAW, 2014c). It is known to occur on white sand on the sandplains of the northern Swan Coastal Plain and the Northern Sandplain (DPAW, 2014c). It flowers in early to mid-spring (September and October) (DPAW, 2014c; Meney and Pate, 1999).

The locations of *Chamelaucium* sp. Gingin (N.G. Marchant 6) (T) and *Hypolaena robusta* (P4) recorded from the study area are provided in Table 15. The locations of Threatened and Priority listed flora within the study area is provided in Figure 9.

Table 15 Threatened and Priority listed taxa recorded from the study area

Taxa	Phenology and life form	Individuals	Zone 50J, GDA 94	
			Easting	Northing
<i>Chamelaucium</i> sp. Gingin (N.G. Marchant 6) (T)	Adults and seedlings. Buds present on adults.	50+	402225	6517206
<i>Chamelaucium</i> sp. Gingin (N.G. Marchant 6) (T)			402229	6517194
<i>Chamelaucium</i> sp. Gingin (N.G. Marchant 6) (T)			402235	6517193
<i>Chamelaucium</i> sp. Gingin (N.G. Marchant 6) (T)			402222	6517190
<i>Chamelaucium</i> sp. Gingin (N.G. Marchant 6) (T)			402226	6517212
<i>Chamelaucium</i> sp. Gingin (N.G. Marchant 6) (T)	Adults with buds.	10+	402227	6517251



Taxa	Phenology and life form	Individuals	Zone 50J, GDA 94	
			Easting	Northing
<i>Chamelaucium</i> sp. Gingin (N.G. Marchant 6) (T)	Adults with buds.	20+	402232	6517409
<i>Chamelaucium</i> sp. Gingin (N.G. Marchant 6) (T)	Adults with buds.	30+	402298	6517414
<i>Chamelaucium</i> sp. Gingin (N.G. Marchant 6) (T)	Adults and seedlings. Adults with buds.	70+	402324	6517417
<i>Chamelaucium</i> sp. Gingin (N.G. Marchant 6) (T)	Adults.	3	402365	6516987
<i>Chamelaucium</i> sp. Gingin (N.G. Marchant 6) (T)	Adults.	1	402383	6516980
<i>Chamelaucium</i> sp. Gingin (N.G. Marchant 6) (T)	Adults and seedlings. Adults with buds.	10+	402460	6517417
<i>Hypolaena robusta</i> (P4)	Last season's flowers and buds.	Unknown	403976	6514919
<i>Hypolaena robusta</i> (P4)	Last season's flowers and buds.	Unknown	403985	6516766

5.1.9 Introduced Taxa

A total of six introduced taxa were recorded from the study area during the site visit. The six introduced taxa were reviewed to determine if they are WONS, a Declared Pest under the BAM Act or an Environmental Weed with a 'High' rating (Table 16).

Table 16 Introduced taxa recorded from the study area

Species	Common name	Family	WONS (EPBC Act)	Declared pest (BAM Act)	Environmental weed rating (CALM, 1999)	Species-led ranking (DPAW, 2013b)
<i>*Zantedeschia aethiopica</i>	Arum Lily	Araceae	No	Declared Pest (s22)	High	Medium
<i>*Lupinus</i> sp.	Lupin	Fabaceae	No	Permitted (s11)	High	High ¹
<i>*Brassica tournefortii</i>	Wild Turnip	Brassicaceae	No	Permitted (s11)	High	Low
<i>*Briza maxima</i>	Quaking Grass	Poaceae	No	Permitted (s11)	Moderate	Low
<i>*Hypochaeris glabra</i>	Smooth Catsear	Asteraceae	No	Permitted (s11)	Moderate	Low
<i>*Gladiolus caryophyllaceus</i>	Wild Gladiolus	Iridaceae	No	Permitted (s11)	Moderate	Medium

1: The highest ranked Lupin (**Lupinus angustifolia* and **Lupinus cosentinii*) has been chosen to ensure the introduced taxa is appropriately managed at the upper limit.

5.1.9.1 WONS and Declared Pests

None of the six introduced taxa are WONS. Arum Lily (**Zantedeschia aethiopica*) is considered to be a Declared Pest under Section 22 of the BAM Act (see Figure 6). The remaining five introduced taxa are classified as Permitted under Section 11 of the BAM Act.

The BAM Act and regulations were enacted on 1 May 2013. The BAM Act replaces the *Agriculture and Related Resources Protection Act 1976*. The main purposes of the BAM Act that relate to weeds are to:

- Prevent new animal and plant pests (vermin and weeds) and diseases from entering Western Australia.
- Manage the impact and spread of those pests already in Western Australia.

Organisms are grouped into four main classifications:

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

Under the BAM Act, all Declared Pests are placed in one of three categories, namely C1 (exclusion), C2 (eradication) or C3 (management). Arum Lily has been placed in the C3 (management) category and it is prohibited to keep in WA. Arum Lily was recorded from one location in the southwest corner of the study area (Table 17; see Plate 5).

Table 17 GPS coordinate (Zone 50J, GDA94) for the known Arum Lily location

	Easting	Northing
Arum Lily (<i>*Zantedeschia aethiopica</i>)	402409	6514543

5.1.9.2 Environmental Weeds and Weed Prioritisation Process

The Environmental Weed Strategy for Western Australia (EWSWA) (CALM, 1999) has detailed criteria for the assessment and rating of introduced flora based on their impact on biodiversity. The criteria included:

- Invasiveness – ability to invade bushlands in good to excellent condition or ability to invade waterways (score of yes or no).
- Distribution – wide current or potential distribution including consideration of known history of widespread distribution elsewhere in the world (score as a yes or no).
- Environmental impacts – ability to change the structure, composition and function of ecosystems in particular an ability to form a monoculture in a vegetation community (score as a yes or no).

The EWSWA uses the following scoring system:

- High – an introduced flora species that scores yes to all three criteria. An introduced flora species with a high rating would indicate prioritising this weed for control and/or research.
- Moderate – an introduced flora species that scores yes to two of the three criteria. Rating an introduced flora species as moderate would indicate that control or research effort should be directed if funds are available, however it should be monitored.

- Mild – an introduced flora species that scores yes to one of the three criteria. A mild rating would indicate that monitoring and control of the introduced flora species is necessary where appropriate.
- Low – an introduced flora species that scores no to all three criteria. A low rating would mean that this species would require a low level of monitoring.

The EWSWA (CALM, 1999) provided a ranking of weed species on a state-wide basis against three criteria – invasiveness, distribution and environmental impacts (as detailed above). A total of 1350 weeds were rated through this process as high, moderate, mild or low, with 34 weed species being rated as high.

The State-wide ratings from the Strategy are now considered to be too broad to be of use from an on-ground operational perspective and are now out of date (DPAW, 2013b). In an effort to address these issues and implement an integrated approach to weed management on DPAW-managed lands in WA, the Weed Prioritisation Process for DPAW was developed in 2008.

DPAW proposed that the Weed Prioritisation Process was to prioritise in each DPAW Region, with the aim being to establish both a species-led and an asset-protection-based approach to weed management (DPAW, 2013b). The species-led process assessed weed species for their invasiveness, ecological impacts, potential and current distribution and feasibility of control. The resulting priorities focus on infestations of species which are considered to be high impact, rapidly invasive and still at a population size which is feasible to eradicate or contain to a manageable size. Hence, weed species which are already widespread did not rank as a high priority through this part of the process.

The rating for each of the six introduced taxa with regards to the EWSWA and the Species-led process is detailed in Table 16.

5.2 Fauna

5.2.1 Fauna Habitats

A total of three fauna habitats were recorded in the study area: Banksia Woodland, Eucalypt Woodland and a Dampland (Figure 10). Tracks comprised 9 ha. Habitat assessments were completed at 26 sites across the study area (Appendix H). Habitats are summarised in Table 18 and detailed in the following sections.

Table 18 Fauna habitat types

Habitat type	Area (ha)	Habitat value	Black Cockatoo value
Banksia Woodland	663	Moderate	Moderate
Eucalypt Woodland	315	High	High
Dampland	3	Moderate	Low

5.2.1.1 Banksia Woodland

The vegetation of this habitat type is typified by *Banksia attenuata*, *Banksia menziesii*, *Eucalyptus tottiana* and *Nuytsia floribunda* woodland over *Allocasuarina humilis*, *Xanthorrhoea preissii* and *Macrozamia riedlei* over various herb and sedge species. The Banksia Woodland habitat is generally located on the geographically flat section of the study area. This habitat type has occasional and sporadic mature Jarrah trees growing with in it and they are usually associated with the buffer zone between the Banksia woodland and Eucalypt Woodland habitats. The sandy soils of this habitat provide ideal substrate for burrowing species such as dragons and goannas. Microhabitats provided by this habitat include leaf litter, exfoliating bark and Banksia flowers which provide a feeding resource to nectivores. Due to the dominance of the Banksia species this habitat type does not contain many tree hollows or hollows logs. The Banksia



Woodland habitat is classified as being in excellent condition with little weed impact, old fire age and some dieback effected areas and it provides moderate habitat value.

5.2.1.2 Eucalypt Woodland

The vegetation of this habitat type is typified by *Eucalyptus marginata*, *Eucalyptus todtiana* and *Corymbia calophylla* over *Banksia attenuata* and *Banksia menziesii* over herbs and sedges. The Eucalypt Woodland habitat is generally dominated by jarrah over most of the study area with Marri becoming increasingly more common along the western border of the site. The sandy soils of this habitat provide ideal substrate for burrowing species such as dragons and goannas. Microhabitats provided by this habitat include sandy soils, leaf litter, exfoliating bark, hollow logs and tree hollows. The dense canopy foliage and presence of tree hollows provides suitable habitat for a range of birds, specifically for the species that nest in tree hollows such as parrots. The abundant leaf litter and fallen logs produce refuge for ground dwelling fauna. The Eucalypt Woodland habitat is classified as being in excellent condition with little weed impact, old fire age and some dieback effected areas and it provides high habitat value.

5.2.1.3 Dampland

The vegetation of this habitat type is typified by *Banksia attenuata* woodland over *Kunzea glabrescens* and *Banksia menziesii* shrubland over *Macrozamia riedlei* and *Xanthorrhoea preissii* over various sparse herbs in a seasonally inundated depression. The Dampland habitat is located in the low lying part, in the southwest of the study area. The Dampland is a small remnant (3 ha) after the rest of the habitat was cleared and used as pastures in the surrounding properties. This habitat type as its name suggests is an area where moisture collects and during the winter months becomes seasonally waterlogged. The damp nature of this habitat provides an ideal environment for amphibians. Microhabitats provided by this habitat include damp soil, leaf litter, exfoliating bark and dense mid-story vegetation which provide habitat for many bird species. The Dampland habitat is classified as being in excellent condition with little weed impact, old fire age and it provides moderate habitat value.

5.2.2 Black Cockatoo Habitat Assessment

The habitat types of the study area were assessed upon the habitat they provide to Black Cockatoos and classified as being high, moderate or low value habitats. The Eucalypt Woodland provides quality foraging, roosting and breeding habitat and is classified as being high value Black Cockatoo habitat. The Banksia Woodland provides quality foraging habitat and is classified as being moderate value Black Cockatoo habitat, due to the lack of breeding habitat. The Dampland provides limited foraging habitat and is classified as being low value Black Cockatoo habitat (Table 18 and Figure 11). A description of the foraging, roosting and breeding habitat is provided in the following sections.

5.2.2.1 Foraging Assessment

The study area contains 17 plant species that are known foraging resources for Black Cockatoos (Valentine and Stock, 2008, and Chapman, 2007) (Table 19). All habitat types contained multiple foraging resources, as such the entire study area can be classified as foraging habitat for Black Cockatoos which equates to approximately 981 ha of foraging habitat. No signs of current and historical foraging evidence were located.

Table 19 Foraging Resources of the study area

Foraging species	Foraging resource
<i>Banksia attenuata</i>	flowers, seeds
<i>Banksia dallanneyi</i>	flowers, seeds
<i>Banksia grandis</i>	flowers, seeds



Foraging species	Foraging resource
<i>Banksia menziesii</i>	flowers, seeds
<i>Banksia sessilis</i>	flowers, seeds
<i>Corymbia calophylla</i>	flowers, seeds, nectar
<i>Eucalyptus marginata</i>	seeds
<i>Eucalyptus todtiana</i>	seeds
<i>Hakea costata</i>	seeds
<i>Hakea lissocarpha</i>	seeds
<i>Hakea prostrata</i>	seeds
<i>Hakea ruscifolia</i>	seeds
<i>Hakea stenocarpa</i>	seeds
<i>Hakea trifurcata</i>	seeds
* <i>Lupinus</i> sp.	seeds
<i>Mesomelaena tetragona</i>	seeds
<i>Mesomelaena pseudostygia</i>	seeds
<i>Xanthorrhoea preissii</i>	seeds

5.2.2.2 Roosting Assessment

The Eucalypt Woodland habitat contains stands of tall trees that are located close to riparian environments and permanent water sources, which according to the Cockatoo referral guidelines constitutes roosting habitat for Black Cockatoos (DSEWPAC, 2012). Trees or stands of trees that match this description were examined for evidence of recent use as a roost site (feathers and droppings), however none was located.

A database search was completed for known roost locations for Carnaby’s Cockatoos with none located in the study area or its immediate surrounds. The closest known roost sites occur in Gingin and Yanchep which are approximately 17 km north and west of the study area respectively (Burnham et al., 2010).

5.2.2.3 Breeding Assessment

As the study area was too large to accurately measure individual trees, a tree dentistry survey was used to give an estimate of the number of potential breeding trees (Appendix I). The study area contains an estimated 6,353 trees that have a DBH over 500 mm. This number is most likely an underestimate as the Banksia Woodland contained some suitable sized trees, however these were omitted from the total tree estimate as their sporadic nature would make the tree density estimates inaccurate. The Cockatoo referral guidelines states “in a woodland stand with trees of suitable diameter at breast height, all trees of all ages and size are potentially important for maintaining breeding in the long term,” as such the Eucalypt Woodland is classified as breeding habitat (approximately 315 ha). The tree density survey identified areas of high, moderate and low tree densities within the Eucalypt Woodland. Areas containing a tree density of between 0-9 trees per hectare were classified as low density, areas with densities of 10-19 trees per hectare were classified as moderate density and areas containing 20 or more trees per hectare were classified as being high density (Table 20 and Figure 11).



Table 20 Breeding tree density

Tree density	Area (ha)
Eucalypt Woodland – High Density	193
Eucalypt Woodland – Moderate Density	112
Eucalypt Woodland – Low Density	10

A total of 30 trees with hollows classified as suitable for current breeding (with an opening greater than 20 cm diameter) were opportunistically identified across the site (Appendix I). However, there was no evidence of their use as historic breeding sites (chew marks around hollow openings and droppings). As stated these records were opportunistically recorded while walking around the study area and do not represent the full breeding capability of the site.

The availability of foraging habitat within 6 to 12 km of breeding sites is important in providing the resources necessary for raising chicks (DSEWPAC, 2012). The study area and the surrounding nature reserves (Boonanarring Nature Reserve and Leda Nature Reserve) contain large amounts of quality foraging habitat supporting any potential breeding sites in the vicinity.

5.2.3 Faunal Assemblage

From the desktop assessment a total of 221 species have been previously recorded in the vicinity of the study area (Appendix J). These include 12 amphibians, 47 reptiles, 134 birds and 28 mammals. As stated earlier all marine and aquatic species have been omitted from this list as no suitable habitat is present. Of these 39 species were recorded during the survey including one species of amphibian, three species of reptile, 32 species of bird and three species of mammal. The Black-eared Cuckoo (*Chrysococcyx osculans*) was recorded during the survey but has not been previously recorded from the vicinity. This record is just outside of the southerly distribution of this otherwise common species.

5.2.3.1 Amphibians

From the desktop review a total of 12 species of amphibian were identified as being previously recorded in the vicinity of the study area. One species, the Quacking Frog (*Crinia georgiana*) was recorded in the Eucalypt Woodland habitat type during the survey (Appendix J).

5.2.3.2 Reptiles

From the desktop review a total of 47 species of Reptile were identified as being previously recorded in the vicinity of the study area. Three species, the Buchanan’s Snake-eyed Skink (*Cryptoblahperus buchananii*), West Coast *Ctenotus* (*Ctenotus fallens*) and the Southern Shovel-nosed Snake (*Brachyuropus semifasciatus*) were recorded in the Eucalypt Woodland habitat type during the survey (Appendix J).

5.2.3.3 Birds

From the desktop review a total of 134 species of birds were identified as being previously recorded in the vicinity of the study area. A total of 32 species were recorded during the survey. The most speciose families recorded during the survey were Psittacidae (Parrots) with four species, Meliphagidae (Honeyeaters) with four species and Cuculidae (Cuckoos) with three species (Appendix J).

5.2.3.4 Mammals

From the desktop review a total of 28 species of mammals were identified as being previously recorded in the vicinity of the study area. A total of three species of mammal were recorded during the survey, the Western Grey Kangaroo (*Macropus fuliginosus*), Western Brush Wallaby (*Macropus irma*) and the Red Fox (*Vulpes vulpes*) which is an introduced species (Appendix J).

5.2.4 Conservation Significant Fauna

The Western Brush Wallaby (*Macropus irma*) listed as Priority 4 was the only conservation significant fauna species recorded during the survey (Table 21 and Figure 10).

From the desktop assessment a total of 14 conservation significant species have been previously recorded in the study area. Of these one species was recorded, six species are classified as 'Likely' to occur, three species are classified as 'Possible' to occur and four species are classified as 'Unlikely' to occur (Table 22).

Table 21 Location of recorded conservation significant fauna

Species	Conservation status	Habitat type	Easting	Northing
Western Brush Wallaby (<i>Macropus irma</i>)	P4	Eucalypt Woodland	50J 404973	6515779

Table 22 Likelihood of occurrence for conservation significant fauna

Species	Conservation status	Habitat relevance	Likelihood ¹
Western Carpet Python (<i>Morelia spilota imbricata</i>)	S4	All habitat types within the study area provide habitat for this species. Especially the Eucalypt Woodland which contains Tree hollows and hollow logs used by this species to shelter in. The Western Carpet Python has been previously recorded 20 km southwest of the study area (GHD, 2013a).	Likely
Black-striped Snake (<i>Neelaps calonotos</i>)	P3	The Banksia and Eucalypt Woodland of the study area contain the leaf litter and loose soil preferred by this species. The Black-striped Snake has been previously recorded 8 km south of the study area in Muchea (DPAW, 2014b).	Likely
Peregrine Falcon (<i>Falco peregrinus</i>)	S4	The study area does not contain the cliff faces this species prefers to nest on. However, due to the vagrant nature of the Peregrine Falcon it may use the study area as part of a wider foraging territory. This species has been previously recorded in the vicinity of the study area (ATA, 2007, DPAW, 2014a and Birdata, 2014).	Possible
Bush Stone-curlew (<i>Burhinus grallarius</i>)	P4	Although suitable habitat exists in the study area for this species there have been limited recent records of this species on the Swan Coastal Plain and is thought to be locally extinct due to predation from feral species.	Unlikely
Brush Bronzewing (<i>Phaps elegans</i>)	P4	The Eucalypt Woodlands provides marginal habitat for this species, but lacks the dense shrubs and understory this species prefers. This species is thought to be locally extinct on the Swan Coastal Plain (Johnstone and Storr, 1998).	Unlikely
Forest Red-tailed Black Cockatoo (<i>Calyptorhynchus banksii naso</i>)	Vu, S1	The Eucalypt Woodland provides both foraging and breeding habitat for this species and the Banksia Woodland provides foraging habitat for this species. Based upon the distribution map in the referral guidelines the study area is at the northern extent of this species distribution. There have been no records of this species in the vicinity of the study area, the closest occurring approximately 40 km south of the study area (DPAW, 2014b).	Possible
Carnaby's Cockatoo (<i>Calyptorhynchus latirostris</i>)	En, S1	The Eucalypt Woodland provides both foraging and breeding habitat for this species and the Banksia Woodland provides foraging habitat for this species. There have been numerous records of this species occurring in the vicinity of the study area (Burbidge <i>et al</i> , 1996; ATA, 2007; GHD, 2013a; DPAW, 2014a, b).	Likely

Species	Conservation status	Habitat relevance	Likelihood ¹
Baudin's Cockatoo (<i>Calyptorhynchus baudinii</i>)	Vu, S1	The Eucalypt Woodland provides both foraging and breeding habitat for this species and the Banksia Woodland provides foraging habitat for this species. The study area is mapped as occurring outside of this species current distribution (DSEWPAC, 2012) and the most recent record of this species in the vicinity is from more than 30 years ago (DPAW, 2014a).	Unlikely
Barking Owl (<i>Ninox connivens</i>)	P2	This species prefers the thick vegetation present in the forests of the deep southwest of Western Australia, rather than the open woodlands located in the study area. The closest recent record of this species is from an isolated record approximately 50 km south of the study area.	Unlikely
Fork-tailed Swift (<i>Apus pacificus</i>)	Mi, S3	The Fork-tailed Swift is an almost exclusively aerial species, foraging and sleeping on the wing. This species is independent of terrestrial habitats. This species has been previously recorded in the vicinity of the study area (Birddata, 2014).	Possible
Rainbow Bee-eater (<i>Merops ornatus</i>)	Mi, S3	The Rainbow Bee-eater is one of the most widespread bird species in Australia (Barrett et al., 2003) occurring in a range of habitats. All habitat types of the study area provide suitable habitat for the Rainbow Bee-eater. This species has been previously recorded in the vicinity of the study area (Tingay, 1994, Burbidge, 1996, ATA, 2007, GHD, 2013a, DPAW, 2014a and DPAW, 2014b)	Likely
Western Quoll (<i>Dasyurus geoffroii</i>)	Vu, S1	The Western Quoll occurs in a wide range of habitats including woodlands, dry sclerophyll forests and riparian vegetation, where it creates dens in hollow logs, burrows, tree hollows and cavities. All habitats in the study area provide foraging habitat for this species with the Eucalypt Woodland providing potential den sites with the presence of tree hollows and hollow logs. There are scattered records of this species in the vicinity of the study area, the closest occurring in Bindoon (DPAW, 2014a).	Likely
Southern Brown Bandicoot (<i>Isodon obesulus fusciventer</i>)	P5	The Southern Brown Bandicoot occurs in areas containing dense ground cover such as forests, woodlands, scrub and heathlands. It is particularly prevalent in areas surrounding wetlands and damplands. The Dampland habitat provides ideal habitat for this species however the conical diggings typical of this species were not identified during the survey. This species has been previously recorded in Bindoon (DPAW, 2014a) and in the vicinity of the study area (Tingay, 1994, GHD, 2013a and DPAW, 2014b).	Likely

Species	Conservation status	Habitat relevance	Likelihood ¹
Western Brush Wallaby (<i>Macropus irma</i>)	P4	The Western Brush Wallaby occurs in open forests or woodlands, favouring open seasonally wet flats and thickets (van Dyck and Strahamn, 2008). The Eucalypt Woodland and Banksia Woodland provide ideal habitat for this species and one individual was recorded in the Eucalypt Woodland during the survey. This species has been previously recorded in the vicinity to the study area (Burbidge, 1996).	Recorded

1. Likelihood definitions:

Recorded – The species was recorded within the study area, historically or during the survey.

Likely – Suitable habitat is present and records of this species exist close to the study area.

Possible – Suitable habitat is present however no records exist in the vicinity, or records exist in the vicinity but suitable habitat is nearby but not in the study area.

Unlikely – Neither suitable habitat nor records exist near the study area.



6 DISCUSSION

6.1 Flora

A detailed Level 1 flora and vegetation assessment, in accordance with the EPA's Guidance Statement No. 51 (EPA, 2004a), was undertaken. The assessment involved a desktop review of available and relevant literature and a site reconnaissance involving the sampling of 30 relevés (simplified floristic sampling points) located throughout the study area.

The site reconnaissance survey involved the identification of vascular plant taxa recorded from the 30 relevés and from site traverses to identify additional vascular plant taxa not identified at each of the relevés. The survey also included an assessment of the presence/absence and population size of the Threatened and Priority listed taxa known to occur in the study area.

6.1.1 Vegetation


A total of four broad floristic formations and 16 vegetation associations were delineated from the study area during the July 2014 site visit. The vegetation associations recorded from the study area were considered to be in excellent condition with isolated patches of very good and good condition vegetation. The areas of vegetation in good and very good condition were located on the outer edges of the study area against the cleared paddocks and along areas of previously disturbed areas (i.e. the power line infrastructure corridor along the western boundary).

The four broad floristic formations included: *Eucalyptus* woodland, *Corymbia* woodland, *Banksia* woodland and *Banksia* shrubland. The dominant formation across the study area was *Eucalyptus* woodland which included vegetation associations with an upper storey dominated by *Eucalyptus todtiana* and *Eucalyptus marginata*. The *Banksia* shrubland and *Banksia* woodland was separated into two separate formations based on the height and dominance of the *Banksia* species. The *Banksia* woodland formation consisted of associations with *Banksia attenuata* and *Banksia menziesii* greater than 10 m high.

The sixteen vegetation associations are not considered to be unique to the study area, however they do represent two Priority Ecological Communities (SCP23b and Banksia Yellow-Orange Sands) and one Threatened Ecological Community (SCP20c) according to data provided by DPAW. The presence of the TEC and two PECs was identified during the desktop review, while the distribution and extent of the PEC Banksia Yellow-Orange Sands is considered to be wider spread throughout the study area based on the vegetation association descriptions and extent.

In addition to the TEC and two PECs identified by DPAW during the desktop review, an additional two TECs, SCP20a and SCP20b, and one PEC, SCP21c, are inferred to occur in the study area. The TECs and PECs are located throughout the study area and in association with the known TEC and PECs locations, the majority of the vegetation within the study area is considered to be significant.

The presence and extent of the TECs and the two PECs cannot be accurately confirmed due to the lack of systematic quadrat sampling of the floristic composition recorded within the study area and a multivariate analysis and comparison of regional and existing datasets (including the dataset from Gibson *et al.*, 1994) has not been completed. However, a comparison of the floristic information collected at each of the 30 relevés and the biological and geological information known for each of the TEC and PECs has been completed. An inference on the floristic community type described from Gibson *et al.* (1994) can be made to identify possible TECs and PECs present within the study area.



The retention and vesting of the study area into a DPAW conservation estate will increase the pre-European extent within formal protection (DPAW conservation estates, Bush Forever sites in DPAW managed lands and Bush Forever sites in Regional Parks). The new extent within formal protection will not significantly increase to ensure they are above the 30% threshold however will push the Moondah complexes above the 10% endangered level.

The study area is located within a north-south ecological corridor that connects the Boonanarring Nature Reserve in the north and Leda Nature Reserve in the south. The corridor will allow the continual movement of genetic material (via insect and wind pollination) in a north-south movement to maintain genetic integrity.

6.1.2 Flora

A total of 154 vascular plant taxa from 38 families and 88 genera were recorded from the study area, including 148 native taxa and six introduced taxa. This number is considered to significantly increase if the survey was undertaken at the optimum time in spring for the Swan Coastal Plain.

One Threatened taxon, *Chamelaucium* sp. Gingin (N.G. Marchant 6) and one Priority listed taxon, *Hypolaena robusta* (P4), were recorded from the study area. An additional five Priority listed taxa, *Acacia cummingiana* (P3); *Caustis* sp. Gigas (A.S. George 9318) (P2); *Schoenus griffinianus* (P3); *Verticordia rutilastra* (P3); and *Verticordia serrata* var. *linearis* (P3), have previously been recorded from the study area. These five Priority listed taxa were not recorded at the time of the site reconnaissance.

The five Priority listed taxa not recorded at the time of the survey may still persist in the study area. The timing of the survey was not optimal for identifying the two *Verticordia* species and the *Schoenus* and *Caustis* species. Searches were conducted for *Acacia cummingiana* at the known location along Reserve Road but it was not recorded.

Chamelaucium sp. Gingin (N.G. Marchant 6) was recorded from 12 point locations totalling approximately 200 individuals. This number is considered to only represent a subset of the individuals known to occur in the northwest corner of the study area and the adjacent DPAW managed lands.


The study area is considered to represent critical habitat for *Chamelaucium* sp. Gingin (N.G. Marchant 6) according to the interim recovery plan (Stack and English, 2003). The study area represents current known occupancy, similar within 200 m and a corridor for pollination between populations located adjacent to the study area (Stack and English, 2003).

Hypolaena robusta (P4) was recorded from two locations within the study area and is known from one other location within the study area.

An assessment of the likelihood of the conservation significant flora identified from the desktop review occurring within the study area, concluded that ten conservation significant taxa are likely to occur within the study area. An additional 15 conservation significant taxa may potentially occur within the study area based on known locations and habitat preferences. The remaining 30 conservation significant taxa are not expected to occur within the study area based on habitat preferences and the current known locations of these taxa (Appendix D).

Of the ten conservation significant species likely to occur in the study area, only one, *Chamelaucium* sp. Gingin (N.G. Marchant 6), is listed Threatened (Declared Rare-Extant) under the WC Act and the EPBC Act. The remaining 19 Threatened taxa identified from the desktop review are not expected to occur in the study area based on their known distribution and preferred habitat requirements.

A total of six introduced taxa were recorded from the study area. The six introduced taxa are not considered to be WONS, while the Arum Lily (*Zantedeschia aethiopica*), recorded from the southwest corner in vegetation association Ba, is considered to be a Declared Pest under the BAM Act. The remaining



five introduced taxa are common weed species of disturbed or degraded sites and are present within the study area in low densities. The majority of the weeds are encroaching from the cleared paddocks located to the southwest and east of the study area.

6.2 Fauna

6.2.1 Fauna Habitats

The study area contains approximately 663 ha of Banksia Woodland, 315 ha of Eucalypt Woodland and 3 ha of Dampland habitat. The majority of the study area is classified as excellent condition, with dieback being the only major disturbance.

The fauna habitats present in the study area are considered to be common on a local scale with similar habitat existing in the immediate vicinity. Chandala Nature Reserve, Barracca Nature Reserve, Breera Road Nature Reserve and Yeal Nature Reserve are all located within 10 km of the study area. The close proximity of the study area to these permanent sections of native vegetation increases its local importance and value as an offset site. Habitat connectivity occurs with Breera nature reserve to the north, Chandala Nature Reserve to the east and even Bullsbrook Nature Reserve along a drainage line to the south of the study area. Drainage lines are well known conduits for fauna movement as they provide a well-covered/vegetated habitat to provide safe passage between areas. Due to its position and surrounding habitats the study area has an importance far greater than its 988 ha size suggests.

The large size of the study area and the excellent condition of the habitats indicates the full suite of microhabitats native fauna rely upon is present, e.g.: thick leaf litter, old logs and hollows, fruit/flower bearing trees. As such, the vast majority of the species in Appendix J are expected to occur in the study area. The large area of Banksia Woodland (663 ha) provides a wealth of foraging resource for nectivorous species such as honeyeaters and Honey Possums that are not readily supported by the fragmented landscapes present in urban areas.

The moderate to old age of the trees in the study area means they have become a hollow bearing resource, many species of bird and mammal rely on as integral part of their life cycle e.g.: for breeding and shelter. Galahs and Australian Ringnecks were seen using hollows during the survey. The lack of recent fire in some sections of the study area has meant that tree branches and limbs have fallen but are yet to produce tree hollows or hollow logs, which would increase the habitat value of the study area.

6.2.2 Black Cockatoo Habitat

The study area provides suitable foraging, roosting and breeding habitat for the Carnaby's Cockatoo and to a lesser extent the Forest Red-tailed Cockatoo (due to the study area occurring at the northern extent of its distribution). During the survey no evidence of either species of Black Cockatoo was recorded in the study area however the presence of such species can be difficult to assess due to their seasonal movement patterns and sporadic nature.

The location of the study area is strategic as it supports Carnaby's Cockatoos during their migration to and from breeding sites in the Wheatbelt. Carnaby's Cockatoos that have been breeding in the Dandaragan, Moora and Bindoon regions potentially move through the vicinity of the study area prior to their movement south through the Swan Coastal Plain. Bindoon and the areas around it have been identified as an appropriate location to be recommended as offset site and Chittering has been identified as an area under pressure (Johnstone and Kirkby, 2011).

The study area contains 17 species of known foraging resources for Black Cockatoos and approximately 981 ha classified as foraging habitat. The habitats present are dominated by Jarrah, Marri and *Banksia* species which are all important foraging species. The mature age of the foraging species (predominantly



Jarrah, Marri and *Banksia* species) allows a greater yield of fruiting bodies/seed pods as compared to immature habitats. Given the large area of foraging habitat and the excellent condition of the vegetation the study area provides an important foraging resource for Black Cockatoos in the vicinity.

Roost sites for Black Cockatoos typically have tall, dense canopied trees, are close to water where the birds can drink and close to food trees such as *Banksias* and Marri. The roost trees are usually clumped and at larger roosts, cover an area of at least five hectares (Burnham et al., 2010). The study area provides ideal setting as a potential roost site, as it contains these conditions. The closest known roost sites for Carnaby's Cockatoos occur in Gingin and Yanchep which are approximately 17 km north and west of the study area respectively (Burnham et al., 2010). These sites are known from their inclusion in the Great Cocky Count where potential roost sites are surveyed. As no roost surveys have been conducted in the study area or its direct surrounds an accurate assessment of its use as a roost site cannot be ascertained. The entire Eucalypt Woodland habitat is classified as containing roosting habitat which equates to approximately 315 ha.

The tree age in the study area is sufficient to produce large hollows with potential to yield more with subsequent fires. For hollows to be of use to Carnaby's Cockatoos dimensions must be a minimum of 14 cm entrance size and at least 50 cm deep (Groom, 2011). As such, the study area contains habitat that can be classified as having current breeding potential for Carnaby's Cockatoos in a region known to have breeding records (Johnstone and Kirkby, 2011). The Cockatoo referral guidelines states "in a woodland stand with trees of suitable diameter at breast height, all trees of all ages and size are potentially important for maintaining breeding in the long term," as such the Eucalypt Woodland is classified as breeding habitat (approximately 315 ha). The tree density survey results show that the study area contains large areas (192 ha) with a high tree density, with more than 20 trees with a DBH over 500 mm per hectare. An estimated 6,353 trees with a DBH over 500 mm occur in the study area. As such, the study area contains large areas of high quality breeding habitat for Black Cockatoos.

6.2.3 Conservation Significant Fauna

The only conservation significant fauna recorded in the study area was the Priority 4 listed Western Brush Wallaby (*Macropus irma*). A further six species of conservation significance are considered Likely to occur in the study area.

The Western Brush Wallaby is listed as Priority 4, rare, near threatened and other species in need of monitoring under the DPAW Priority listings. It occurs only in the South West of Western Australia and has undergone a massive decline due to habitat fragmentation in the Wheatbelt and fox predation. Due to foxes some populations have experienced an 80% reduction between the 1970s and 1990s. However, fox control has allowed this species to become more common throughout its range (Van Dyck and Strahan, 2008). Limited records for this species occur for the vicinity of the study area (DPAW, 2014b). One individual was recorded in the Eucalypt Woodland but it is also expected to occur across the Banksia Woodland habitat.

The Western Carpet Python (*Morelia spilota imbricata*) occurs only along the southwestern portions of Western Australia and is listed as Schedule 4 under the WC Act. Threatening processes include habitat destruction and changed fire regimes, with the impact of feral predators being unknown (Pearson et al., 2005 and DEC, 2012). This species requires large areas of undisturbed bushland (Bush et al., 2007) and is expected to occur in all habits types of the study area. The large area of excellent condition habitat and abundance of logs and tree hollows suggest the study area is ideal habitat for this species.

The Black-striped Snake (*Neelaps calonotos*) is listed as Priority 3, poorly-known species under the DPAW Priority listings. It occurs only along the Swan Coastal Plain with the bulk of this species known distribution occurring in the Perth region, however there have been recent records of this species further north near Dongara and Eneabba suggesting it has a broader distribution (Bush et al., 2010). Threatening processes



involve habitat destruction within its small distribution. Both the Banksia Woodland and Eucalypt Woodland provide ideal habitat for this species. There have been records of this species from the vicinity of the study area from Muchea and Gingin (DPAW, 2014b).

The Carnaby's Cockatoo (*Calyptorhynchus latirostris*) is listed as Endangered under the EPBC Act and Schedule 1 under the WC Act. This species is endemic to the southwest of Western Australia, from Kalbarri in the north to Esperance (DSEWPAC, 2012). In the last 45 years the Carnaby's Cockatoo population has dropped to by 50% to an estimated 40,000 individuals (Johnstone et al., 2008 and Cale, 2003). The major threats to this species include clearing of their core breeding habitat in the Wheatbelt and the clearing of foraging resources on the Swan Coastal Plain (Cale, 2003). There are numerous records of this species in the vicinity of the study area (Burbidge et al., 1996, ATA, 2007, GHD, 2013a, b, DPAW, 2014a and DPAW, 2014b), including breeding records from Bindoon and Gingin (Johnstone and Kirkby, 2011). As mentioned previously the Banksia Woodland provides foraging habitat for this species and the Eucalypt Woodland provides foraging, roosting and breeding habitat for this species.

The Rainbow Bee-eater (*Merops ornatus*) is listed as Migratory under the EPBC Act and Schedule 3 under the WC Act. The Rainbow Bee-eater is one of the most widespread birds species in Australia distributed across mainland Australia (Barrett et al., 2003). There are no known threats to this common species. All habitat types are expected to be used by this species.

The Western Quoll (*Dasyurus geoffroii*) is listed as Vulnerable under the EPBC Act and Schedule 1 under the WC Act. Once distributed over 70% of Australian this species distribution is now down to 5% of its former range, restricted to the southwest of Western Australia (Orell and Morris, 1994). The major threats to this species include feral predators, habitat clearing and changed fire regimes (Smith et al., 2004). The Western Quoll has large home range, 400 ha for females and 900 ha for males. Given the connectivity with surrounding areas of bush and the large size of the site the potential exists for this species to reside in the study area or its surrounds. All habitat types would be used as foraging habitat and the hollows logs found in the Eucalypt Woodland provides suitable den site locations. The Western Quoll has been recently recorded in Bindoon.

The Southern Brown Bandicoot (*Isodon obesulus fusciventer*) is listed as Priority 5, conservation dependent species under the DPAW Priority listing. The West Australian sub species is distributed along the coast from Guilderton to Esperance (DPAW, 2014b). The major threatening processes for this species are fragmentation and loss of habitat, predation by foxes, cats and in residential areas dogs. The Dampland habitat and the surrounding Woodlands provide habitat for this species. This species has been previously recorded in Bindoon and in the vicinity of the study area (Tingay, 1994, GHD, 2013a and DPAW, 2014b).

6.3 Conservation Value

In summary, the study area is considered to be of high conservation value comprising habitat for a significant number of threatened flora and fauna species. Some of these species are likely to be impacted by the NorthLink WA project. The vegetation is representative of a number of Threatened and Priority Ecological Communities, some of which likely to be impacted by the NorthLink WA Project. The addition of the study area to the conservation estate will substantially increase the estate with the adjacent Class C Reserve and provide protection of an important ecological linkage.

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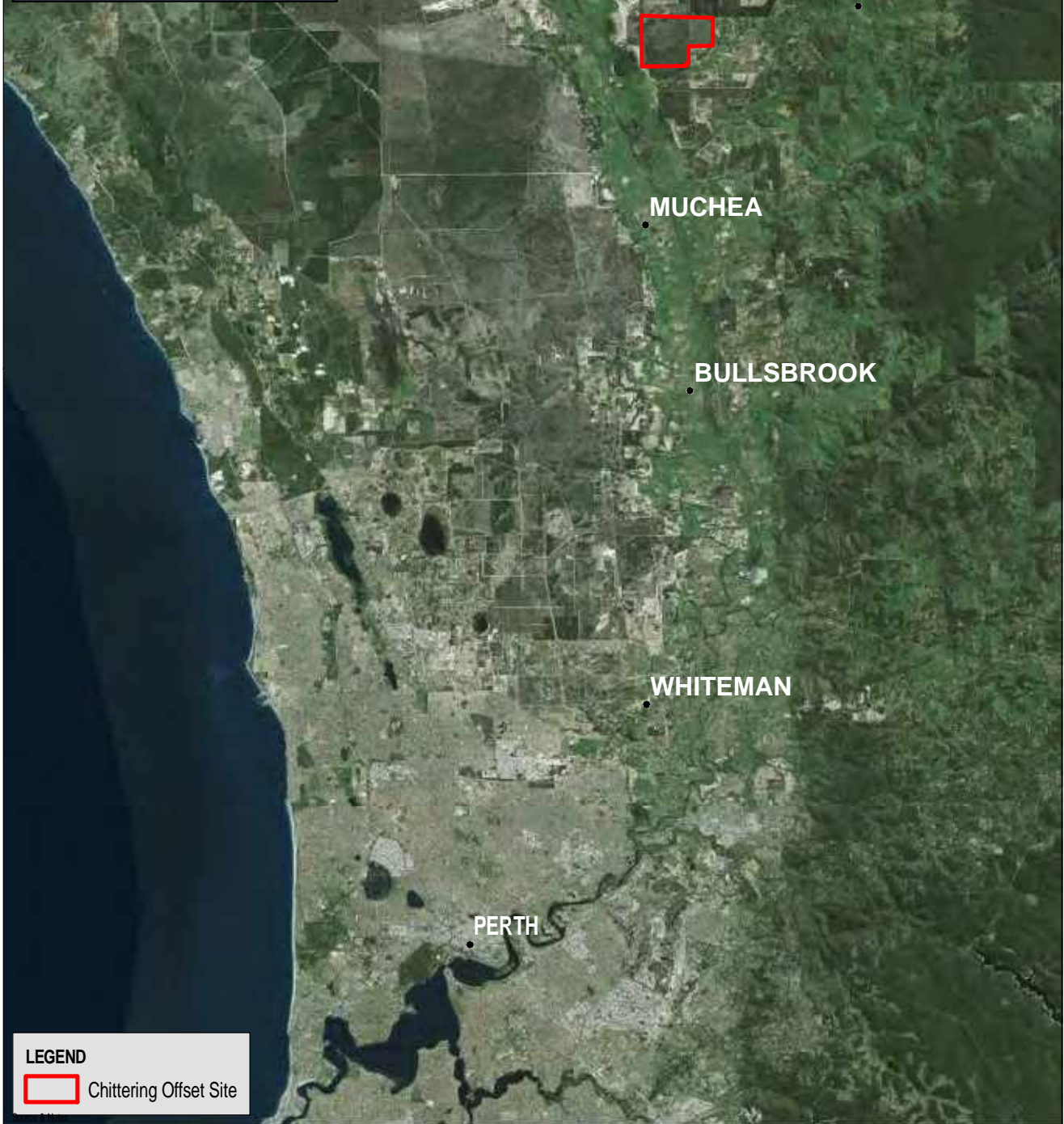
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Figures




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LEGEND

Chittering Offset Site



Date:
14.04.2015
MXD:
4483AA_06_GIS001_1
File Name:
4483AA_06_F001_GIS

Main Roads WA



Regional Location
Flora, Vegetation and
Fauna Assessment

Figure No:
1



Source & Notes
Aerial Imagery from Google Earth Pro (10.01.2015).



Date:
14.04.2015
MXD:
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File Name:
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Main Roads WA



Study Area
Flora, Vegetation and
Fauna Assessment

Figure No:

2



LEGEND

- Chittering Offset Site
- Vegetation Complex**
- Coonambidgee Complex
- Karamal Complex-South
- Mogumber Complex-South
- Moondah Complex
- Reagan Complex

Source & Notes
 Vegetation complex mapping from DPAW (January 2015).
 Aerial Imagery from Google Earth Pro (10.01.2015).

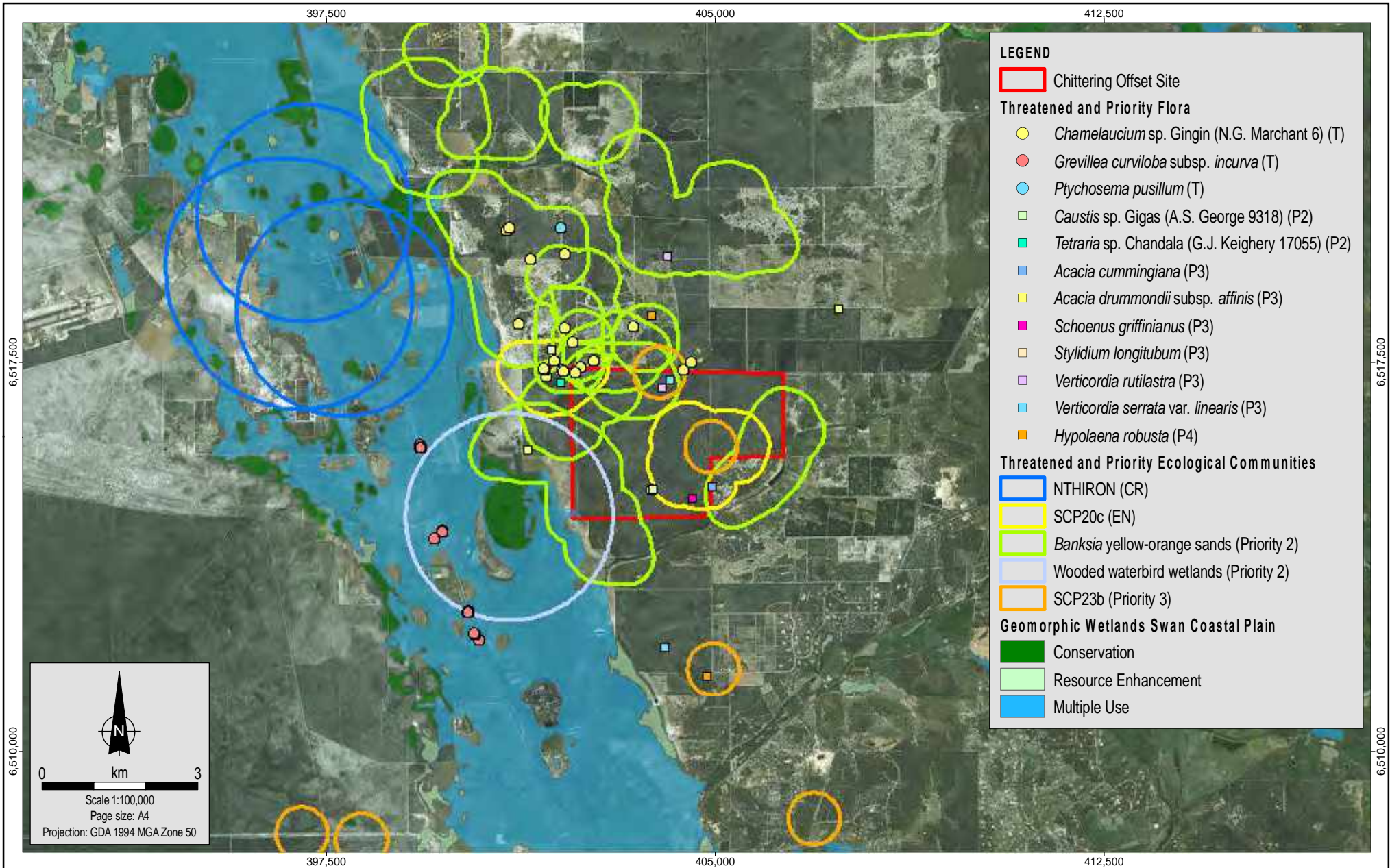


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Main Roads WA

Vegetation Complexes
 Flora, Vegetation and
 Fauna Assessment

Figure No:
4



LEGEND

- Chattering Offset Site
- Threatened and Priority Flora**
- *Chamelaucium* sp. Gingin (N.G. Marchant 6) (T)
- *Grevillea curviloba* subsp. *incurva* (T)
- *Ptychosema pusillum* (T)
- Caustis* sp. Gigas (A.S. George 9318) (P2)
- Tetralia* sp. Chandala (G.J. Keighery 17055) (P2)
- Acacia cummingiana* (P3)
- Acacia drummondii* subsp. *affinis* (P3)
- Schoenus griffinianus* (P3)
- Stylidium longitubum* (P3)
- Verticordia rutilastra* (P3)
- Verticordia serrata* var. *linearis* (P3)
- Hypolaena robusta* (P4)
- Threatened and Priority Ecological Communities**
- NTHIRON (CR)
- SCP20c (EN)
- Banksia* yellow-orange sands (Priority 2)
- Wooded waterbird wetlands (Priority 2)
- SCP23b (Priority 3)
- Geomorphic Wetlands Swan Coastal Plain**
- Conservation
- Resource Enhancement
- Multiple Use

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Source & Notes
Conservation significant flora and vegetation mapping from Coffey (August 2014).
Aerial imagery from ArcGIS Online.



Date: 14.04.2015
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File Name: 4483AA_06_F008_GIS

Main Roads WA
NorthLinkWA

Flora and Vegetation Constraints
Flora, Vegetation and
Fauna Assessment

Figure No:
5



LEGEND

- **Zantedeschia aethiopica*
- Chittering Offset Site

Vegetation Condition

- Excellent
- Very good to excellent
- Very good

Source & Notes
 **Zantedeschia aethiopica* location and vegetation condition mapping from Coffey (2014)
 Aerial Imagery from Google Earth Pro (10.01.2015).

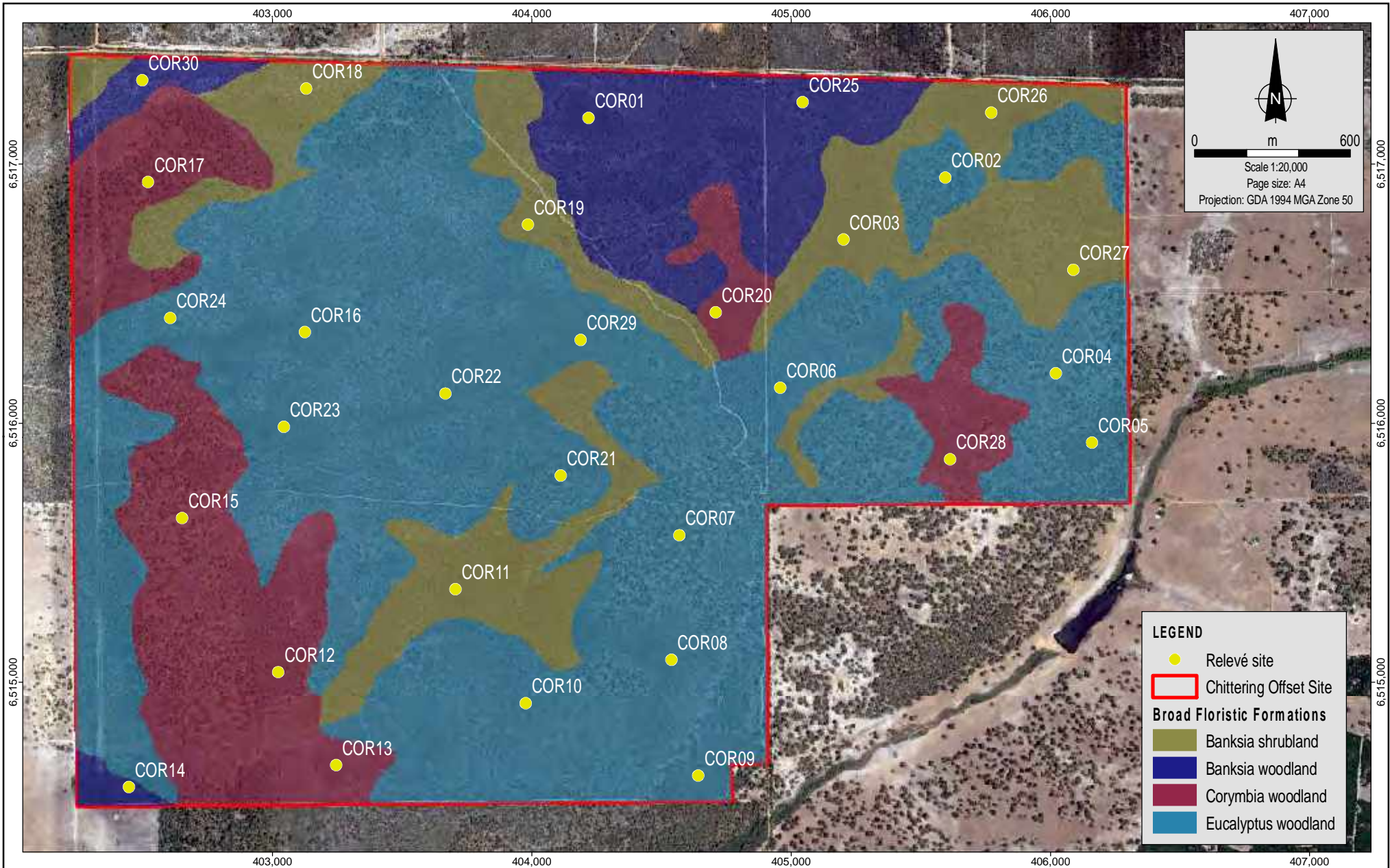


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Main Roads WA

Vegetation condition and introduced flora
 Flora, Vegetation and
 Fauna Assessment

Figure No:
6



Source & Notes
 Relevé sites and broad floristic formation mapping from Coffey (2014).
 Aerial Imagery from Google Earth Pro (10.01.2015).



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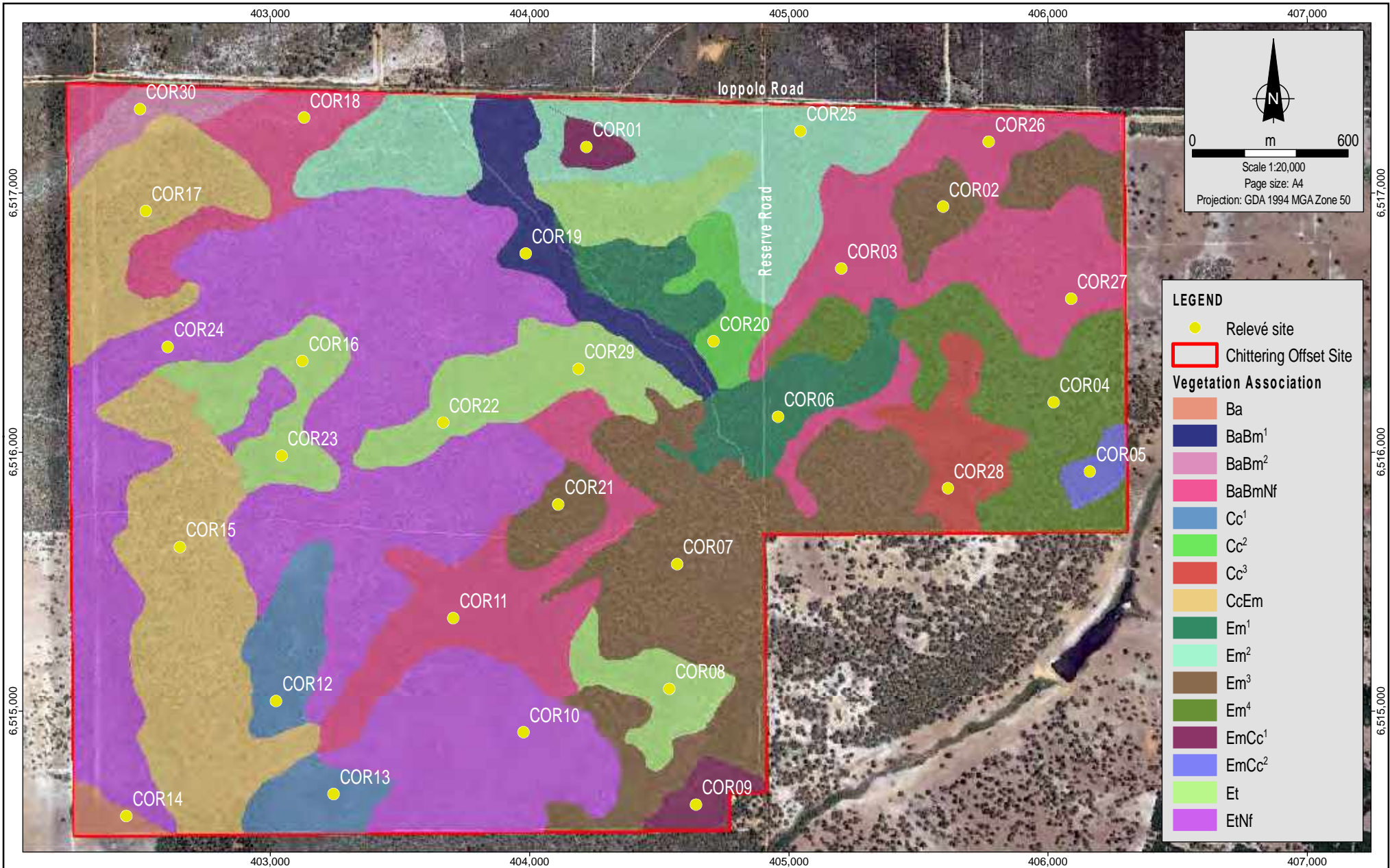
Main Roads WA



Broad Floristic Formations
 Flora, Vegetation and
 Fauna Assessment

Figure No:

7



Source & Notes
 Relevé sites and vegetation association mapping from Coffey (August 2014).
 Aerial imagery from Google Earth Pro (10.01.2015).



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14.04.2015
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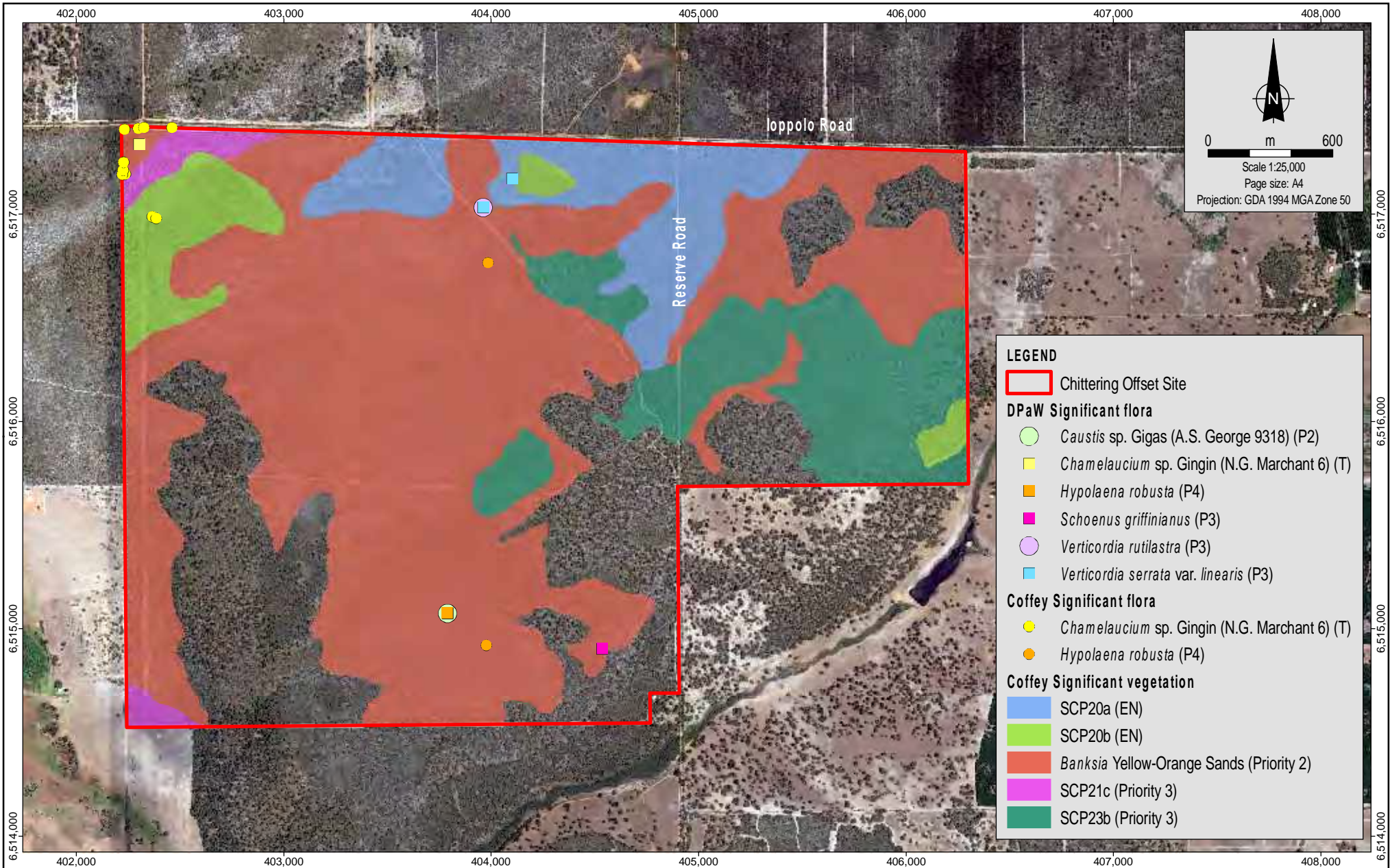
Main Roads WA



Vegetation Associations
 Flora, Vegetation and
 Fauna Assessment

Figure No:

8



Source & Notes
 Conservation significant flora and vegetation mapping from Coffey (August 2014).
 Aerial imagery from Google Earth Pro (10.01.2015).



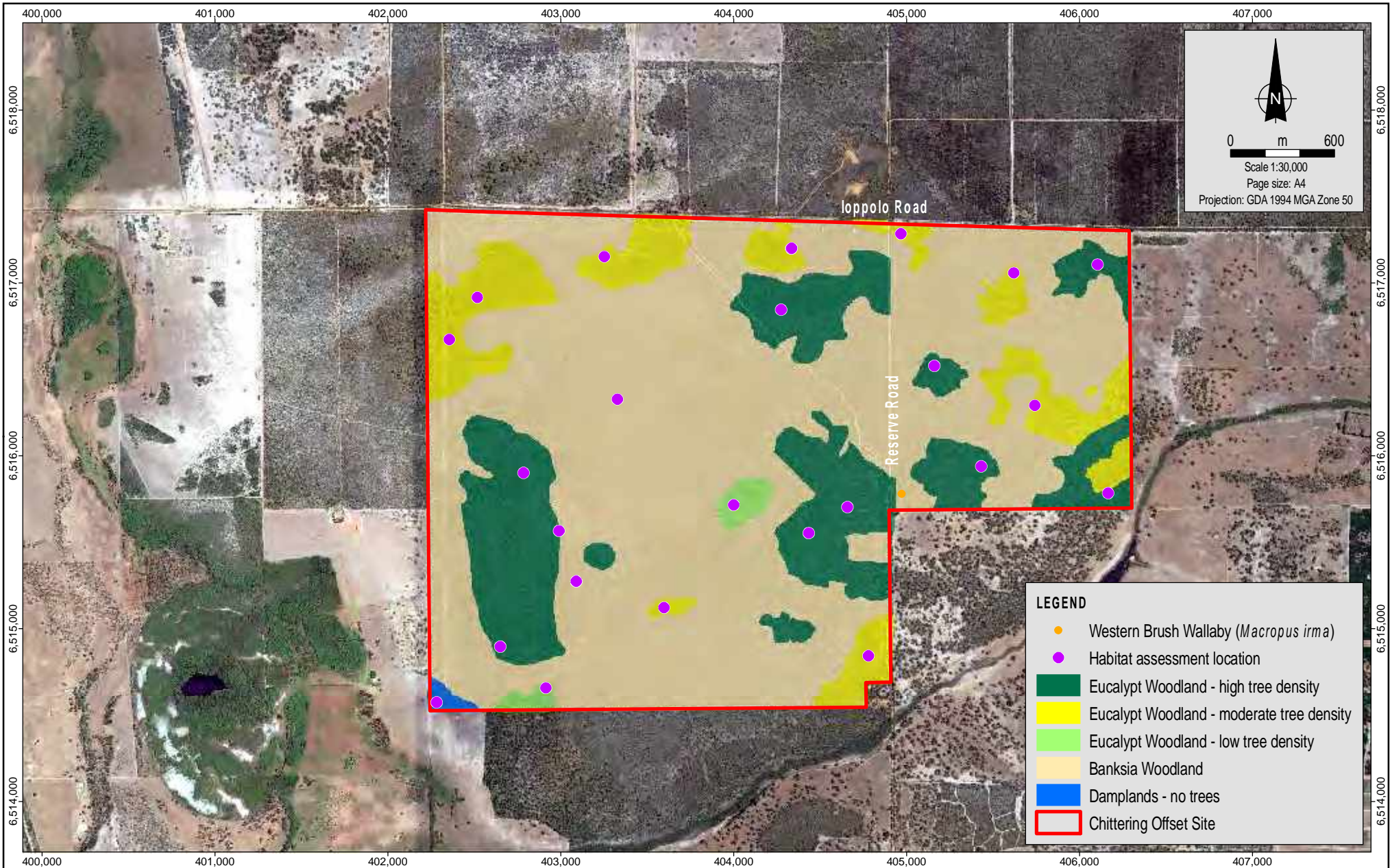
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Main Roads WA



Conservation Significant Flora and Vegetation
 Flora, Vegetation and
 Fauna Assessment

Figure No:
9



Source & Notes
 Fauna habitat and tree density from Coffey (August 2014).
 Aerial Imagery from Google Earth Pro (10.01.2015).



Date:
14.04.2015
 MXD:
4483AA_06_GIS011_1
 File Name:
4483AA_06_F010_GIS

Main Roads WA



Fauna Habitat and Tree Density
 Flora, Vegetation and
 Fauna Assessment

Figure No:
10



Source & Notes
 Black Cockatoo habitat mapping from Coffey (August 2014).
 Aerial Imagery from Google Earth Pro (10.01.2015).



Date:
14.04.2015
 MXD:
4483AA_06_GIS020_1
 File Name:
4483AA_06_F011_GIS

Main Roads WA
 NorthLinkWA

Black Cockatoo Habitat
 Flora, Vegetation and
 Fauna Assessment

Figure No:
11



APPENDIX A

Department of Parks and Wildlife Database Searches



Your Ref:
Our Ref: **12-0614FL**
Enquiries: Myrto Robert
Phone: (08) 9218 8760
Fax: (08)
Email: flora.data@dpaw.wa.gov.au

Coffey Environments
PO Box 4223
Victoria Park WA 6979

Attention: John Trainer

Dear John Trainer,

REQUEST FOR THREATENED AND PRIORITY FLORA INFORMATION

I refer to your request of 30 May 2014 for Threatened (Declared Rare) and Priority Flora information in the Chittering area. The search was conducted within 5km radial area of the central coordinates you submitted.

A search was undertaken for this area of **(1)** the Department's *Threatened (Declared Rare) and Priority Flora* database (for results, *if any*, see "TPFL" – coordinates are GDA94), **(2)** the *Western Australian Herbarium Specimen* database for priority species opportunistically collected in the area of interest (for results, *if any*, see "WAHERB"- coordinates are GDA94 – see condition number 9 in the attached 'Conditions in Respect of Supply' and **(3)**, the Department's *Threatened and Priority Flora List* [this list is searched using 'place names'. This list, which may also be used as a species target list, 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) – for results, *if any*, see "TP List"]. The results are attached electronically to this email.

Attached also are the conditions under which this information has been supplied. Your attention is specifically drawn to the seventh point, which refers to the requirement to undertake field investigations for the accurate determination of Threatened and Priority flora occurrence at a site. *The information supplied should be regarded as an indication only of the Threatened and Priority flora that may be present and may be used as a target list in any surveys undertaken.*

The information provided does not preclude you from obtaining and complying with, where necessary, land clearing approvals from other agencies.

An invoice for \$300 (plus GST) to supply this information will be forwarded.

It would be appreciated if any populations of Threatened and Priority flora you encounter in the area could be reported to this Department to ensure their ongoing management.

If you require any further details, or wish to discuss Threatened and Priority flora management, please contact Dr Ken Atkins, Manager, Species and Communities Branch, on (08) 9334 0455.

Yours faithfully

Miss Myrto Robert

.....
A/THREATENED FLORA DATABASE OFFICER
for the Director General

9 June 2014

DEPARTMENT OF PARKS AND WILDLIFE

THREATENED (DECLARED RARE) AND PRIORITY FLORA INFORMATION

CONDITIONS IN RESPECT OF SUPPLY OF INFORMATION

1. All requests for data to be made in writing to the Director General, Department of Parks and Wildlife, Attention: Threatened Flora Database Officer, Species and Communities Branch.
2. The data supplied may not be supplied to other organisations, nor be used for any purpose other than for the project for which they have been provided, without the prior written consent of the Director General, Department of Parks and Wildlife.
3. Specific locality information for Threatened and Priority Flora is regarded as confidential, and should be treated as such by receiving organisations. Specific locality information may not be used in public reports without the written permission of the Director General, Department of Parks and Wildlife. Publicly available reports may only show generalised locations or, where necessary, show specific locations without identifying species. Species and Communities Branch is to be contacted for guidance on the presentation of Threatened and Priority Flora information.
4. Note that the Department of Parks and Wildlife respects the privacy of private landowners who may have Threatened and Priority Flora on their property. Threatened and Priority Flora locations identified in the data as being on private property should be treated in confidence, and contact with property owners made through the Department of Parks and Wildlife.
5. Receiving organisations should note that while every effort has been made to prevent errors and omissions in the data provided, they may be present. The Department of Parks and Wildlife accepts no responsibility for this.
6. Receiving organisations must also recognise that the database is subject to continual updating and amendment, and such considerations should be taken into account by the user.
7. **It should be noted that the supplied data do not necessarily represent a comprehensive listing of the Threatened and Priority Flora of the area in question. Its comprehensiveness is dependant on the amount of survey carried out within the specified area. The receiving organisation should employ a botanist, if required, to undertake a survey of the area under consideration.**
8. Acknowledgment of the Department of Parks and Wildlife as source of the data is to be made in any published material. The unique reference number that is given upon the request for information should be quoted when referencing the data. Copies of all such publications are to be forwarded to the Department of Parks and Wildlife, Attention: The Manager, Species and Communities Branch.
9. The development of the PERTH Herbarium database was not originally intended for electronic mapping (eg. GIS ArcView). The latitude and longitude coordinates for each entry are not verified prior to being databased. It is only in recent times that collections have been submitted with GPS coordinates. Therefore, be aware when using this data in ArcView that some records may not plot to the locality description given with each collection.

Species and Communities Branch

17 Dick Perry Ave, Technology Park, Kensington

Phone: (08) 9334 0455 Fax: (08) 9334 0278

Locked Bag 104, Bentley Delivery Centre, Bentley, Western Australia 6983

www.dpaw.wa.gov.au

DECLARED RARE AND PRIORITY FLORA LIST

CONSERVATION CODES

for Western Australian taxa

T: **Threatened Flora** (Declared Rare Flora - Extant)
Schedule 1 under the *Wildlife Conservation Act 1950* Rare Flora Notice

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. The assessment of the conservation status of these species is based on their national extent.

X: **Presumed Extinct Flora** (Declared Rare Flora – Extinct)
Schedule 2 under the *Wildlife Conservation Act 1950* Rare Flora Notice

Taxa which have been adequately searched for and there is no reasonable doubt that the last individual has died, and have been gazetted as such.

Threatened Flora (Schedule 1) are further ranked by the Department according to their level of threat using IUCN Red List criteria:

CR: **Critically Endangered** – considered to be facing an extremely high risk of extinction in the wild.

EN: **Endangered** – considered to be facing a very high risk of extinction in the wild.

VU: **Vulnerable** – considered to be facing a high risk of extinction in the wild.

A list of the current rankings can be downloaded from DPAW's [Listing of species and ecological communities](http://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities) webpage at

<http://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities>

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Species that have not yet been adequately surveyed to be listed under Schedule 1 or 2 are added to the Priority Flora and Priority Fauna Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora or fauna. Species that are adequately known, are rare but not threatened, or meet criteria for Near Threatened, or that have been recently removed from the threatened list for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring. Conservation Dependent species are placed in Priority 5.

Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.

1: Priority One: Poorly-known species

Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.

2: Priority Two: Poorly-known species

Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.

3: Priority Three: Poorly-known species

Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.

4: Priority Four: Rare, Near Threatened and other species in need of monitoring

(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands.

(b) Near Threatened. Species that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.

(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

5: Priority Five: Conservation Dependent species

Species that are not threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

Recommendations for additions, deletions or changes to the Declared Rare and Priority Flora List should be forwarded to the Flora Administration Officer or Senior Botanist Species and Communities Branch, DEC.

Species and Communities Branch

17 Dick Perry Ave, Technology Park, Kensington

Phone: (08) 9334 0455 Fax: (08) 9334 0278

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ABBREVIATIONS USED IN THREATENED AND PRIORITY FLORA DATABASE

VESTING

AAP	Aboriginal Planning Authority
AGR	Chief Executive, Dep. of Agriculture
ALT	Aboriginal Land Trust
APB	Agricultural Protection Board of WA
BGP	Botanical Gardens & Parks Authority
BSA	Boy Scouts Association
CC	Conservation Commission – NPNCA - LFC
CGT	Crown Grant in Trust
COM	Commonwealth of Australia
CRO	Crown Freehold-Govt Ownership
CRW	Crown
DAG	Dep. of Agriculture
DOW	Dep. of Water
DPI	Dep. of Planning
EXD	Exec Direc CALM
FES	Fire and Emergency Services Aust.
HOW	Dep. of Housing/State Housing Commission
ILD	Industrial Lands Develop. Auth
LAC	LandCorp
LGA	Shire/LGA
MAG	Minister for Agriculture
MCB	Metropolitan Cemeteries Board
MED	Ministry of Education
MHE	Minister for Health
MIN	Minister for Mines
MPL	Ministry for Planning
MPR	Minister for Prisons
MRD	Main Roads WA
MTR	Minister for Transport
MWA	Minister for Water Resources
MWO	Minister for Works
NAT	Natural Trust of Australia WA
NON	Not Vested
PLB	Pastoral Lands Board
PRI	Private/Freehold
RAI	Public Transport Authority
REL	Religious Organisation
SPC	State Planning Commission
SYN	Synergy (ex Western Power)
SWA	State of Western Australia
TEL	Telstra
UNK	Unknown
WAT	Water Corporation
WEL	Minister Community Welfare
WRC	Water & Rivers Commission
XPL	Ex-Pastoral Lease

PURPOSES

ABR	Aboriginal Reserve
ACC	Access Track
AER	Aerodrome
AIR	Airport
ARS	Agricultural Research Station
BAP	Baptist Union of WA
CAM	Camping
CAR	Caravan park
CEM	Cemetery
CFA	Conservation of Fauna
CFF	Conservation Of Flora & Fauna
CFL	Conservation of Flora
CHU	Church
CMN	Communications
COM	Common
CON	Conservation Park
CPK	Car Park
CRM	Conservation & Resource Management
DEF	Defence
DRA	Drain

EDE	Educational Endowment
EDU	Educational purposes UWA
ENE	Enjoyment of Natural Environ.
EPL	Ex-pastoral Lease (Sect 33(2) CALM Act)
EPS	Explosives
EXC	Excepted from sale
EXL	Exploration Lease
EXP	Experimental Farm
FIR	Firing Range
FOR	State Forest
FP	Foreshore Purposes
GE	General Lease
GHA	Grain Handling
GOL	Golf
GRA	Gravel Pit
GVT	Government Requirements
HAR	Harbour Purposes
HEP	Heritage Purposes
HER	Heritage trail
HOS	Hospital
KEN	Kennels
LGA	LGA/Shire Requirements
LPR	Landscape Protection
MIN	Mining lease
MUN	Municipal Purposes
NPK	National Park
NRE	Nature Reserve
OTH	Other
PAR	Parkland (& Recreation)
PAS	Pastoral lease
PCR	Proposed for Conservation
PFF	Protection of Flora & Fauna
PFL	Protection of Flora
PIC	Picnic ground
PLA	Plantation
PMC	Protection of Meteorite Crater
POS	Public Open Space
PPA	Public parkland
PRS	Prison site
PUR	Purchase Lease
PUT	Public Utility
QUA	Quarry
RAC	Racecourse
RAD	Radio Station
REC	Recreation
REH	Rehabilitation/Re-establish Native Plants
RRE	Railway Reserve
RUB	Rubbish
SAL	Saleyards
SAN	Sand
SCH	School-site
SET	Settlers requirements
SHO	Showgrounds
SNN	Sanitary
SOI	Soil Conservation
STO	Stopping place
STK	Stock Route
TIM	Timber
TOU	Tourism
TOW	Town-site
TRA	Training Ground
TRI	Trig station
UCL	Unallocated Crown Land
UNK	Unknown
VER	Road Verge
VPF	Vermin Proof Fence
WAT	Water
WLS	Wildlife Sanctuary
WOO	Firewood

ABBREVIATIONS USED IN THE WESTERN AUSTRALIAN HERBARIUM DATABASE

Geocode Method - The method that was used to record the latitude and longitude.

Auto - Indicates that the coordinate data in the record was created automatically (i.e. by software), usually by creating a coordinate from information provided in the Nearest Named Place or Locality textual description fields.

GAP - Acronym for "Generalised Arbitrary Point" as used in HISPID. GAP indicates that the coordinate data was obtained manually from the Nearest Named Place or Locality textual description fields.

GPS - Acronym for "Global Positioning System". GPS indicates that the coordinate data in the record was obtained from a GPS unit by the collector of the specimen.

MAN - Shorthand for manual. MAN indicates that the coordinate data was created by hand using some method not allowed for by one of the other manual Geocode Method values, in particular, TOPO, GAP, or GPS.

TOPO - Shorthand for topographic map. TOPO indicates that the coordinate data was obtained by plotting textual locality details against a topographic map.

None - Indicates that no coordinate data has been supplied by the collector.

Unknown - Indicates that there is no known method for determining the coordinate data. Should be used if the collector provided no indication of how they sampled the specimen's coordinate data.

PREC (Precision) - precision ratings for coordinates.

Precision 1: Absolutely precise (to nearest 100m or nearest second) and must be GPS determined. For example 35°26'42"S 123°40'26"E

Precision 2: Falling within a diameter of 3km (ca 2 minutes) or if no GPS mentioned in collecting notes. (The location must be able to be pinpointed on a 1:250 000 map, a spot locality. For example 35°26'42"S 123°40'26"E

Precision 3: Falling within a diameter of 10km (ca 7 minutes) or for degrees and minutes, where seconds have not been given. For example 35°26'_"S 123°40'_"E

Precision 4: Falling within a diameter of ca 50km (30 minutes). For example 35°26'_"S 123°40'_"E

Precision 5: Where a location is a prescribed large geographical area within a state or only the state is given. Diameter is greater than 50km. For example 35°_"_"S 123°_"_"E

Precision 6: used when localities are New Holland, Eastern Australia or Not given. Fields will be left blank.

Clinton Van Den Bergh

From: Communities Data <Communities.Data@DPaW.wa.gov.au>
Sent: Tuesday, 10 June 2014 2:56 PM
To: John Trainer; Fauna Data; Flora Data; Communities Data
Cc: Denise True; Clinton Van Den Bergh; Paul Mitrovski; Natassja Raymond
Subject: Results of TEC/PEC Search - Coffey (Bindoon) (Our Ref:08-0614EC) (Your Ref:)
Attachments: TEC-PEC_metadata_26072011.pdf; Conditions of supplying TEC and PEC data.pdf; Bindoon_Coffey_TecPecSearchResults_10062014.dbf; Bindoon_Coffey_TecPecSearchResults_10062014.prj; Bindoon_Coffey_TecPecSearchResults_10062014.sbn; Bindoon_Coffey_TecPecSearchResults_10062014.sbx; Bindoon_Coffey_TecPecSearchResults_10062014.shp; Bindoon_Coffey_TecPecSearchResults_10062014.shp.xml; Bindoon_Coffey_TecPecSearchResults_10062014.shx

Hi,

I refer to your request on the 30 of May 2014 for information on threatened and priority ecological communities occurring within a 10km radius of the co-ordinates provided in the email below.

A search was undertaken on the Department's Threatened Ecological Communities database. Please find attached a buffer shapefile from the database where records were found. If you do not use shapefiles please use the (.dbf file) this can be open in excel as a spreadsheet. Please note that this information is not to be given to any external third parties as it may contain information regarding private property.

Please note not all priority ecological communities are currently recorded on our database. You may like to view the current list in related documents at http://www.dpaw.wa.gov.au/images/documents/plants-animals/threatened-species/Listings/Priority_ecological_communities_list_Sept2013.pdf

Attached are the conditions under which this information has been supplied. The information supplied should be regarded as an indication only of the threatened and priority ecological communities that may be present.

It would be appreciated if any occurrences of threatened and priority ecological communities encountered by you in the area could be reported to this Department to ensure their ongoing management. An occurrence report form and associated manual can be found at <http://www.dpaw.wa.gov.au/plants-and-animals/monitoring/96-standards/140-standard-report-forms?showall=&start=2>

Search area response information is only accurate at the time of provision. Over time, new occurrences or modifications to existing occurrences may occur as information becomes available. It is recommended that searches be re-submitted every six months where projects occur over a long period of time.

An invoice for \$220 (including GST) for the supply of this information will be forwarded.

Your request for information reference number for this search is: 08-0614EC. Please quote this unique reference number when acknowledging the Department of Parks and Wildlife as a source of the data in any published material.

Kind Regards

Wendy Chow | TEC Ecologist | Species & Communities Branch
Department of Parks and Wildlife | Kensington | Ph. 9334 0554 | wendy.chow@dpaw.wa.gov.au



From: John Trainer [<mailto:John.Trainer@coffey.com>]
Sent: Friday, 30 May 2014 3:23 PM
To: Fauna Data; Flora Data; Communities Data
Cc: Denise True; Clinton Van Den Bergh; Paul Mitrovski; Natassja Raymond
Subject: ecological database search

Hi All,

Could I please request a threatened fauna, flora and ecological communities database searches for the following area with a 10km buffer (or whichever you deem appropriate). This information will be used for a consultant's report.

Fauna: Species list format
Flora: CSV and DBF format
Ecological Communities: CSV and DBF format

Ippollo Rd muchea

50J 403670 E
6515930 S

Please respond to all parties CC'd into this email as not all members will be in the office.

Thanks

John Trainer
Senior Environmental Consultant/ Zoologist

Suite 2, 53 Burswood Road, Burswood WA 6100
PO Box 4223 Victoria Park WA 6979

t: +61 8 9269 6200

m: +61 400 224 012



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DEPARTMENT OF ENVIRONMENT AND CONSERVATION

THREATENED AND PRIORITY ECOLOGICAL COMMUNITIES INFORMATION

CONDITIONS IN RESPECT OF SUPPLY OF INFORMATION

1. All requests for data are to be made in writing to the Director General, Department of Environment and Conservation Attention: Species and Communities Branch
2. The data supplied may not be supplied to other organisations, nor be used for any purpose other than for the project for which they have been provided, without the prior written consent of the data custodian (Val English), Species and Communities Branch.
3. Specific locality information for threatened and priority ecological communities (TECs/PECs) is regarded as confidential, and should be treated as such by receiving organisations. Specific locality information for TECs/PECs may not be used in public reports without the written permission of the Director General, Department of Environment and Conservation. Publicly available reports may only show generalised locations (ie buffer locations). The TEC database manager is to be contacted for guidance on the presentation of TEC/PEC information.
4. Note that the Department of Environment and Conservation respects the privacy of private landowners who may have threatened and priority ecological communities on their property. Locations of TECs/PECs identified in the data as being on private property should be treated in confidence, and contact with property owners made through the Department of Environment and Conservation.
5. Receiving organisations should note that while every effort has been made to prevent errors and omissions in the data provided, they may be present. The Department of Environment and Conservation accepts no responsibility for this.
6. Receiving organisations must also recognise that the Threatened Ecological Communities database is subject to continual updating and amendment, and such considerations should be taken into account by the user.
7. It should be noted that the supplied data do not necessarily represent a comprehensive listing of the threatened and priority ecological communities of the area in question. Its comprehensiveness is dependant on the amount of survey carried out within the specified area. Private property has been relatively little surveyed. The receiving organisation should employ a consultant, if there is any likelihood of the presence of any threatened or priority ecological community, to undertake a survey of the area under consideration.
8. Acknowledgment of the Department of Environment and Conservation as source of the data is to be made in any published material. Copies of all such publications are to be forwarded to the Department of Environment and Conservation, Attention: Manager, Species and Communities Branch.

Threatened and Priority Ecological Community buffers in WA

UNDER NO CIRCUMSTANCES IS THIS DATA TO BE PROVIDED TO ANY THIRD PARTIES, for more details see conditions for the supply of this information.

Citation

Title: Threatened and Priority Ecological Community buffers in WA
Custodian: Department of Environment & Conservation

Description

Abstract: Ecological communities throughout WA that are "Presumed Totally Destroyed", "Critically Endangered", "Endangered", "Vulnerable", "Priority 1-5", "Lower Risk" and "Not evaluated". Communities are based on various life-forms including plants, invertebrates and micro-organisms.

Geographical Bounding Box

North: -14.788854
South: -35.005719
East: 128.870214
West: 113.765525

Data Currency and Status

Beginning Date: 1/1/94
Ending Date: current
Maintenance/Update: As requested

Access

Stored Data Format: ESRI shapefile
Coordinate System: GCS_GDA_1994

Access Constraints: Digital data is only available with written permission of the custodian. In addition, some occurrence data eg. location of sites on private land, is password restricted.

Data Quality

Positional Accuracy: Point location data within occurrences usually from GPS fix, usually within 100 metres. Some digitized from hard copy.

Attribute Accuracy: Not documented.

Logical Consistency: Not documented.

Completeness: Information on specific communities was obtained from regional, subregional or specific habitat surveys of floristic communities, invertebrate communities, wetland assemblages and communities of micro-organisms.

Attributes List:

<u>Name</u>	<u>Description</u>
BDY_ID	Associated boundary polygon unique identifier
OCC_UNIQUE	Unique occurrence identifier
COM_ID	Shortened community name identifier
COM_NAME	Community name
CT_DESC	State listed Category of Threat
S_ID_COUNT	Number of Site IDs within a buffer
FIRST_S_ID	First site identifier
LAST_S_ID	Last site identifier
BUFFER	Buffer radius from site ID or boundary in metres

General Information:

Priority Ecological Communities

- There are 284 known PECs and subtypes , 271 (~95%) of these on the TEC/PEC database
- The location of priority communities is good, but not complete across the state
- There is a formal list of PECs at <http://www.dec.wa.gov.au/content/view/849/2017/>
- Many PECs are awaiting endorsement as TECs

buffers

- The buffer radius around each occurrence of a TEC or PEC is included to help ensure that developments with potential to impact groundwater or surface water are picked up.
- For wetland TEC or PECs we seek to include an area within the buffer zone that is intended to help protect groundwater and surface water. The area required to protect different types of wetlands from a variety of hydrological impacts will, of course, differ.

- For upland TEC or PECs that are believed not to be groundwater dependent, the buffer area radius encompasses the TEC or PEC site location recorded in the TEC database, and extends at least to the furthest point in the occurrence. This is to ensure that the 'buffer' area encompasses at least the entire TEC or PEC. This means that some linear occurrences may need a larger buffer radius to encompass the entire occurrence.
- Occurrences with a buffer distance of 0 are no longer extant.

Contact Information

Contact Organisation: Department of Environment & Conservation
Contact Position: TEC Database Administrator - Species and Communities Branch
Mail Address: Locked Bag 104, Bentley Delivery Centre
Suburb/Locality: Kensington
Country/State: WA
Postcode: 6983
Telephone: (08) 9334 0116
Fax: (08) 9334 0300
Email: communities.data@dec.wa.gov.au

Metadata Information

Metadata Date: current



APPENDIX B

EPBC Act Database Search for MNES



EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

Report created: 04/07/14 11:16:40

[Summary](#)

[Details](#)

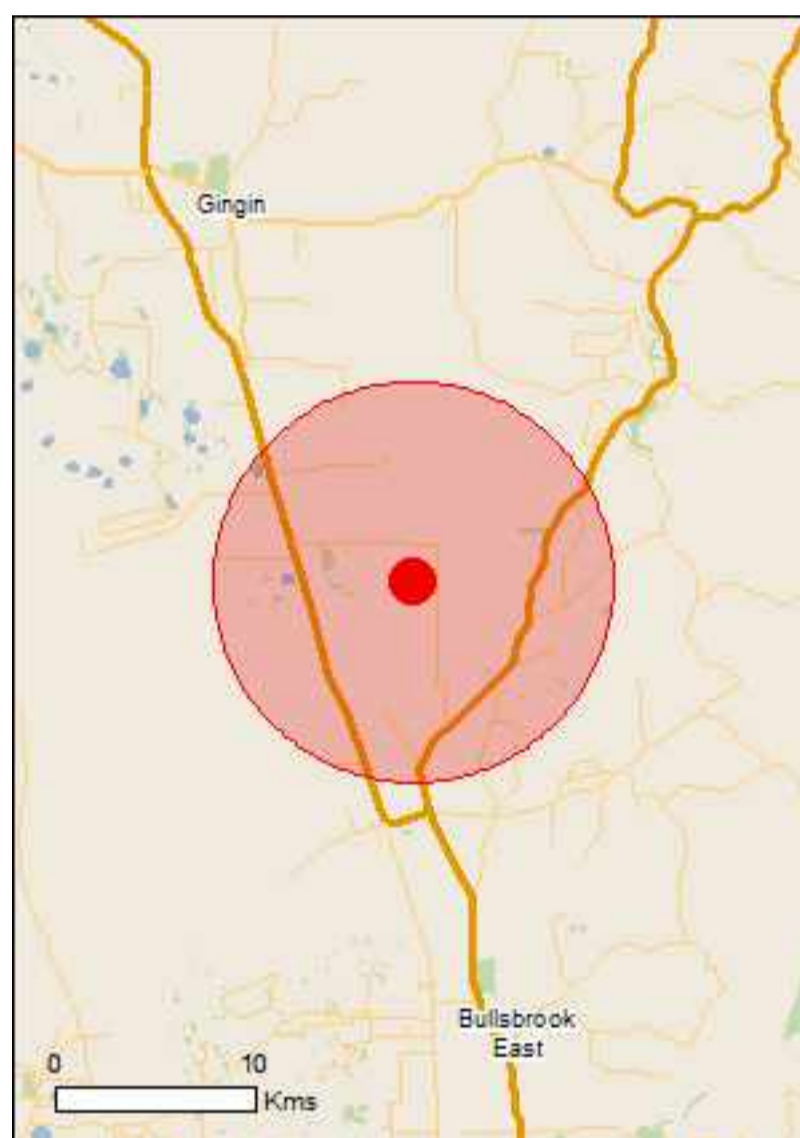
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

[Acknowledgements](#)



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

[Coordinates](#)

[Buffer: 10.0Km](#)



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the [Administrative Guidelines on Significance](#).

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Listed Threatened Ecological Communities:	1
Listed Threatened Species:	26
Listed Migratory Species:	6

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As [heritage values](#) of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate.

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

A [permit](#) may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	1
Commonwealth Heritage Places:	1
Listed Marine Species:	7
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

Place on the RNE:	3
State and Territory Reserves:	6
Regional Forest Agreements:	1
Invasive Species:	38
Nationally Important Wetlands:	1
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities

[\[Resource Information \]](#)

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Shrublands and Woodlands on Perth to Gingin ironstone (Perth to Gingin ironstone association) of the Swan Coastal Plain	Endangered	Community known to occur within area

Listed Threatened Species

[\[Resource Information \]](#)

Name	Status	Type of Presence
Birds		
Calyptorhynchus latirostris Carnaby's Black-Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Breeding likely to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Mammals		
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat likely to occur within area
Plants		
Andersonia gracilis Slender Andersonia [14470]	Endangered	Species or species habitat likely to occur within area
Anigozanthos viridis subsp. terraspectans Dwarf Green Kangaroo Paw [3435]	Vulnerable	Species or species habitat likely to occur within area
Caladenia huegelii King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Centrolepis caespitosa [6393]	Endangered	Species or species habitat likely to occur within area
Chamelaucium sp. Gingin (N.G.Marchant 6) Gingin Wax [64649]	Endangered	Species or species habitat known to occur within area
Conospermum densiflorum subsp. unicephalatum One-headed Smokebush [64871]	Endangered	Species or species habitat may occur within area
Darwinia foetida Mucheas Bell [83190]	Critically Endangered	Species or species habitat known to occur within area
Diuris micrantha Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat may occur within area
Diuris purdiei Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat may occur within area
Drakaea elastica Glossy-leaved Hammer-orchid, Praying Virgin [16753]	Endangered	Species or species habitat likely to occur within area
Eleocharis keigheryi Keighery's Eleocharis [64893]	Vulnerable	Species or species habitat likely to occur within area
Epiblema grandiflorum var. cyaneum Baby Blue Orchid, Blue Babe-in-the-cradle Orchid, Blue Babe-in-a-cradle [67182]	Endangered	Species or species habitat may occur within area
Eucalyptus balanites Cadda Road Mallee, Cadda Mallee [24264]	Endangered	Species or species habitat may occur within area
Eucalyptus leprophloia Scaly Butt Mallee, Scaly-butt Mallee [56712]	Endangered	Species or species habitat may occur within area
Grevillea corrugata a shrub [65445]	Endangered	Species or species habitat known to occur within area
Grevillea curviloba subsp. curviloba Curved-leaf Grevillea [64908]	Endangered	Species or species habitat known to occur within area
Grevillea curviloba subsp. incurva Narrow curved-leaf Grevillea [64909]	Endangered	Species or species habitat known to occur within area
Lepidosperma rostratum Beaked Lepidosperma [14152]	Endangered	Species or species habitat likely to occur within area
Ptychosema pusillum Dwarf Pea [11268]	Vulnerable	Species or species habitat likely to occur within area
Thelymitra manginii K.Dixon & Batty ms. [67443]	Endangered	Species or species habitat likely to occur within area
Thelymitra stellata Star Sun-orchid [7060]	Endangered	Species or species habitat known to occur within area

Name	Status	Type of Presence
Verticordia plumosa var. pleiobotrya Narrow-petalled Featherflower, Mundijong Featherflower [55803]	Endangered	Species or species habitat may occur within area
Listed Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Migratory Wetlands Species		
Ardea alba Great Egret, White Egret [59541]		Breeding known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat likely to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [\[Resource Information \]](#)

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Defence - MUCHEA ARMAMENT RANGE

Commonwealth Heritage Places [\[Resource Information \]](#)

Name	State	Status
Natural		
Muehea / Pearce Air Weapons Range	WA	Indicative Place

Listed Marine Species [\[Resource Information \]](#)

Name	Threatened	Type of Presence
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Breeding known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat likely to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area

Extra Information

Places on the RNE [\[Resource Information \]](#)

Note that not all Indigenous sites may be listed.

Name	State	Status
Natural		
Mueha / Pearce Air Weapons Range	WA	Indicative Place
Lake Chandala Area	WA	Registered
Yeal - Gnangara Area	WA	Registered

State and Territory Reserves [\[Resource Information \]](#)

Name	State
Barracca	WA
Breera Road	WA
Burroloo Well	WA
Chandala	WA
Timaru	WA
Unnamed WA50678	WA

Regional Forest Agreements [\[Resource Information \]](#)

Note that all areas with completed RFAs have been included.

Name	State
South West WA RFA	Western Australia

Invasive Species [\[Resource Information \]](#)

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resources Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Funambulus pennantii Northern Palm Squirrel, Five-striped Palm Squirrel [129]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur

Name	Status	Type of Presence within area
Brachiaria mutica Para Grass [5879]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Genista linifolia Flax-leaved Broom, Mediterranean Broom, Flax Broom [2800]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area
Ramphotyphlops braminus Flowerpot Blind Snake, Brahminy Blind Snake, Cacing Besi [1258]		Species or species habitat likely to occur within area

Nationally Important Wetlands		[Resource Information]
Name		State
Chandala Swamp		WA

Coordinates

-31.48843 115.98843

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [-Department of Environment, Climate Change and Water, New South Wales](#)
- [-Department of Sustainability and Environment, Victoria](#)
- [-Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [-Department of Environment and Natural Resources, South Australia](#)
- [-Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts](#)
- [-Environmental and Resource Management, Queensland](#)
- [-Department of Environment and Conservation, Western Australia](#)
- [-Department of the Environment, Climate Change, Energy and Water](#)
- [-Birds Australia](#)
- [-Australian Bird and Bat Banding Scheme](#)
- [-Australian National Wildlife Collection](#)
- Natural history museums of Australia
- [-Museum Victoria](#)
- [-Australian Museum](#)
- [-SA Museum](#)
- [-Queensland Museum](#)
- [-Online Zoological Collections of Australian Museums](#)
- [-Queensland Herbarium](#)
- [-National Herbarium of NSW](#)
- [-Royal Botanic Gardens and National Herbarium of Victoria](#)
- [-Tasmanian Herbarium](#)
- [-State Herbarium of South Australia](#)
- [-Northern Territory Herbarium](#)
- [-Western Australian Herbarium](#)
- [-Australian National Herbarium, Atherton and Canberra](#)
- [-University of New England](#)
- [-Ocean Biogeographic Information System](#)
- [-Australian Government, Department of Defence](#)
- [-State Forests of NSW](#)
- [-Geoscience Australia](#)
- [-CSIRO](#)
- Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the [Contact Us](#) page.



APPENDIX C

Linear *Phytophthora* Dieback Risk Assessment

**Linear *Phytophthora* Dieback Risk Assessment of
M2091 Ioppolo Road, Chittering**

Prepared for Coffey Environments Australia Pty Ltd

Ref: T14008

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Terratree Pty Ltd

Executive Summary

Coffey Environments Australia Pty Ltd commissioned Terratree Pty Ltd to undertake a linear *Phytophthora* Dieback assessment of tracks and other potential disease vectors within and surrounding a block of native vegetation. The site is located in the Shire of Chittering approximately 80 km north of Perth. The site is 983 ha and mainly comprised of Banksia woodland with some areas of Marri (*Corymbia calophylla*) open forest.

The assessment was conducted in accordance with the Department of Parks and Wildlife's (DPaW) *Manual for detecting Phytophthora Dieback disease* (Procedures for DPaW managed lands) (DPaW 2013). Tracks, water courses and hard-hooved feral animals are considered to be the most likely vectors of disease into the study area. A linear Dieback assessment was determined to be an appropriate method for assessing the risk and likelihood of Dieback presence within and adjacent to the site.

Vegetation within the study area was categorised according to three different levels of risk:

- 1. High Risk:** Areas where *P. cinnamomi* has been recovered from samples and disease symptoms are consistent with the presence of Dieback.
- 2. Moderate Risk:** Areas exhibiting past or current disturbances (logging, grazing, dumping etc.) which has altered vegetation structure and composition and areas downslope of confirmed infestations, or vegetation exhibiting disease symptoms but have not returned positive results for *P. cinnamomi*.
- 3. Low Risk:** Areas of protectable uninfested vegetation (as determined by a registered Dieback interpreter), which exhibit multiple healthy indicator species, vegetation in Pristine to Very Good condition (Keighery scale 1-3), no disease pattern or chronology, and no significant risks from disease vectors or current land use.

The total study area, in terms of the linear corridor that was assessed, is 119.2ha. This is comprised of 19.4 ha of High Risk (16.3 %), 12.2 ha of Moderate Risk (10.2 %) and 87.6 ha (73.5 %) of Low Risk vegetation

In total, 11 soil and tissue samples were taken from recently dead and dying disease indicator species. Two positive results for *P. cinnamomi* were reported. In addition, a tissue sample was taken to test for canker and this returned a positive result for *Cytospora* sp.

In conclusion, the linear assessment determined that the majority of the study area (linear assessment corridor) is uninfested and therefore presented a low risk of spreading Dieback into areas outside the study corridor. While it is likely that the majority of the 983 ha site is uninfested, caution must be exercised when extrapolating the disease status and/or risk to vegetation that has not been assessed outside the study area.

Terratree makes the following recommendations in relation to assessment and management of Dieback at the site:

- A comprehensive Dieback assessment of the site should be completed in accordance with current Department of Parks and Wildlife standards (DPaW 2013).
- Protectable areas should be clearly demarcated and signposted.
- Additional sampling should be done in moderate risk areas.
- A Dieback management plan, including an access management strategy, should be developed for the site.

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Appendix 2: Sample Results from the Vegetation Health Services laboratory

1 Introduction

Coffey International (Coffey) commissioned Terratree Pty Ltd (Terratree) to undertake a linear *Phytophthora* Dieback (Dieback) assessment of tracks and other potential disease vectors within and surrounding a 983 ha block of native vegetation ('the site') in the Shire of Chittering. The linear assessment corridor includes a 25 m area either side of tracks and unsealed roads within and adjacent to the site, watercourses and other potential disease vectors (hereafter referred to as the 'study area').

1.1 Background

Phytophthora Dieback ('Dieback') is a soil borne pathogen with a range of plant hosts in the southwest of Western Australia. These predominantly belong to the Proteaceae, Ericaceae, Myrtaceae, Xanthorrhoeaceae and Fabaceae plant families. While some plant species are resistant, others are susceptible to the disease caused by the pathogen resulting in chlorosis, dieback and usually death.

According to the most recent Western Australian (WA) State of the Environment Report (Environmental Protection Authority 2007) *Phytophthora* Dieback, a Priority 1 Threat, is the third greatest threat to biodiversity after salinity and climate change. It is a more serious threat than weeds, native vegetation clearing, acid sulphate soils and soil erosion. It is significant in WA because:

- Over 40% (2,300) of the native plant species and half of the endangered plant species in the southwest of WA are susceptible to the pathogen
- The changes in plant community composition and structure that Dieback causes has impacts throughout the whole ecosystem, including on the indigenous fauna
- Dieback can lead to significant soil erosion as a result of the loss of susceptible vegetation

The Dieback pathogen is widespread in areas with greater than 800 mm of annual rainfall, less extensive in areas that receive between 600–800 mm and mainly restricted to water-gaining sites in areas that receive 400–600 mm. The pathogen does not occur in areas that receive less than 400 mm of annual rainfall. In WA, Dieback is a significant environmental issue for projects between Geraldton in the Midwest and Esperance on the South Coast and is widespread in the Southwest region.

1.2 Project Location and Description

The study area is located in the Shire of Chittering approximately 80 km north of Perth, approximately 15 km north of Muchea (**Figure 1**). The 960 ha site is mainly comprised of Banksia woodland with some Marri (*Corymbia calophylla*) open forest.

1.3 Regulatory Context

Phytophthora Dieback management is required under the following regulatory mechanisms in WA:

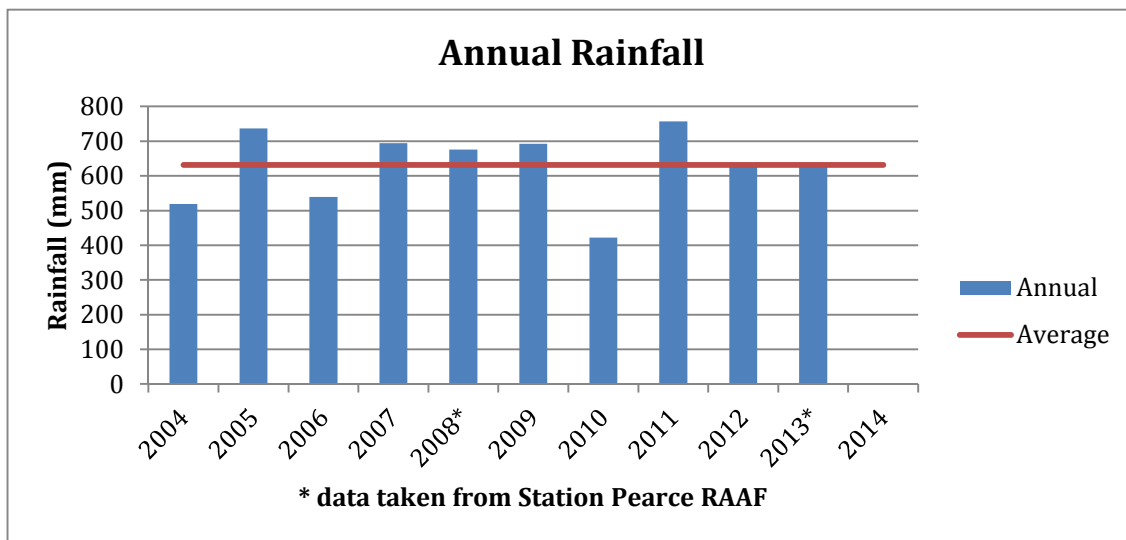
- *Phytophthora* Dieback is listed as a Key Threatening Process with the Federal Government under the *Environmental Protection and Biodiversity Conservation Act (1999)*
- *Environmental Protection Act (1986)* Part V S.50A "Serious Environmental Harm" provisions

2 Existing Environment

2.1 Climate

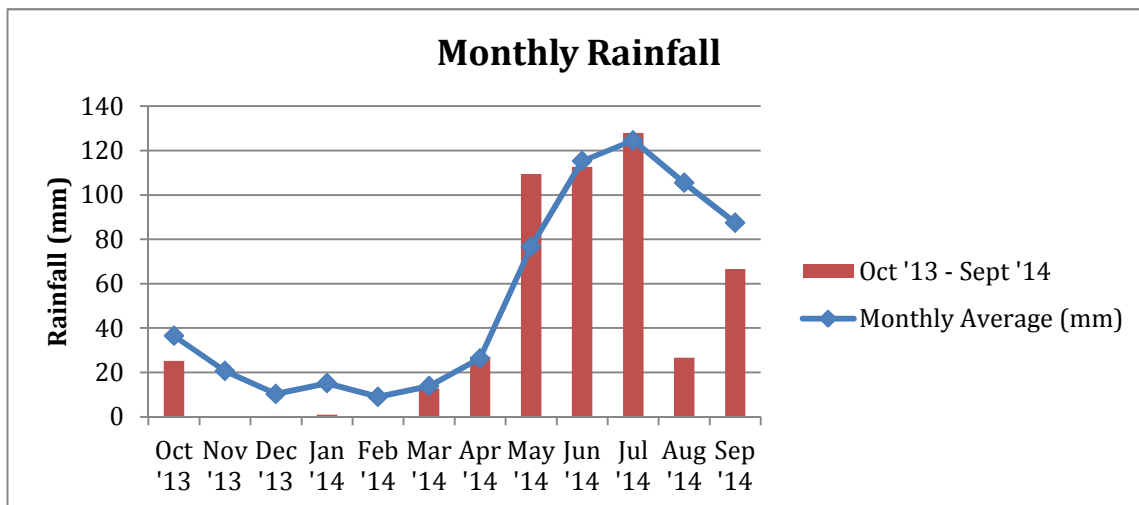
The Swan Coastal Plain region has a Mediterranean type climate with hot dry summers and cool wet winters. The warmest month is February, with an average monthly temperature of 30.4°C. The coolest month is July, with an average temperature of 18.3 °C.

Based on data from the Gingin Aero station (# 9178), the average annual rainfall for Muchea is 631.7 mm. The seasonal rainfall pattern for Muchea indicates an overall reduction in rainfall compared to historical averages, but exhibits variability in this trend, with years of significantly reduced rainfall interspersed with years of average to slightly above average rainfall (**Graph 1**). Significantly, the rainfall for 2010 was only 422 mm, which is 33% below average annual rainfall.



Graph 1: Annual rainfall at Gingin Aero station # 9178 (BoM, 2014)

Most rain falls in the cooler months of June-August. During winter 2014, this station received average or above-average rainfall until July, but a significant drop in rainfall was recorded during August and September compared to the long-term average.



Graph 2: Monthly rainfall at Gingin Aero station (# 9178) (2013-14) (BOM, 2014)

2.2 Biogeography

The study area is located in the Swan Coastal Plain Interim Biogeographic Regionalisation of Australia (IBRA) Bioregion, Perth Sub-Region (SWA02). This sub-region is dominated by woodlands of *Banksia* and Tuart on sandy soils, Sheoak on outwash plains, and paperbark in swampy areas. The colluvial and aeolian sand areas represent three phases of Quaternary marine sand dune development (which provide relief), and include a complex series of seasonal fresh water wetlands, alluvial river flats, coastal limestone and several off-shore islands. Younger sandy areas and limestone are dominated by heath and/or Tuart woodlands, while *Banksia* and Jarrah–*Banksia* woodlands are found on the older dune systems (Mitchell *et. al*, 2002).

2.3 Flora and Vegetation

Five vegetation complexes (Hedde *et. al* 1980) have been identified within the site. Descriptions of these vegetation complexes along with their interpretability for the presence of Dieback are presented below:

Moondah - supports predominantly a low closed to low open forest of *Banksia attenuata*, *B. menziesii*, *B. prionotes* and *Eucalyptus todtiana* on the slopes; and an open-woodland of Marri-*Banksia* in the valleys. Along the water courses, the vegetation is dominated by woodland of *E. rudis*, *Melaleuca raphiophylla* with some mixture of *M. preissiana* and thickets of *Kunzea vestita* in the understorey. One of the distinctive features of the Moondah vegetation complex is the presence of large number of *B. prionotes*. In other respects, due to the sandy soils, the vegetation has affinities with Mogumber, Cullala and Reagan complexes. Upland areas of the Moondah vegetation complex are highly interpretable for the presence of Dieback; however, the wetland areas are generally uninterpretable.

Reagan - supports vegetation ranging from low open-woodland of *B. attenuata*, *B. menziesii* and *E. todtiana* to closed heath depending on the depth of the soil. The composition of the understorey varies slightly depending on the proportion of sand and gravel. Plant species include *Adenanthos cygnorum*, *Petrophile linearis*, *Mesomelaena tetragona*, *Casuarina humilis*, *Mesomelaena stygia*, *Hakea trifurcata*, *Daviesia juncea* and species of *Hibbertia*, *Eremaea*, *Conospermum* and *Conostephium*. The Reagan complex is generally highly interpretable for the presence of Dieback.

Karamel South - is dominated by an open forest of Jarrah-Marri with a definite second storey of *B. grandis* on the gravelly soils with *B. attenuata* and *B. menziesii* on the sandier soils. Elsewhere on the Dandaragan Plateau, *B. grandis* is restricted mainly to the Gingin complex. Small areas of Wandoo occur in pockets on Karamal South. Other species in the open forest of Jarrah-Marri include *Stirlingia latifolia*, *B. sessilis*, *B. nivea*, *Hakea ruscifolia*, *Petrophile linearis*, *Jacksonia floribunda* and species of *Calytrix*, *Conostephium* and *Hakea*. The Karamel South complex is generally highly interpretable for the presence of Dieback.

Mogumber South - is dominated by an open-woodland of Marri with a well-defined second storey of Pricklybark-*Banksia* (*E. todtiana*, *B. attenuata*, *B. menziesii* and *B. ilicifolia*) The same pattern of Marri extending further north than Jarrah, seen of on the northern Swan Coastal Plain, is repeated in this area. Although localised patches of Jarrah are to be found, they are restricted in size and number. As one goes from the higher rainfall in the south to the lower rainfall in the north, Jarrah disappears first, then Marri. The intermingling of Pricklybark and Jarrah evident on the Bassendean sand dunes near Perth and Gnangara is repeated in the Mogumber complex. Understorey species vary considerably depending on proportion of sand and gravel, depth of sand and moisture levels, but include such species as *Nuytsia floribunda*, *Stirlingia latifolia*, *Petrophile linearis*, *Daviesia pectinata*, *Calothamnus sanguineus*, *Mesomelaena tetragona*, *Baeckea camphorosmae*, *Hypocalymma angustifolium*, *Leptocarpus scariosus*, *Casuarina humilis*, *Lyginia tenax* and *Bossiaea eriocarpa*. The Mogumber South complex is generally highly interpretable for the presence of Dieback.

Coonambidgee complex –this vegetation ranges from a low open forest to low woodland of *E. todtiana*, *Banksia attenuata*, *B. ilicifolia* with local admixtures of *B. prionotes*, to an open woodland of *Corymbia calophylla* and *Banksia* species. The Coonambidgee complex is generally highly interpretable for the presence of Dieback.

3 Methods

The Dieback assessment was done by DPAW registered Dieback Interpreter Joseph Grehan and Field Assistant Kelby Jennings in August 27th and 28th, 2014. While the assessment occurred during the optimal time of the year, sampling conditions were sub-optimal due to the lower than average winter rainfall.

The linear Dieback assessment was conducted in accordance with the *Manual for detecting Phytophthora Dieback disease* (Procedures for DPaW managed lands) (DPaW 2013). These recently updated Dieback Interpreters' guidelines now categorise land that has been cleared of native vegetation (such as farmland) as 'excluded' from assessment. Non-vegetated areas that are 'excluded' from assessment include pasture, pits, easements, development, large roads (sealed and unsealed) permanent flooding and parkland tree stands. Excluded areas are distinguished from unmappable areas by the fact that unmappable areas retain the ability to regenerate and eventually become mappable. **Table 1** presents the *Phytophthora* occurrence categories, impacts and syndromes (DPaW 2013), which include the unmappable category.

The unmappable category is allocated to areas of native vegetation which have been disturbed, but native vegetation will recover over time and may become interpretable and therefore mappable. Examples of unmappable areas include vegetation that has been impacted by fire, timber harvesting, flooding or mining with subsequent rehabilitation. The recovery time for unmappable areas may take longer than 3 years (DPaW 2013). **Table 1** presents details of the different Dieback occurrence categories as defined in DPaW's draft Dieback interpreter's guidelines (DPaW 2013).

Table 1: *Phytophthora* occurrence categories, impacts and syndromes (as cited in DPaW 2013)

<i>Phytophthora</i> occurrence mapping	Impact Rating	Syndrome	Comment
Infested: Impacts of <i>Phytophthora</i> Dieback are visible	High	Endemic or Extremely destructive Epidemic	
	Moderate	Commonly a variable epidemic but may also exist as or be progressing to an extremely destructive epidemic	This syndrome may not have reached full destructive potential, depending on the age of infestation. It might be progressing to High Impact, epidemic syndrome
	Low None of the susceptible overstorey is affected by disease	Variable epidemic Disease apparent	Although overall impact is low, it is not low enough to be given 'no apparent disease' syndrome
			May consist of very low level endemic disease in an environment not favourable to the pathogen
Uninfested: Areas of natural undisturbed or low disturbance vegetation free of symptoms that Indicate <i>Phytophthora</i> Dieback	Nil	No apparent disease	
Uninterpretable: Areas of natural undisturbed vegetation where susceptible plants are too few for interpretation of <i>Phytophthora</i> Dieback	None, or none perceptible	No apparent disease	May consist of very low level endemic disease in an environment not favourable to the pathogen
Unmappable: Keighery disturbance rating 4 or greater	Predicted impact rating may be forecast based using landform and vegetation types	Not assessable	

The Keighery vegetation disturbance scale (DPaW 2013) presented in **Table 2** was used to determine the interpretability of the vegetation. Areas with a vegetation condition rating of 1-3 (Pristine - Very Good) are considered to be mappable. In addition, there must be enough disease indicator species present to enable a diagnosis of the disease status. An area with a vegetation condition rating of 4 (Good) is possibly mappable; however, it is up to the interpreter's discretion. Unmappable and excluded areas are given a condition rating of 5 or 6 (Degraded or Completely Degraded).

Table 2: Keighery (1994) Vegetation Disturbance Scale and Assessability (as cited in DPaW 2013)

Interpretability	Scale		Condition
Mappable	1	Pristine	Pristine or nearly so, no obvious signs of disturbance
	2	Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species
	3	Very Good	Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing
Possibly Mappable, discretion required	4	Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, Dieback and grazing.
Unmappable or Excluded from assessment	5	Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, Dieback and grazing.
	6	Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as "parkland cleared" with the flora comprising weed or crop species with isolated native trees or shrubs.

3.1 Linear Assessment

A linear Dieback assessment was done on the tracks and unsealed roads within and adjacent to the study area. During the assessment, visual evidence of disease absence or presence was recorded within a 50 m wide corridor, 25m either side of the track or unsealed road. Other potential disease vectors including watercourses and disturbed areas in and adjacent to the site were also assessed. Reconnaissance of the study area was completed prior to commencing the linear assessment to determine the following:

- Access
- Identify interpretable vegetation and disease expression if present
- Identify possible disease vectors e.g. tracks, utility corridors, ground disturbance, feral animals etc.
- Determine the location of high risk areas (e.g. areas of high disturbance and water-gaining sites)
- Identify other impacts to vegetation (e.g. drought, cankers, herbivory, *Armillaria luteobubalina*, fire)

The assessment involved driving the tracks and unsealed roads within and surrounding the study area recording evidence of presence or absence of Dieback. When necessary areas outside the linear corridor were assessed, including watercourses and disturbed areas, to determine the broader landscape context and to ensure uninfested areas were protectable.

3.2 Disease Risk Categories

Vegetation within the study area was categorised into three different disease risk categories as described below in **Table 3**.

Table 3: Disease Risk Categories

Disease Risk Category	Description
High	Areas where <i>Phytophthora cinnamomi</i> has been recovered from samples and disease symptoms are consistent with the presence of Dieback.
Medium	Areas exhibiting past or current disturbances (logging, grazing, dumping etc.) which have altered vegetation structure and composition. Also includes areas downslope of confirmed infestations, or which exhibit disease symptoms but have not returned positive results for <i>P. cinnamomi</i> .
Low	Areas of protectable uninfested vegetation (as determined by a registered Dieback interpreter), which exhibit multiple healthy indicator species, vegetation in Pristine to Very Good condition (Keighery scale 1-3), no disease pattern or chronology, and no significant risks from disease vectors or current land use.

3.3 Sampling

Soil and tissue samples of recently dead or dying disease indicator species were collected and lodged with the DPaW's Vegetation Health Services Laboratory (VHS) where diagnostic baiting was conducted. All sample point locations were recorded with a hand-held GPS. The following sampling strategy was applied when determining sample locations:

Initial standards sampling: Initial samples are taken to determine disease behaviour. The results inform the sampling strategy and enable testing of early hypotheses (e.g. are other factors causing the deaths of susceptible species such as *Armillaria luteobubalina* or drought).

Sampling to support infested diagnosis: Recently dead and dying indicator species are sampled to support an infested diagnosis.

Sampling to support an uninfested diagnosis: Recently dead and dying indicator species are sampled to support an uninfested diagnosis. Caution must be exercised when claiming that a negative result means that an area is uninfested, because false negative results can be recorded when inoculum levels are depleted from prolonged unfavourable environmental conditions for the pathogen.

All sampling strictly adheres to the following procedures:

- All tools used in sampling are thoroughly sterilised with a 70:30 mixture of methylated spirits and water before samples are taken. It must be ensured that the tools are dry prior to sampling so that the results are not compromised.
- The area around the base of the plant being sampled is cleared of leaf litter and debris so that this material is not included in the sample.
- The plant sampled is excavated to suitable depth to ensure that adequate plant tissue material can be obtained from the roots and cambium layer around the collar of the plant being sampled.
- Material from all around the plant is taken in addition to any obvious lesions to avoid missing any infected material. All the plant tissue material and a few handfuls of soil from around the roots and other places in the soil profile are placed in a polythene bag.
- Enough distilled water to moisten the soil is poured into the bag to ensure the survival of any inoculum that may be present in the sample.
- All relevant information pertaining to the plant sampled and sample location is recorded on the Sample Information Sheet.
- Two aluminium tags with the date, project name, sample number, species sampled and the name of the interpreter are written. One tag is placed in the sample bag and the other is tied near the sample site which is also flagged with a day-glow orange flagging banner.
- The sample hole is backfilled to prevent fauna from becoming trapped.
- All tools are brushed off (to remove excess soil) and sterilised to prevent contamination of the next sample site and sample.

3.4 Mapping

Field evidence and observations were used to prepare the Dieback risk map (**Figure 2**) within the study area. The information used in mapping includes:

1. Sample results
2. Interpretability determined from vegetation condition and disease indicator present
3. Topography and drainage

3.5 Limitations

The DPaW's draft Dieback interpreters guidelines (DPaW 2013) discuss the limitations of linear assessment (P.88)

While a linear assessment uses the same methods as comprehensive transect assessments, it is often regarded as significantly more difficult to do, because the linear assessment corridor is easily taken out of context from wider landscape units. Phytophthora occurrence assessment boundaries may only briefly intersect linear corridors, giving little relative perspective to the wider landscape unit.

The following limitations were encountered during the assessment:

- The widespread impact of drought on the vegetation made Dieback interpretation more difficult.
- The impacts of canker species on susceptible vegetation, particularly *Banksia* species, made Dieback interpretation more difficult.
- Some areas were uninterpretable due to past disturbance caused by logging and grazing.
- Although the survey was conducted during the optimal time, negative sample results can be due to low inoculum levels for *Phytophthora cinnamomi* and therefore it is possible to obtain false negative results.

4 Results

In total, 11 soil and tissue samples were collected from recently dead and dying disease indicator species. The samples were baited at the VHS laboratory. In addition, a tissue sample was taken to test for canker and this returned a positive result for *Cytospora* sp. *Banksia* species including *Banksia attenuata*, *B. menziesii*, and *B. grandis* were the preferred species to sample because they are highly susceptible to the pathogen (Brandis 1983). The sample results are presented in **Table 4** below.

Table 4: Sample Results

Sample No.	Species	Easting GDA 94, Zone 50	Northing GDA 94, Zone 50	Result
CS01	<i>Banksia attenuata</i>	404805	6514443	<i>P. cinnamomi</i>
CS02	<i>Banksia grandis</i>	404874	6511350	Negative
CS03	<i>Banksia menziesii</i>	405328	6517342	Negative
CS04	<i>Banksia attenuata</i>	406281	6517239	Negative
CS05	<i>Banksia grandis</i>	406273	6516533	Negative
CS06	<i>Banksia menziesii</i> & <i>Banksia attenuata</i>	402347	6517398	<i>P. cinnamomi</i>
CS07	<i>Banksia attenuata</i>	402678	6514603	Negative
CS08	<i>Banksia attenuata</i>	403319	6514552	Negative
CS9	<i>Banksia grandis</i>	404215	6514542	<i>Cytospora</i> sp. (Canker)
CS10	<i>Banksia attenuata</i>	404459	6517350	Negative
CS11	<i>Xanthorrhoea preissii</i>	402356	6516852	Negative

The total study area in terms of the linear corridor that was assessed is 119.2ha. This is comprised of 19.4 ha of High Risk (16.3 %), 12.2 ha of Moderate Risk (10.2 %) and 87.6 ha (73.5 %) of Low risk vegetation (**Figure 2**).

5 Discussion

5.1 High Risk Areas

High risk areas are defined as areas where *Phytophthora cinnamomi* has been recovered and disease symptoms consistent with Dieback have been observed. Depending on disease expression symptoms may include:

- Multiple disease indicator species deaths
- Disease pattern and chronology
- Reduction in species richness and cover
- The presence of a disease vector (e.g. track, watercourse, evidence of animal vectors such as pigs)

The linear assessment identified three high risk areas within and adjacent to the study area:

1. The northern section of the power line track near Ippolo Road is infested with recently dead *Banksia attenuata* and *B. menziesii* returning a positive result for *P. cinnamomi* (sample CS08). The infestation runs down the slope along the power line but doesn't appear to extend further than 50 to 100m either side of the track. This section of the power line track poses a high risk of spreading Dieback through the site (**Plates 1 & 2**).
2. The unsealed road along the western boundary of the unnamed DPaW reserve to the west of the study area boundary is infested with two historical results for *P. cinnamomi* (VHS 2014). This unsealed road poses a high risk of vectoring disease along Ippolo Road and into the study area.
3. A section of vegetation on the northern side of the creek located to the south of site boundary is infested. A recently dead *Banksia attenuata* returned a positive result for *P. cinnamomi* (Sample CS01). It is believed that the disease has been vectored into the riparian zone of the creek by feral pigs (**Plate 3**) because there was no distinct disease pattern along the watercourse. The track crossing the creek into the southern boundary of study area poses a high risk as a disease vector.

5.2 Moderate Risk Areas

Two of the moderate risk areas have past disturbances, including logging and grazing, which have resulted altered vegetation structure and some disease indicator species deaths, but have not yielded positive results for *P. cinnamomi* (**Plate 4**). The other moderate risk area is along the power line track downslope of a confirmed infestation. Although this area did not yield a positive result for *P. cinnamomi* there were multiple disease indicator species deaths and additional sampling may recover a positive result

5.3 Low Risk Areas

Low risk areas are areas that have been determined to be uninfested by a DPaW registered Dieback Interpreter. While an uninfested diagnosis can be supported by negative sample results for *P. cinnamomi*, an area cannot be determined to be uninfested on sample results alone (**Plate 5**). Observable factors which can be used in making an uninfested diagnosis include the following:

- Multiple healthy disease indicator species.
- Vegetation condition is rated as 1-3 on the Keighery vegetation condition scale.
- No evidence of disease pattern or chronology.
- Indicator species deaths can be attributed to other factors i.e. drought, canker or *Armillaria*.

5.4 Other Potential Impacts to Vegetation

There may be other factors that caused the observed deaths of disease indicator species, including drought, other *Phytophthora* species, pathogenic fungi and *Armillaria luteobubalina* (*Armillaria* or Australian Honey Fungus).

5.4.1 Other *Phytophthora* species

Phytophthora arenaria is thought to be a native Australian species of *Phytophthora*, however its centre of diversity is still to be determined (C, Crane. Pers. Comm 16/12/2014). The website 'Phytophthora Database' describes the characteristics of *P. arenaria* as follows:

Phytophthora arenaria A. Rea, M. Stukely & T. Jung has been isolated in Western Australia from kwongan heath-land stands since the early 1980s (Burgess et al. 2009, Rea et al. 2011), but was misidentified as *P. citricola*. With the exception of one isolate from Bunbury (south-west coast) *P. arenaria* has been isolated exclusively from the northern sand plains. Most isolates were associated with dead or dying *Banksia* or *Eucalyptus* species; however, isolates were also recovered in association with asymptomatic *Banksia* and *Eucalyptus* species. The first isolation of this taxon was from soil in native kwongan vegetation near Kalbarri in 1986. *Phytophthora arenaria* has thick oospore walls and physiological characteristics that appear to be adaptations favouring survival in the harsh kwongan ecosystem suggesting that this species may be endemic to Western Australia. However, the most closely related species is *P. alticola* a species described from South Africa and the origin of both species requires further examination (<http://www.phytophthoradb.org>).

Another species, *Phytophthora multivora*, which has often been misdiagnosed for *P. citricola*, can persist in alkaline soil (Scott et al. 2009) which is suppressive to *P. cinnamomi*. The ability of *P. multivora* to survive in alkaline soils has implications for hygiene management because using limestone as a sterilising road-base material, as it has been previously used due to its antagonism to *P. cinnamomi*, may not be effective for managing *P. multivora* spread.

5.4.2 Other Pathogenic Fungi

The impact of cankers caused by pathogenic fungus on Proteaceous species was examined by Crane and Burgess (2013). The study examined the impact that aerial cankers are having on coastal vegetation between Esperance and Cervantes and demonstrated pathogenicity in seven *Banksia* spp. over a wide geographic range. The pathogenic fungus was identified as a new genus and species within the *Cryphonectriaceae* (*Diaporthales*) and is described as *Luteocirrhus shearii* gen. sp. nov. The fungus causes the death of single branches; however, it can lead to multiple branch deaths or cause complete crown dieback as occurred with some of the *Banksia baxteri* and *B. verticillata* sampled (Crane and Burgess 2013).

A tissue sample taken from a recently dead *Banksia grandis* was tested for the presence of canker at VHS. *Cytospora* sp. was recovered from the sample which is likely to indicate an inability of the plant to contain the fungi because this canker species can also be present on healthy plants (**Appendix 1**). *Banksia* species including *Banksia attenuata*, *B. grandis*, *B. prionotes* and *B. menziesii* displaying symptoms consistent with those described by Crane and Burgess, but not characteristic of *P. cinnamomi* disease expression, were observed throughout the study area. Canker impacts were observed throughout the study area and were generally discernible from Dieback symptoms by the death of single branches or lesions emanating above the trunk collar (**Plates 6, 7 & 8**).

5.4.3 Drought

Impacts to vegetation as a result of prolonged drought were differentiated from impacts caused by *P. cinnamomi* by the following characteristics:

- No disease pattern or chronology in the surrounding vegetation.
- The plant had senesced gradually rather than succumbing quickly as is usually the case with deaths attributed to *P. cinnamomi*.

- No visible lesions or mycelium on the roots of the dead or dying plant.
- Re-shooting or epicormic growth visible on dying plants (**Plates 9 & 10**).

The presence of single or multiple dead branches with the remainder of the plant appearing to be healthy may be attributed to drought or pathogenic fungi.

5.4.4 *Armillaria* (Australian Honey Fungus)

Armillaria luteobubalina (Armillaria or Australian Honey Fungus) is a species of mushroom which causes Armillaria root-rot in affected plants. The fungus is widespread in Jarrah (*Eucalyptus marginata*) and Karri (*E. diversicolor*) forests of the southwest of WA, but has also been recorded in coastal vegetation between Cape Arid (120 km east of Esperance) to Cervantes (160 km north-west of Perth) (Shearer *et al* 1997). *Armillaria* is dispersed by spores produced by the mushroom and also reproduces vegetatively through the roots of affected plants. It affects many of the same plant genera as *Phytophthora* in particular members of the Myrtaceae and Proteaceae plant families, such as *Eucalyptus* and *Banksia* species. *Armillaria* forms a quite visible white or yellow leathery mycelial sheath which is visible beneath the bark in the roots or lower stem. Other observable factors that can be applied in the diagnosis of *Armillaria* infection include:

- Clusters of fruiting bodies around or near the base of the plant
- A pungent mushroom smell
- An inverted V shaped scar at the base of the plant
- Yellow-white stringy rot under the bark in the roots and base of affected plants (DEC, 2012)

While some of the mycelium observed may be as a result of *Armillaria*, the assessment occurred at the wrong time of the year to observe fruiting bodies and therefore confirm the presence of the fungus. It is possible that *Armillaria luteobubalina* is present within the study area and contributing to the death of the vegetation.

6 Conclusion and Recommendations

Tracks, water courses and hard-hooved feral animals are considered to be the most likely vectors of disease in the study area. Therefore a linear Dieback assessment was considered an appropriate method for assessing the risk and likelihood of Dieback presence within and adjacent to the study area. The linear assessment determined that the majority of the study area is uninfested and therefore presents a low risk of spreading Dieback into areas outside the study corridor. While it is likely that the majority of the 983 ha site is uninfested, caution should be used when extrapolating the disease status and/or risk to vegetation that has not been assessed outside the study area.

Terratree makes the following recommendations in relation to the linear *Phytophthora* Dieback assessment of the study area:

- A comprehensive Dieback assessment of the site should be completed in accordance with *Manual for detecting and mapping Phytophthora Dieback disease* (Procedures for DPaW managed lands) (DPaW 2013).
- Protectable areas should be clearly demarcated and signposted.
- Additional samples from moderate risk areas should be taken.
- A Dieback management plan, including an access management strategy, should be developed for the site.

7 References

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Conservation and Land Management, Western Australia Scott P.M., Burgess T.I., Barber P.A., Shearer B.L., Stukely M.J.C., Hardy G.E.St J., Jung T. (2009) *Phytophthora multivora* sp. nov., a new species recovered from declining *Eucalyptus*, *Banksia*, *Agonis* and other plant species in Western Australia. *Persoonia*. 22: 1–13. Published online 2009 February 2. doi: 10.3767/003158509X415450

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Western Australian Native Plants Susceptible and Resistant to *Phytophthora cinnamomi* Compiled by E. Groves, G. Hardy & J. McComb, Murdoch University

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8 Glossary of Terms

Assessment – (*Phytophthora* occurrence) any combination of activities including, detection, diagnosis (interpretation), mapping and demarcation of *Phytophthora* Dieback disease in natural ecosystems.

Assessment Area – An area where *Phytophthora* occurrence assessment is possible, or will be possible in the short to medium term. This area may be larger or smaller than the proponent's project area.

Disease - The combination of a pathogen, host and correct environmental conditions, which results in disease symptoms or death of a host.

Environment - The sum of all external factors which act on an individual organism during its lifetime.

Excluded Area – An area of high disturbance in which native vegetation is unlikely to recover.

Host - means the plant which is invaded by a pathogen and from which the pathogen derives its energy.

Indicator species – Plant species that are more susceptible to *Phytophthora* disease and reliably show symptoms earlier than other species.

Infection – The invasion of a host organism's bodily tissue by disease causing organisms. In relation to Dieback this refers to an individual plant and not the population.

Infested – The state of being invaded or overrun by pests or parasites. In relation to Dieback it refers to a population of plants and not individual plants.

Inoculum – Cells, tissue, or viruses that are used to inoculate a new culture

Pathogen – Any organism or factor causing disease within a host

Pathogenic – Causing or capable of causing disease

***Phytophthora* Dieback** – A term referring to the disease symptoms caused by *Phytophthora* species in susceptible vegetation.

Susceptible – Likely to be influenced or able to be harmed by particular pathogen

Sporulation - a type of reproduction that occurs in fungi, algae, and protozoa and involves the formation of spores by the spontaneous division of a cell into four or more daughter cells, each of which contains a part of the original nucleus.

Symptom – A phenomenon that arises from, and accompanies a particular disease or disorder and serves as an indication of it

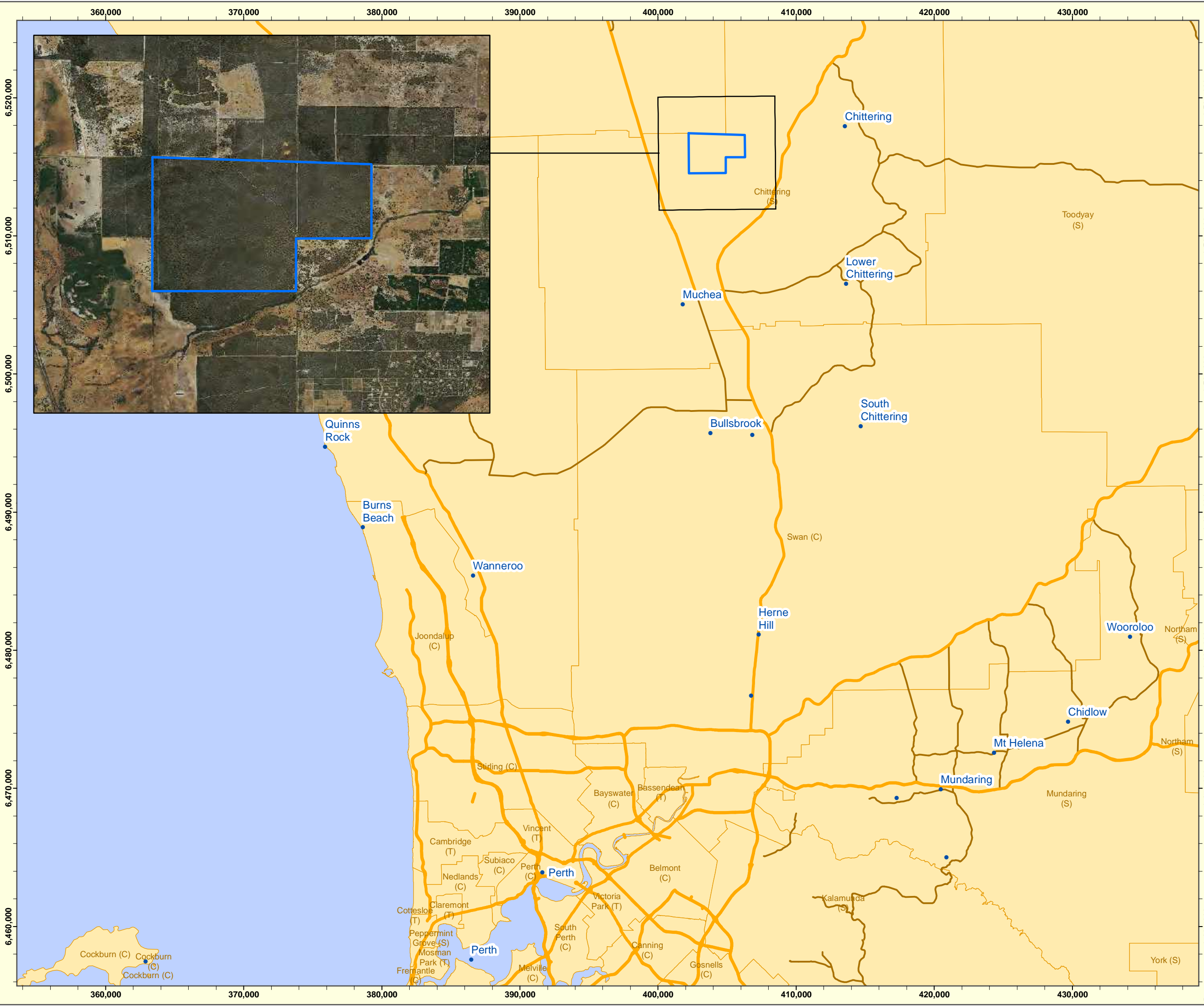
Uninfested – An area that does not contain infected plants or show visible signs of disease

Uninterpretable – a natural area where there are inadequate visible symptoms present to make a diagnosis

Unmappable – A naturally vegetated area that has had disturbance and from which is likely to recover in the short term

Unprotectable – A disease free area that is likely to become infested within a given time

Figures



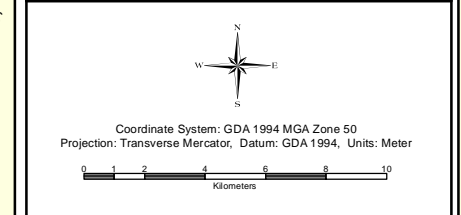
LEGEND

- Site boundary
- Towns
- Road (Primary Distributor)
- Road (Regional Distributor)

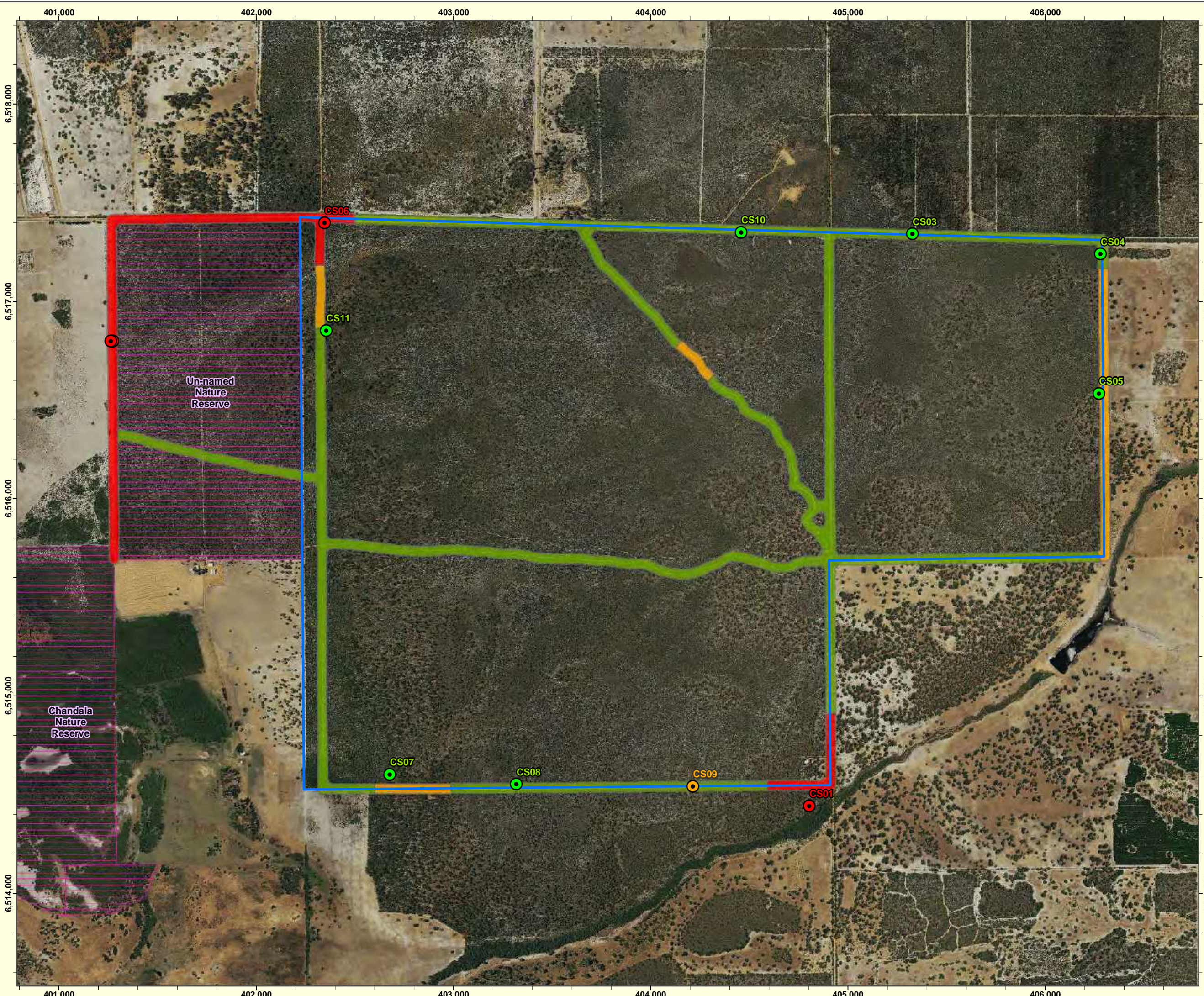


SITE LOCALITY

**Chittering Dieback
Reconnaissance Survey**



Scale @ A3: 1:250,000	Figure 01
Date: 22/09/2014	
Revision: Rev A	
Project No: TS14013	
Prepared: R Cullen	
Checked: J Botterill	
Reviewed: N King	



LEGEND

- Site boundary
- DPaW managed lands

Dieback sample results


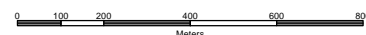
- Cytospora* sp. (canker)
- P. cinnamomi*
- Negative



Dieback risk assessment

- High
- Moderate
- Low



LINEAR DIEBACK RISK ASSESSMENT AND SAMPLE RESULTS
Chittering Dieback
Reconnaissance Survey


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


Scale @ A3: 1:17,500	Figure 02
Date: 22/09/2014	 
Revision: Rev C	
Project No: TS14013	
Prepared: R Cullen	
Checked: J Botterill	
Reviewed: N King	

9 Plates



Plate 1: High risk vegetation: Infested *Banksia* woodland with multiple indicator species deaths, disease pattern and chronology



Plate 2: Dead *Banksia attenuata* adjacent to disease vector (power line access track)



Plate 3: Evidence of feral pig activity, a likely vector for the positive *P. cinnamomi* sample



Plate 4: Medium risk vegetation - Area at risk due to historical disturbance due to logging, nearby areas of Infested vegetation and indicator species deaths.



Plate 5: Low risk vegetation - Uninfested woodland with low levels of disturbance and intact vegetation in Excellent condition



Plate 6: *Banksia grandis* exhibiting canker impacts



Plate 7: *Banksia* trunk exhibiting canker lesions on the cambium layer



Plate 8: *Banksia attenuata* exhibiting partial death due to canker



Plate 9: *Banksia* woodland exhibiting drought impacts



Plate 10: *Banksia attenuata* re-shooting after drought impact

10 Appendices

Appendix 1: Vegetation Health Services Laboratory report on positive identification of *Cytospora* sp. (canker) in CS11

Appendix 2: Sample Results from the Vegetation Health Services laboratory

PLANT DISEASE SAMPLE INFORMATION SHEET

CLIENT NAME Terratree Joe Grehan joeg@terratree.com.au

SAMPLE *Banksia grandis* canker CS 11 (canker) Fig. 1.

DIAGNOSIS A *Cytospora* sp. (Fig 2 & 3) was isolated and most likely indicates some inability of the plant to contain the fungi which can also be present on healthy plants.



Fig. 1 sample

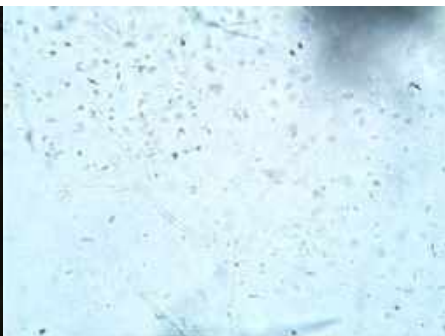


Fig. 2 Curved conidia



Fig.3 Alantoid conidia

THE PATHOGEN *Cytospora* sp. along with other genera in the Valsaceae, are commonly isolated from stem and twig cankers of *Eucalyptus*, *Hakea* and *Banksia* sp. of south-western Australia (Shearer 1994) They have a worldwide reputation as pathogens and cause extensive damage to tree crops. However in south-western Australia they often exist as benign endophytes (present in host tissues asymptotically) or wound pathogens causing disease only when the host is compromised in some way. Trees affected by drought, insect attack, defoliation by fungi, sunscald, herbicides or mechanical injury are predisposed to infection and disease development.

SYMPTOMS Twig and branch death.

HOST RANGE Myrtaceae, Proteaceae and Ericaceae

DISTRIBUTION Ubiquitous across the south-west but can have local high inoculum levels in infection pockets.

CONTROL Really need to trial this first to look at host/pathogen/fungicide response. Unsure? Is it warranted?

LABORATORY SAMPLES CC1721 not retained

SITE CS 11 Chittering

Boulder

MAP REFERENCE E 404215 N 6514542 Zone 50

19/9/2014

Colin Crane

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Science Division

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Email: colin.crane@dpaw.wa.gov.au

Shearer BL (1994) The major plant pathogens occurring in native ecosystems of south-western Australia, Journal of the Royal Society of Western Australia 77, 113-122.

VEGETATION HEALTH SERVICE - PHYTOPHTHORA SAMPLE INFORMATION SHEET

SEND TO: Vegetation Health Service, Science Division - D.E.C, 17 Dick Perry Ave KENSINGTON 6151 Phone: (08) 9334 0317 Fax: (08) 9334 0114

CONTACT DETAILS of sender

Name Joe Graham Terratree
 Fax No. 011 9335 4228 Phone No. 0411 200 3658
 DEC Office or Company Name Terratree Pty Ltd

GDA
 (1)
 GDA 94

Job Type (Please indicate)
 D.E.C. (C) Alcoa (A)
 Recoup (R) FPC
 Private (P) Other _____

VHS USE ONLY
 Date received 29/9/14
 Date faxed 12/9/14

VHS Identification Number (VHS USE ONLY)	Sample Date	Sample label (Give location, eg. Forest Block or Shire, etc. and sample number)	Plant species sampled	Site Impact (2)	Zone 50 or 51	Map Reference (3)	Land Tenure (4)	RESULT s/s root (5)	RESULT bait (5)
VHS31279	27/8/14	CS01 (chitting)	<i>Banksia attenuata</i>	M	50	E 404805 N 6514443	P		CIN
VHS31288	27/8/14	CS02 "	<i>Banksia grandis</i>	M	50	E 404874 N 6511350	P		NEG
VHS31281	27/8/14	CS03 "	<i>Banksia menziesii</i>	M	50	E 405325 N 6512242	P		NEG
VHS31282	27/8/14	CS04 "	<i>Banksia attenuata</i>	M	50	E 404251 N 6512232	P		NEG
VHS31283	27/8/14	CS05 "	<i>Banksia grandis</i>	H	50	E 400273 N 6516532	P		NEG
VHS31284	27/8/14	CS06 "	<i>B. menziesii</i>	L	50	E 401375 N 6516788	P		SUB
VHS31285	28/8/14	CS07 "	<i>B. menziesii</i>	NA	50	E 401251 N 6517193	P		AS FOR 31284
VHS31286	28/8/14	CS08 "	<i>B. menziesii</i> + <i>B. attenuata</i>	H	50	E 402347 N 6517395	P		CIN

NOTES:

1. Please tick this box if your map references are supplied in the GDA 94 standard. If not, please specify the datum used.
2. Site Impact - Low, Moderate, or High (as in the Dieback Interpreter's Manual).
3. An MGA map reference with prefixes must be supplied for all samples.
4. Land Tenure - State Forest (SF), National Park (NP), Reserve (R), Westrail (W), Private (P), Gravel Pit (GP), or other. (Other - describe in comments below).
5. Result codes used - CIN = *Phytophthora cinnamomi*, MUL = *P. multivora*, CRY = *P. cryptogea*, PI = *P. inundata*, ARE = *P. areolaris*, ELO = *P. elongata*, THE = *P. thomophila*, PM = *P. megasperma*, PN = *P. nicotianae*, CON = *P. constricta*, NEG = negative, SUB = subcultured for further tests

Please Note: a). NEG results cannot be used to represent a total absence of *Phytophthora* in the sampled area. b). Information from your samples will be incorporated into the VHS database.

COMMENTS:

VEGETATION HEALTH SERVICE - PHYTOPHTHORA SAMPLE INFORMATION SHEET

SEND TO: Vegetation Health Service, Science Division – D.E.C, 17 Dick Perry Ave KENSINGTON 6151 Phone: (08) 9334 0317 Fax: (08) 9334 0114

CONTACT DETAILS of sender

Name: Joe Graham
 Fax No. Mob 0402003658 Phone No. 93354228
 DEC Office or Company Name Terratree Pty Ltd

GDA
(1)
GDA 94 <input checked="" type="checkbox"/>

Job Type (Please indicate)	
D.E.C. (C)	Alcoa (A)
Recoup (R)	FPC
Private (P)	Other _____

VHS USE ONLY	
Date received	<u>30/3/14</u>
Date sampled	<u>12/9/14</u>

VHS Identification Number (VHS USE ONLY)	Sample Date	Sample label (Give location, eg. Forest Block or Shire, etc. and sample number)	Plant species sampled	Site Impact (2)	Zone 50 or 51	Map Reference (3)	Land Tenure (4)	RESULT s/s root (5)	RESULT bait (6)
 VHS31287	<u>28/8/14</u>	<u>CS09 (Whitting)</u>	<u>Banksia attenuata</u>	<u>M</u>	<u>50</u>	<u>E 402678</u> <u>N 6574203</u>	<u>P</u>		<u>NEG</u>
 VHS31288	<u>28/8/14</u>	<u>CS10 "</u>	<u>B. attenuata</u>	<u>L</u>	<u>50</u>	<u>E 403319</u> <u>N 6574352</u>	<u>P</u>		<u>NEG</u>
	<u>28/8/14</u>	<u>CS11 "</u>	<u>CANKER sample</u> <u>B. grandis</u>	<u>M</u>	<u>50</u>	<u>E 404215</u> <u>N 6574342</u>	<u>P</u>		
 VHS31289	<u>28/8/14</u>	<u>CS12 "</u>	<u>B. attenuata</u>	<u>L</u>	<u>50</u>	<u>E 404459</u> <u>N 6577350</u>	<u>P</u>		<u>NEG</u>
 VHS31290		<u>CS13 "</u>	<u>Xanthorrhoea</u> <u>preissii</u>	<u>M</u>	<u>50</u>	<u>E 402356</u> <u>N 6576352</u>	<u>P</u>		<u>NEG</u>
						<u>E -----</u> <u>N -----</u>			
						<u>E -----</u> <u>N -----</u>			
						<u>E -----</u> <u>N -----</u>			

NOTES:

1. Please tick this box if your map references are supplied in the GDA 94 standard. If not, please specify the datum used
2. Site impact - Low, Moderate, or High (as in the Dieback Interpreter's Manual).
3. An MGA map reference with prefixes must be supplied for all samples.
4. Land Tenure - State Forest (SF), National Park (NP), Reserve (R), Westrail (W), Private (P), Gravel Pit (GP), or other. (Other - describe in comments below).
5. Result codes used - CIN = *Phytophthora cinnamomi*, MUL = *P. multivora*, CRY = *P. cryptogea*, PI = *P. inundata*, ARE = *P. aranaria*, ELO = *P. elongata*, THE = *P. thermophila*, PM = *P. megasperma*, PN = *P. nicotianae*, CON = *P. constricta*, NEG = negative, SUB = subcultured for further tests

Please Note: a). NEG results cannot be used to represent a total absence of *Phytophthora* in the sampled area. b). Information from your samples will be incorporated into the VHS database.

COMMENTS:



APPENDIX D

Conservation
Significant Flora
Known to Occur or
Potentially Occur
Within the Study
Area

Species ¹	Conservation code ²			Habit ³	Habitat ³	Flowering period ³	Likelihood of occurrence
	EPBC Act	WC Act	DPAW				
<i>Acacia anomala</i>	VU	VU		Slender, rush-like shrub	Lateritic soils. Slopes.	Aug to Sep	Possible
<i>Acacia cummingiana</i>			3	Sprawling, straggly, rush-like shrub	Grey or yellow sand, lateritic gravel. Sandplains, lateritic breakaways.	May to Jun/ Aug	Likely
<i>Acacia drummondii</i> subsp. <i>affinis</i>			3	Erect shrub	Lateritic gravelly soils.	Jul to Aug	Likely
<i>Acacia pulchella</i> var. <i>reflexa</i> acuminate bracteole variant (R.J. Cumming 882)			3	Shrub, 0.3-1 m high	Sandy loam or sandy clay over laterite. Woodland.	Jul to Sep	Possible
<i>Adenanthos cygnorum</i> subsp. <i>chamaephyton</i>			3	Prostrate, mat-forming, non-lignotuberous shrub	Grey sand, lateritic gravel.	Jul/Sep to Dec/Jan	Possible
<i>Andersonia gracilis</i>	EN	VU		Slender erect or open straggly shrub	White/grey sand, sandy clay, gravelly loam. Winter-wet areas, near swamps.	Sep to Nov	Unlikely
<i>Anigozanthos viridis</i> subsp. <i>terraspectans</i>	VU	VU		Rhizomatous, perennial, herb	Grey sand, clay loam. Winter-wet depressions.	Aug to Sep	Unlikely
<i>Caladenia huegelii</i>	EN	CR		Tuberous, perennial, herb	Grey or brown sand, clay loam.	Sep to Oct	Possible
<i>Caustis</i> sp. Gigas (A.S. George 9318)			2	Erect, open sedge	Flat, dry white sand.	Aug to Nov	Likely
<i>Centrolepis caespitosa</i>	EN		4	Tufted annual, herb	White sand, clay. Salt flats, wet areas.	Oct to Dec	Unlikely
<i>Chamaescilla gibsonii</i>			3	Clumped tuberous, herb	Clay to sandy clay. Winter-wet flats, shallow water-filled claypans.	Sep	Unlikely

Species ¹	Conservation code ²			Habit ³	Habitat ³	Flowering period ³	Likelihood of occurrence
	EPBC Act	WC Act	DPAW				
<i>Chamelaucium</i> sp. Gingin (N.G. Marchant 6)	EN	VU		Unknown	Unknown.	Unknown	Likely
<i>Conospermum densiflorum</i> subsp. <i>Unicephalatum</i>	EN	EN		Erect, much-branched shrub	Clay soils. Low-lying areas.	Sep to Nov	Unlikely
<i>Cyathochaeta teretifolia</i>			3	Rhizomatous, clumped, robust perennial, grass-like or herb (sedge),	Grey sand, sandy clay. Swamps, creek.	Unknown	Unlikely
<i>Darwinia foetida</i>	CR	EN		Unknown	Unknown.	Unknown	Unlikely
<i>Diuris micrantha</i>	VU	VU		Tuberous, perennial, herb	Brown loamy clay. Winter-wet swamps, in shallow water.	Sep to Oct	Unlikely
<i>Diuris purdiei</i>	EN	EN		Tuberous, perennial, herb	Grey-black sand, moist. Winter-wet swamps.	Sep to Oct	Unlikely
<i>Drakaea elastica</i>	EN	CR		Tuberous, perennial, herb	White or grey sand. Low-lying situations adjoining winter-wet swamps.	Oct to Nov	Unlikely
<i>Drosera occidentalis</i> Morrison subsp. <i>occidentalis</i>				Fibrous-rooted, rosetted perennial, herb	Sandy & clayey soils. Swamps & wet depressions.	Nov to Dec	Unlikely
<i>Drosera sewelliae</i>			1	Fibrous-rooted, rosetted perennial, herb	Laterite & silica sand soils.	Oct	Possible
<i>Eleocharis keigheryi</i>	VU	VU		Rhizomatous, clumped perennial, grass-like or herb (sedge),	Clay, sandy loam. Emergent in freshwater: creeks, claypans.	Aug to Nov	Unlikely
<i>Eucalyptus balanites</i>	EN	CR		Mallee	Sandy soils with lateritic gravel	Oct to Dec	Unlikely

Species ¹	Conservation code ²			Habit ³	Habitat ³	Flowering period ³	Likelihood of occurrence
	EPBC Act	WC Act	DPAW				
<i>Eucalyptus leprophloia</i>	EN	EN		Mallee	White or grey sand over laterite. Valley slopes.	Aug to Oct	Unlikely
<i>Gastrolobium nudum</i>			2	Spreading, twiggy shrub	Red-brown clay, brown loam, gravel, laterite, granite. Flats, slopes, hilltops, ridges, valleys, breakaways.	Feb	Possible
<i>Grevillea candolleana</i>			2	Spreading shrub	Laterite, lateritic loam. Hillsides.	Aug to Sep	Possible
<i>Grevillea corrugata</i>	EN	VU		Shrub, 1.5-2.5 m high	Gravelly loam. Roadsides.	Aug to Sep	Unlikely
<i>Grevillea curviloba</i> subsp. <i>curviloba</i>	EN	CR		Prostrate to erect shrub	Grey sand. Winter-wet heath.	Oct	Possible
<i>Grevillea curviloba</i> subsp. <i>incurva</i>	EN	EN		Prostrate to erect shrub	Sand, sandy loam. Winter-wet heath.	Aug to Sep	Possible
<i>Grevillea evanescens</i>			1	Erect, robust shrub	Brown Spearwood sand.	Unknown	Possible
<i>Hibbertia glomerata</i> subsp. <i>ginginensis</i>			1	Erect shrub	Sand, brown clay, laterite. Near roadsides.	Jul to Sep	Possible
<i>Hibbertia helianthemoides</i>			4	Spreading to erect, low or prostrate shrub	Clayey sand over sandstone or loam over quartzite. Hills and scree slopes.	Jul/Sep to Oct	Unlikely
<i>Hypocalymma sylvestre</i>		CR		Spreading shrub	Yellow-brown sandy loam. Woodland on lateritic hilltop.	Aug	Unlikely
<i>Hypolaena robusta</i>			4	Dioecious rhizomatous, perennial, herb	White sand. Sandplains.	Sep to Oct	Likely

Species ¹	Conservation code ²			Habit ³	Habitat ³	Flowering period ³	Likelihood of occurrence
	EPBC Act	WC Act	DPAW				
<i>Isotropis cuneifolia</i> subsp. <i>glabra</i> Keighery			2	Prostrate to ascending, spreading perennial, herb or shrub	Sand, clay loam. Winter-wet flats.	Sep	Unlikely
<i>Lepidosperma rostratum</i>	EN	EN		Rhizomatous, tufted perennial, grass-like or herb (sedge)	Peaty sand, clay.	Unknown	Unlikely
<i>Leucopogon squarrosus</i> subsp. <i>trigynus</i>			2	Unknown	Unknown.	Unknown	Unlikely
<i>Meionectes tenuifolia</i>			3	Unknown	Unknown.	Unknown	Unlikely
<i>Myriophyllum echinatum</i>			3	Erect annual, herb	Clay. Winter-wet flats.	Nov	Unlikely
<i>Oxymyrrhine coronata</i>			4	Unknown	Unknown.	Unknown	Unlikely
<i>Persoonia rudis</i>			3	Erect, often spreading shrub	White, grey or yellow sand, often over laterite.	Sep to Dec/Jan	Possible
<i>Pithocarpa corymbulosa</i>			3	Erect to scrambling perennial, herb	Gravelly or sandy loam. Amongst granite outcrops.	Jan to Apr	Unlikely
<i>Platysace ramosissima</i>			3	Perennial, herb	Sandy soils.	Oct to Nov	Possible
<i>Ptychosema pusillum</i>	VU	VU		Perennial, herb	Sand. Rises	Aug to Oct	Possible
<i>Schoenus griffinianus</i>			3	Small, tufted perennial, grass-like or herb (sedge),	White sand.	Sep to Oct	Likely
<i>Stylidium cymiferum</i>			3	Rosetted perennial, herb	Brown loam over laterite. Uplands, Wandoo woodland.	Oct to Nov	Unlikely
<i>Stylidium longitubum</i>			3	Erect annual (ephemeral), herb	Sandy clay, clay. Seasonal wetlands.	Oct to Dec	Likely

Species ¹	Conservation code ²			Habit ³	Habitat ³	Flowering period ³	Likelihood of occurrence
	EPBC Act	WC Act	DPAW				
<i>Stylidium squamellosum</i>			2	Caespitose perennial, herb	Brown to red-brown clay loam. Winter-wet habitats and depressions, open woodland, shrubland.	Oct to Nov	Unlikely
<i>Synaphea grandis</i>			4	Tufted shrub	Laterite.	Oct to Nov	Possible
<i>Tetraria</i> sp. Chandala (G.J. Keighery 17055)			2	Unknown	Unknown.	Unknown	Likely
<i>Tetratheca pilifera</i>			3	Spreading shrub	Gravelly soils.	Aug to Oct	Unlikely
<i>Thelymitra stellata</i>	EN	EN		Tuberous, perennial, herb	Sand, gravel, lateritic loam.	Oct to Nov	Unlikely
<i>Trichocline</i> sp. Treeton (B.J. Keighery & N. Gibson 564)			2	Tuberous, perennial, herb	Sand over limestone, sandy clay over ironstone. Seasonally wet flats.	Unknown	Unlikely
<i>Verticordia lindleyi</i> subsp. <i>lindleyi</i>			4	Erect shrub	Sand, sandy clay. Winter-wet depressions.	May/Nov to Dec/Jan	Unlikely
<i>Verticordia rutilastra</i>			3	Shrub	Sand & lateritic gravel. Hills.	Sep to Nov	Likely
<i>Verticordia serrata</i> var. <i>linearis</i>			3	Shrub, to 1 m high	White sand, gravel. Open woodland.	Sep to Oct	Likely

1. See Section 4.1 for a comprehensive list of databases and reports reviewed to obtain the list of conservation significant flora.

2. See Appendix D for the descriptions of the conservation codes.

3. Descriptions and flowering periods obtained from DPAW (2014).



APPENDIX E

State and Federal Conservation Code Descriptions



1 STATE CONSERVATION CODES

1.1 Flora and fauna

T: Threatened species

Specially protected under the *Wildlife Conservation Act 1950*, listed under Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora (which may also be referred to as Declared Rare Flora).

Species 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.

X: Presumed extinct species

Specially protected under the *Wildlife Conservation Act 1950*, listed under Schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice for Presumed Extinct Fauna and Wildlife Conservation (Rare Flora) Notice for Presumed Extinct Flora (which may also be referred to as Declared Rare Flora).

Species which have been adequately searched for and there is no reasonable doubt that the last individual has died, and have been gazetted as such.

IA: Migratory birds protected under an international agreement

Specially protected under the *Wildlife Conservation Act 1950*, listed under Schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice.

Birds that are subject to an agreement between governments of Australia and Japan, China and The Republic of Korea relating to the protection of migratory birds and birds in danger of extinction.

S: Other specially protected fauna

Specially protected under the *Wildlife Conservation Act 1950*, listed under Schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice.

Threatened Fauna and Flora are further recognised by the Department of Parks and Wildlife according to their level of threat using IUCN Red List criteria. The ranking are:

CR Critically Endangered - considered to be facing an extremely high risk of extinction in the wild.


EN Endangered – considered to be facing a very high risk of extinction in the wild.

VU Vulnerable – considered to be facing a high risk of extinction in the wild.

Species that have not yet been adequately surveyed to be listed under Schedule 1 or 2 are added to the Priority Flora and Priority Fauna Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora or fauna. Species that are adequately known, are rare but not threatened, or meet criteria for Near Threatened, or that have been recently removed from the threatened list for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring. Conservation Dependent species are placed in Priority 5.

1: Priority One: Poorly-known species

Species that are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, rail reserves and Main



Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes.

2: Priority Two: Poorly-known species

Species that are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, unallocated Crown land, water reserves, etc. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes.

3: Priority Three: Poorly-known species

Species that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them.

4: Priority Four: Rare, Near Threatened and other species in need of monitoring

- (a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands.
- (b) Near Threatened. Species that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.
- (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

5: Priority Five: Conservation dependent species

Species that are not threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

1.2 Ecological Communities

Presumed Totally Destroyed (PD)

An ecological community that has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future.

An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant and either of the following applies (A or B):

- A) Records within the last 50 years have not been confirmed despite thorough searches of known or likely habitats or
- B) All occurrences recorded within the last 50 years have since been destroyed



Critically Endangered (CR)

An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated.

An ecological community will be listed as Critically Endangered when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This will be determined on the basis of the best available information, by it meeting any one or more of the following criteria (A, B or C):


- A) The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% and either or both of the following apply (i or ii):
 - i) geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 10 years);
 - ii) modification throughout its range is continuing such that in the immediate future (within approximately 10 years) the community is unlikely to be capable of being substantially rehabilitated.
- B) Current distribution is limited, and one or more of the following apply (i, ii or iii):
 - i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 10 years);
 - ii) there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes;
 - iii) there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes.
- C) The ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 10 years).

Endangered (EN)

An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future.

An ecological community will be listed as Endangered when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B, or C):

- A) The geographic range, and/or total area occupied, and/or number of discrete occurrences have been reduced by at least 70% since European settlement and either or both of the following apply (i or ii):
 - i) the estimated geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short term future (within approximately 20 years);
 - ii) modification throughout its range is continuing such that in the short term future (within approximately 20 years) the community is unlikely to be capable of being substantially restored or rehabilitated.

- 
- B) Current distribution is limited, and one or more of the following apply (i, ii or iii):
 - i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short term future (within approximately 20 years);
 - ii) there are few occurrences, each of which is small and/or isolated and all or most occurrences are very vulnerable to known threatening processes;
 - iii) there may be many occurrences but total area is small and all or most occurrences are small and/or isolated and very vulnerable to known threatening processes.
 - C) The ecological community exists only as very modified occurrences that may be capable of being substantially restored or rehabilitated if such work begins in the short-term future (within approximately 20 years).

Vulnerable (VU)

An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range.

An ecological community will be listed as Vulnerable when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction or significant modification in the medium to long-term future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B or C):

- A) The ecological community exists largely as modified occurrences that are likely to be capable of being substantially restored or rehabilitated.
- B) The ecological community may already be modified and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations.
- C) The ecological community may be still widespread but is believed likely to move into a category of higher threat in the medium to long term future because of existing or impending threatening processes.

Possible Threatened ecological communities that do not meet survey criteria or that are not adequately defined are added to the Priority Ecological Community List under priorities 1, 2 and 3. These three categories are ranked in order of priority for survey and/or definition of the community, and evaluation of conservation status, so that consideration can be given to their declaration as Threatened ecological communities. Ecological communities that are adequately known, and are rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list, are placed in Priority 4. These ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5.

Priority One: Poorly-known ecological communities

Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤ 5 occurrences or a total area of ≤ 100 ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.



Priority Two: Poorly-known ecological communities

Communities that are known from few occurrences with a restricted distribution (generally ≤ 10 occurrences or a total area of ≤ 200 ha). At least some occurrences are not believed to be under immediate threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.

Priority Three: Poorly known ecological communities

- (i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or:
- (ii) Communities known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or;
- (iii) Communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes.

Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.

Priority Four: Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring.

- (i) Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands.
- (ii) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.
- (iii) Ecological communities that have been removed from the list of threatened communities during the past five years.

Priority Five: Conservation Dependent ecological communities

Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

2 FEDERAL CONSERVATION CODES

2.1 Flora and fauna

Extinct

A native species is eligible to be included in the extinct category at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.



Extinct in the wild

A native species is eligible to be included in the extinct in the wild category at a particular time if, at that time:

- (a) it is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or
- (b) it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.

Critically endangered

A native species is eligible to be included in the critically endangered category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.

Endangered

A native species is eligible to be included in the endangered category at a particular time if, at that time:

- (a) it is not critically endangered; and
- (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.

Vulnerable

A native species is eligible to be included in the vulnerable category at a particular time if, at that time:

- (a) it is not critically endangered or endangered; and
- (b) it is facing a high risk of extinction in the wild in the medium term future, as determined in accordance with the prescribed criteria.

Conservation dependent

A native species is eligible to be included in the conservation dependent category at a particular time if, at that time:

- (a) the species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered; or
- (b) the following subparagraphs are satisfied:
 - (i) the species is a species of fish;
 - (ii) the species is the focus of a plan of management that provides for management actions necessary to stop the decline of, and support the recovery of, the species so that its chances of long term survival in nature are maximised;
 - (iii) the plan of management is in force under a law of the Commonwealth or of a State or Territory;
 - (iv) cessation of the plan of management would adversely affect the conservation status of the species.

2.2 Ecological communities

Critically endangered

An ecological community is eligible to be included in the critically endangered category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.



Endangered

An ecological community is eligible to be included in the endangered category at a particular time if, at that time:

- (a) it is not critically endangered; and
- (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.

Vulnerable

An ecological community is eligible to be included in the vulnerable category at a particular time if, at that time:

- (a) it is not critically endangered nor endangered; and
- (b) it is facing a high risk of extinction in the wild in the medium term future, as determined in accordance with the prescribed criteria.



APPENDIX F

Relevé Floristic Data

RELEVÉ DATA

Site: COR01
Described: CvdB & LD **Date:** 10/07/2014 **Type:** Releve
MGA Zone: 50 404219mE; 6517177mN
Habitat: Mid to upper north facing slope of a laterite rise
Soil: Black brown sandy loam with laterite
Rock Type: Laterite
Vegetation: *Eucalyptus marginata* and *Corymbia calophylla* mid sparse woodland over *Xanthorrhoea preissii* and *Allocasuarina humilis* mid open shrubland over *Hibbertia hypericoides*, *Conostephium pendulum* and *Hakea stenocarpa* low open shrubland
Condition: Excellent
Fire Age: >5 years
Notes Leaf Litter (%): 5
Rock Size (cm): 1-15
Exposed Rock (%): 17
Rock Cover (%): 22



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Acacia drummondii</i> subsp. <i>drummondii</i>		
<i>Allocasuarina humilis</i>	1	1.5
<i>Astroloma pallidum</i>		
<i>Astroloma stomarrhena</i>		
<i>Banksia bipinnatifida</i> subsp. <i>multifida</i>		
<i>Banksia bipinnatifida</i> subsp. <i>multifida</i>		
<i>Calectasia narragara</i>		
<i>Calothamnus sanguineus</i>		
<i>Conostephium pendulum</i>	1	0.5
<i>Corymbia calophylla</i>	1	10
<i>Daviesia physodes</i>		
<i>Daviesia physodes</i>		
<i>Eucalyptus marginata</i>	9	11
<i>Gonocarpus cordiger</i>		
<i>Grevillea pilulifera</i>		
<i>Hakea lissocarpa</i> (forma)	1	0.7
<i>Hakea stenocarpa</i>		
<i>Hibbertia hypericoides</i>	5	0.3
<i>Jacksonia floribunda</i>		
<i>Lepidosperma pubisquameum</i> (flat form)		
<i>Mesomelaena tetragona</i>		
<i>Patersonia occidentalis</i> var. <i>occidentalis</i>		
<i>Petrophile divaricata</i>		
<i>Synaphea spinulosa</i> subsp. <i>spinulosa</i>		
<i>Xanthorrhoea preissii</i>	12	1.8

Site: COR02
Described: CvdB & LD **Date:** 8/07/2014 **Type:** Relve
MGA Zone: 50 405595mE; 6516948mN
Habitat: Consolidated dune rise
Soil: Grey white coarse grained sand
Rock Type: N/A
Vegetation: *Eucalyptus marginata* mid sparse woodland over *Xanthorrhoea preissii* mid sparse shrubland over *Hibbertia hypericoides* and *Melaleuca systema* low heath shrubland over *Lepidosperma pubisquameum* (flat form) and *Mesomelaena pseudostygia* low sparse sedgeland over *Lyginia imberbis* low isolated rushes
Condition: Excellent
Fire Age: >5 years
Notes: Leaf Litter (%): 12



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Bossiaea eriocarpa</i>		
<i>Calytrix flavescens</i>		
<i>Calytrix variabilis</i>		
<i>Conostephium pendulum</i>		0.2
<i>Daviesia physodes</i>		
<i>Eucalyptus marginata</i>	6	13
<i>Gladiolus caryophyllaceus</i>		0.1
<i>Gompholobium tomentosum</i>		
<i>Hakea ruscifolia</i>		
<i>Hibbertia hypericoides</i>	15	0.3
<i>Hibbertia racemosa</i>		
<i>Hyalochlamys globifera</i>		
<i>Isopogon linearis</i>		
<i>Jacksonia floribunda</i>		
<i>Lepidosperma pubisquameum</i> (flat form)	1	0.3
<i>Lepidosperma squamatum</i>		
<i>Leucopogon conostephioides</i>		
<i>Leucopogon gracillimus</i>		
<i>Lomandra hermaphrodita</i>		
<i>Lyginia imberbis</i>	<1	0.3
<i>Melaleuca systema</i>	3	0.3
<i>Mesomelaena pseudostygia</i>	1	0.3
<i>Nuytsia floribunda</i>		
<i>Patersonia occidentalis</i> var. <i>occidentalis</i>		
<i>Persoonia saccata</i>		
<i>Stirlingia latifolia</i>		
<i>Xanthorrhoea preissii</i>	7	2

Site: COR03
Described: CvdB & LD **Date:** 8/07/2014 **Type:** Releve
MGA Zone: 50 405202mE; 6516708mN
Habitat: Upper plain on a consolidated dune rise
Soil: Yellow grey brown coarse-grained sand
Rock Type: N/A
Vegetation: *Banksia attenuata* and *B. menziesii* tall sparse shrubland over *Allocasuarina humilis*, *Daviesia divaricata* subsp. *divaricata* and *Xanthorrhoea preissii* mid heath shrubland over *Eremaea pauciflora* var. *pauciflora* and *Stirlingia latifolia* low open shrubland over *Mesomelaena pseudostygia* low sparse shrubland
Condition: Excellent
Fire Age: >5 years
Notes: Leaf Litter (%): 10



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Allocasuarina humilis</i>	37	1.5
<i>Banksia attenuata</i>	5	3.5
<i>Banksia dallanneyi</i> var. <i>dallanneyi</i>		
<i>Banksia menziesii</i>	3	3.5
<i>Bossiaea eriocarpa</i>		
<i>Calectasia narragara</i>		
<i>Calytrix flavescens</i>		
<i>Calytrix sylvana</i>		
<i>Calytrix variabilis</i>		
<i>Conospermum stoechadis</i>		
<i>Conostephium pendulum</i>		
<i>Conostylis aurea</i>		
<i>Daviesia divaricata</i> subsp. <i>divaricata</i>	1	2
<i>Daviesia triflora</i>		
<i>Drosera</i> ? <i>erythrorhiza</i>		
<i>Drosera pallida</i>		Creeper
<i>Eremaea pauciflora</i> var. <i>pauciflora</i>	4	0.5
<i>Hypocalymma xanthopetalum</i>		
<i>Jacksonia floribunda</i>		
<i>Lomandra sericea</i>		
<i>Lysinema pentapetalum</i>		
<i>Melaleuca systema</i>		
<i>Mesomelaena pseudostygia</i>	2	0.4
<i>Patersonia occidentalis</i> var. <i>occidentalis</i>		
<i>Petrophile macrostachya</i>		
<i>Stirlingia latifolia</i>	1	0.8
<i>Stylidium</i> sp.		
<i>Synaphea spinulosa</i> subsp. <i>spinulosa</i>		
<i>Xanthorrhoea preissii</i>	1	1.4

Site: COR04
Described: CvdB & LD **Date:** 8/07/2014 **Type:** Releve
MGA Zone: 50 406021mE; 6516192mN
Habitat: Upper plain of a consolidated dune rise
Soil: White brown coarse-grained sand
Rock Type: N/A
Vegetation: *Eucalyptus marginata* mid sparse woodland over *Banksia attenuata*, *B. grandis* and *Nuytsia floribunda* tall sparse shrubland over *Jacksonia floribunda* and *Adenanthos cygnorum* subsp. *cygnorum* mid open shrubland over *Eremaea pauciflora* var. *pauciflora*, *Hibbertia hypericoides* and *Melaleuca systema* low heath shrubland over *Mesomelaena pseudostygia* low sparse sedgeland
Condition: Excellent
Fire Age: >5 years
Notes: Leaf Litter (%): 12



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Adenanthos cygnorum</i> subsp. <i>cygnorum</i>	1	1.8
<i>Alexgeorgea nitens</i>		0.3
<i>Banksia attenuata</i>	4	4.5
<i>Banksia grandis</i>	1	4
<i>Bossiaea eriocarpa</i>		0.4
<i>Calytrix variabilis</i>		0.4
<i>Cassytha pomiformis</i>		Creeper
<i>Conostephium pendulum</i>		0.2
<i>Conostylis teretifolia</i> subsp. <i>teretifolia</i>		0.1
<i>Daviesia divaricata</i> subsp. <i>divaricata</i>		2
<i>Daviesia triflora</i>		0.4
<i>Drosera</i> ? <i>erythrorhiza</i>		Prostrate
<i>Eremaea pauciflora</i> var. <i>pauciflora</i>	1	0.5
<i>Eucalyptus marginata</i>	2	11
<i>Gladiolus caryophyllaceus</i>		0.1
<i>Hakea ruscifolia</i>		0.5
<i>Hibbertia hypericoides</i>	1	0.4
<i>Hibbertia racemosa</i>		0.3
<i>Isopogon linearis</i>		0.4
<i>Jacksonia floribunda</i>	1	1.1
<i>Lepidosperma pubisquameum</i> (flat form)		0.3
<i>Leucopogon conostephioides</i>		0.3
<i>Lyginia imberbis</i>		0.3
<i>Lysinema ciliatum</i>		0.6
<i>Melaleuca systema</i>	1	0.2
<i>Mesomelaena pseudostygia</i>	1	0.4
<i>Nuytsia floribunda</i>	1	4.5
<i>Patersonia occidentalis</i> var. <i>occidentalis</i>		0.4
<i>Persoonia saccata</i>		0.3
<i>Scholtzia involucrata</i>		0.3
<i>Stirlingia latifolia</i>		0.4
<i>Synaphea spinulosa</i> subsp. <i>spinulosa</i>		0.4

Site: COR05
Described: CvdB & LD **Date:** 8/07/2014 **Type:** Releve
MGA Zone: 50 406161mE; 6515925mN
Habitat: Upper to mid slope, Moderate slope facing East Southeast
Soil: Brown coarse-grained sandy loam with a laterite subsurface
Rock Type: Laterite
Vegetation: *Eucalyptus marginata* and *Corymbia calophylla* mid woodland over *Xanthorrhoea preissii* mid sparse shrubland over *Hibbertia hypericoides* low open shrubland over *Mesomelaena tetragona* low sparse sedgeland
Condition: Excellent
Fire Age: >5 years
Notes: Leaf Litter (%): 15
 Rock Size (cm): 1-10
 Exposed Rock (%): <1
 Rock Cover (%): <2



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Acacia applanata</i>		0.2
<i>Astroloma pallidum</i>		0.1
<i>Babingtonia camphorosmae</i>		0.3
<i>Banksia bipinnatifida</i> subsp. <i>multifida</i>		0.3
<i>Banksia dallanneyi</i> var. <i>dallanneyi</i>		0.3
<i>Burchardia congesta</i>		0.3
<i>Conostephium pendulum</i>		0.2
<i>Conostylis teretifolia</i> subsp. <i>teretifolia</i>		0.1
<i>Corymbia calophylla</i>	5	12
<i>Daviesia physodes</i>		0.4
<i>Daviesia preissii</i>		0.4
<i>Drosera</i> ? <i>erythrorhiza</i>		
<i>Drosera pallida</i>		Creeper
<i>Eucalyptus marginata</i>	10	12
<i>Gladiolus caryophyllaceus</i>		0.1
<i>Gompholobium marginatum</i>		0.2
<i>Grevillea pilulifera</i>		0.2
<i>Hakea lissocarpha</i> (forma)		0.4
<i>Hibbertia hypericoides</i>	25	0.3
<i>Lagenophora huegelii</i>		
<i>Lepidosperma</i> sp. Northern Sandplains (R. Barrett)		0.1
<i>Lomandra preissii</i>		0.3
<i>Mesomelaena tetragona</i>	2	0.3
Orchidaceae sp.		
<i>Styphelia tenuiflora</i>		0.4
<i>Xanthorrhoea preissii</i>	3	1

Site: COR06
Described: CvdB & LD **Date:** 8/07/2014 **Type:** Releve
MGA Zone: 50 404958mE; 6516136mN
Habitat: Plain on top of a consolidated dune rise
Soil: Grey brown coarse-grained sand
Rock Type: N/A
Vegetation: *Eucalyptus marginata* low sparse woodland over *Banksia attenuata*, *B. menziesii* and *Adenanthos cygnorum* subsp. *cygnorum* tall open shrubland over *Jacksonia floribunda* mid isolated shrubs over *Hibbertia hypericoides* and *Stirlingia latifolia* low open shrubland over *Hypolaena exsulca* low sparse sedges over *Lyginia imberbis* and *Alexgeorgea nitens* low sparse rushland
Condition: Excellent
Fire Age: >5 years
Notes: Leaf Litter (%): 10



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Adenanthos cygnorum</i> subsp. <i>cygnorum</i>	2	4
<i>Alexgeorgea nitens</i>	1	0.1
<i>Astroloma xerophyllum</i>		0.5
<i>Banksia attenuata</i>	16	4.5
<i>Banksia menziesii</i>	2	4.0
<i>Bossiaea eriocarpa</i>		0.2
<i>Calytrix flavescens</i>		0.3
<i>Calytrix variabilis</i>		0.6
<i>Cassytha pomiformis</i>		Creeper
<i>Conospermum crassinervium</i>		0.3
<i>Conostylis teretifolia</i> subsp. <i>teretifolia</i>		0.1
<i>Drosera</i> ? <i>erythrorhiza</i>		0.1
<i>Drosera pallida</i>		creeper
<i>Eremaea pauciflora</i> var. <i>pauciflora</i>	10	0.5
<i>Eucalyptus marginata</i>	1	7.5
<i>Hibbertia hypericoides</i>	1	0.4
<i>Hibbertia subvaginata</i>		0.5
<i>Hypolaena exsulca</i>	1	0.5
<i>Isopogon linearis</i>		0.4
<i>Jacksonia floribunda</i>	0.25	1.2
<i>Leucopogon conostephioides</i>		0.3
<i>Lyginia imberbis</i>	1	0.2
<i>Melaleuca systema</i>		0.3
<i>Mesomelaena tetragona</i>		0.2
<i>Patersonia occidentalis</i> var. <i>occidentalis</i>		0.3
<i>Scholtzia involucrata</i>		0.2
<i>Stirlingia latifolia</i>	1	0.4

Site: COR07
Described: CvdB & LD **Date:** 9/07/2014 **Type:** Releve
MGA Zone: 50 404569mE; 6515568mN
Habitat: Consolidated low dune
Soil: Yellow grey coarse grey sand
Rock Type: N/A
Vegetation: *Eucalyptus marginata* and *Corymbia calophylla* mid sparse woodland over *Xanthorrhoea preissii* and *Calothamnus sanguineus* mid sparse shrubland over *Hibbertia hypericoides*, *Conostephium pendulum* and *Stirlingia latifolia* low heath shrubland over *Mesomelaena pseudostygia* low sparse sedgeland
Condition: Excellent
Fire Age: >5 years
Notes: Leaf Litter (%): 7



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Banksia dallanneyi</i> var. <i>dallanneyi</i>		
<i>Calothamnus sanguineus</i>	1	1
<i>Calytrix variabilis</i>		
<i>Cassytha pomiformis</i>		Creeper
<i>Conostephium pendulum</i>	1	0.5
<i>Corymbia calophylla</i>	1	10
<i>Daviesia physodes</i>		
<i>Drosera pallida</i>		Creeper
<i>Eucalyptus marginata</i>	8	14
<i>Gladiolus caryophyllaceus</i>		
<i>Gompholobium marginatum</i>		
<i>Hibbertia hypericoides</i>	6	0.5
<i>Hibbertia racemosa</i>		
<i>Isopogon linearis</i>		
<i>Kunzea glabrescens</i>		
<i>Lepidosperma pubisquameum</i> (flat form)		
<i>Lepidosperma squamatum</i>		
<i>Macrozamia riedlei</i>		
<i>Mesomelaena pseudostygia</i>	3	0.4
<i>Olearia lehmanniana</i>		0.2
<i>Patersonia occidentalis</i> var. <i>occidentalis</i>		
<i>Stirlingia latifolia</i>	1	0.4
<i>Stylidium</i> sp.		Prostrate
<i>Styphelia tenuiflora</i>		
<i>Xanthorrhoea preissii</i>	3	1.5
<i>Xanthosia huegelii</i>		0.1

Site: COR08
Described: CvdB & LD **Date:** 9/07/2014 **Type:** Releve
MGA Zone: 50 404538mE; 6515087mN
Habitat: Top of a consolidated dune
Soil: Yellow brown coarse sand
Rock Type: N/A
Vegetation: *Eucalyptus tottiana* mid sparse mallee woodland over *Banksia attenuata* tall sparse shrubland over *Allocasuarina humilis* and *Xanthorrhoea preissii* mid sparse shrubland over *Hibbertia hypericoides*, *Calothamnus sanguineus* and *Eremaea pauciflora* var. *pauciflora* low open shrubland
Condition: Excellent - Pristine
Fire Age: >5 years
Notes: Leaf Litter (%): 10



SPECIES LIST

Name	Cover	Height
<i>Acacia extensa</i>		
<i>Acacia sessilis</i>		
<i>Allocasuarina humilis</i>		
<i>Astroloma pallidum</i>		
<i>Banksia attenuata</i>		
<i>Banksia dallanneyi</i> var. <i>dallanneyi</i>		
<i>Bossiaea eriocarpa</i>		
<i>Burchardia congesta</i>		
<i>Calothamnus sanguineus</i>		
<i>Cassytha pomiformis</i>		Creeper
<i>Conostephium pendulum</i>		
<i>Daviesia triflora</i>		
<i>Drosera</i> ? <i>erythrorhiza</i>		
<i>Eremaea pauciflora</i> var. <i>pauciflora</i>		
<i>Eucalyptus tottiana</i>		
<i>Gladiolus caryophyllaceus</i>		
<i>Hakea lissocarpha</i> (forma)		
<i>Hibbertia hypericoides</i>		
<i>Hibbertia racemosa</i>		
<i>Isopogon linearis</i>		
<i>Leptomeria cunninghamii</i>		
<i>Lyginia imberbis</i>		
<i>Mesomelaena pseudostygia</i>		
<i>Nuytsia floribunda</i>		
<i>Patersonia occidentalis</i> var. <i>occidentalis</i>		
<i>Persoonia saccata</i>		
<i>Petrophile macrostachya</i>		
<i>Scholtzia involucrata</i>		
<i>Synaphea spinulosa</i> subsp. <i>spinulosa</i>		
<i>Xanthorrhoea preissii</i>		

Site: COR09
Described: CvdB & LD **Date:** 9/07/2014 **Type:** Releve
MGA Zone: 50 404642mE; 6514639mN
Habitat: Middle to upper slope, moderate slope facing south
Soil: Brown coarse sandy loam
Rock Type: laterite
Vegetation: *Eucalyptus marginata* mid sparse woodland over *Xanthorrhoea preissii* mid sparse shrubland over *Hibbertia hypericoides* low open shrubland over *Lepidosperma pubisquameum* (flat form) and *Mesomelaena tetragona* low sparse sedgeland
Condition: Excellent
Fire Age: >5 years
Notes Leaf Litter (%): 30
 Rock Size (cm): 5-10
 Exposed Rock (%): <1
 Rock Cover (%): 5



SPECIES LIST

Name	Cover	Height
<i>Acacia nervosa</i>		
<i>Astroloma pallidum</i>		
<i>Banksia bipinnatifida</i> subsp. <i>multifida</i>		
<i>Banksia dallanneyi</i> var. <i>dallanneyi</i>		
<i>Bossiaea eriocarpa</i>		
<i>Conostephium pendulum</i>		
<i>Conostylis teretifolia</i> subsp. <i>teretifolia</i>		
<i>Daviesia preissii</i>		
<i>Drosera</i> ? <i>erythrorhiza</i>		
<i>Drosera pallida</i>		
<i>Eucalyptus marginata</i>	9	11
<i>Gompholobium marginatum</i>		
<i>Grevillea pilulifera</i>		
<i>Grevillea pilulifera</i>		
<i>Hakea lissocarpha</i> (forma)		
<i>Hakea trifurcata</i>		
<i>Hibbertia hypericoides</i>	6	0.3
<i>Hibbertia racemosa</i>		
<i>Lepidosperma pubisquameum</i> (flat form)	1	0.3
<i>Lepidosperma</i> sp. Northern Sandplains (R. Barrett)		
<i>Leucopogon gracillimus</i>		
<i>Leucopogon gracillimus</i>		
<i>Lomandra sericea</i>		
<i>Mesomelaena tetragona</i>	1	0.3
<i>Petrophile striata</i>		
<i>Stylidium</i> sp.		
<i>Synaphea spinulosa</i> subsp. <i>spinulosa</i>		
Unknown sp.		
<i>Xanthorrhoea preissii</i>	5	1.5

Site: COR10
Described: CvdB & LD **Date:** 9/07/2014 **Type:** Releve
MGA Zone: 50 403976mE; 6514919mN
Habitat: Mid consolidated dune
Soil: White grey coarse grained sand
Rock Type: N/A
Vegetation: *Eucalyptus todtiana* mid sparse mallee woodland over *Nuytsia floribunda* low sparse woodland over *Banksia attenuata* and *Adenanthos cygnorum* tall sparse shrubland over *Beaufortia elegans* and *Xanthorrhoea preissii* mid sparse shrubland over *Calothamnus sanguineus* and *Hibbertia hypericoides* low sparse shrubland
Condition: Excellent
Fire Age: >5 years
Notes: Leaf Litter (%): 5



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Acacia extensa</i>		
<i>Acacia pulchella</i> var. <i>pulchella</i>		
<i>Adenanthos cygnorum</i>	1	4
<i>Banksia attenuata</i>	2	4
<i>Beaufortia elegans</i>	5	1.4
<i>Bossiaea eriocarpa</i>		
<i>Calothamnus sanguineus</i>	3	0.9
<i>Calytrix variabilis</i>		
<i>Cassytha pomiformis</i>		
<i>Conostephium pendulum</i>		
<i>Conostylis teretifolia</i> subsp. <i>teretifolia</i>		
<i>Daviesia triflora</i>		
<i>Drosera</i> ? <i>erythrorhiza</i>		
<i>Eremaea pauciflora</i> var. <i>pauciflora</i>		
<i>Eucalyptus todtiana</i>	4	6
<i>Hibbertia hypericoides</i>	1	0.5
<i>Hibbertia racemosa</i>		
<i>Hibbertia subvaginata</i>		
<i>Hypolaena robusta</i>		
<i>Isopogon linearis</i>		
<i>Jacksonia floribunda</i>		
<i>Leucopogon conostephioides</i>		
<i>Leucopogon gracillimus</i>		
<i>Lomandra sericea</i>		
<i>Lyginia imberbis</i>		
<i>Nuytsia floribunda</i>	1	6
<i>Patersonia occidentalis</i> var. <i>occidentalis</i>		
<i>Persoonia saccata</i>		
<i>Scholtzia involucrata</i>		
<i>Synaphea spinulosa</i> subsp. <i>spinulosa</i>		
<i>Xanthorrhoea preissii</i>	3	2

Site: COR11
Described: CvdB & LD **Date:** 9/07/2014 **Type:** Releve
MGA Zone: 50 403705mE; 6515359mN
Habitat: Consolidated dune, small depression in mid slope
Soil: Yellow brown coarse-grained sandy loam
Rock Type: N/A
Vegetation: *Banksia attenuata* and *B. menziesii* tall sparse shrubland over *Allocasuarina humilis* and *Xanthorrhoea preissii* mid sparse shrubland over *Eremaea pauciflora* var. *pauciflora*, *Hibbertia hypericoides* and *Melaleuca systema* low sparse shrubland over *Mesomelaena pseudostygia* low sparse sedgeland
Condition: Excellent - Pristine
Fire Age: >5 years
Notes: Leaf Litter (%): 8



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Acacia sessilis</i>		
<i>Allocasuarina humilis</i>	1	1.5
<i>Banksia attenuata</i>	7	5
<i>Banksia dallanneyi</i> var. <i>dallanneyi</i>		
<i>Banksia menziesii</i>	1	5
<i>Calothamnus sanguineus</i>		
<i>Calytrix flavescens</i>		
<i>Cryptandra scoparia</i>		
<i>Daviesia divaricata</i> subsp. <i>divaricata</i>		
<i>Drosera</i> ? <i>erythrorhiza</i>		
<i>Drosera pallida</i>		Creeper
<i>Eremaea pauciflora</i> var. <i>pauciflora</i>	8	0.4
<i>Hakea lissocarpha</i> (forma)		
<i>Hibbertia hypericoides</i>	2	0.3
<i>Isopogon linearis</i>		
<i>Jacksonia floribunda</i>		
<i>Lepidobolus preissianus</i>		
<i>Leptospermum spinescens</i>		
<i>Melaleuca systema</i>	2	0.4
<i>Mesomelaena pseudostygia</i>	21	0.3
<i>Nuytsia floribunda</i>		
<i>Petrophile macrostachya</i>		
<i>Scholtzia involucrata</i>		
<i>Stylidium cygnorum</i>		
<i>Xanthorrhoea preissii</i>	1	1.5

Site: COR12
Described: CvdB & LD **Date:** 10/07/2014 **Type:** Releve
MGA Zone: 50 403022mE; 6515040mN
Habitat: Mid to upper west facing slope
Soil: Dark brown coarse-grained sandy loam, rocky
Rock Type: Laterite
Vegetation: *Eucalyptus marginata* and *Corymbia calophylla* mid sparse woodland over *Xanthorrhoea preissii* mid open shrubland over *Hibbertia hypericoides*, *Acacia celastrifolia* and *Hakea lissocarpha* low sparse shrubland
Condition: Very Good - Excellent
Fire Age: >5 years
Notes: Leaf Litter (%): 18
 Rock Size (cm): 1-15
 Exposed Rock (%): 1
 Rock Cover (%): 4



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Acacia applanata</i>		
<i>Acacia celastrifolia</i>	1	1
<i>Acacia preissiana</i>		
<i>Corymbia calophylla</i>	1	10
<i>Drosera pallida</i>		Creeper
<i>Eucalyptus marginata</i>	3	12
<i>Gompholobium marginatum</i>		
<i>Gonocarpus cordiger</i>		
<i>Grevillea pilulifera</i>		
<i>Hakea lissocarpha</i> (forma)	1	0.4
<i>Hakea stenocarpa</i>		
<i>Hibbertia hypericoides</i>	2	0.7
<i>Hibbertia racemosa</i>		
<i>Hypochaeris glabra</i>		
<i>Lomandra sericea</i>		
<i>Macrozamia riedlei</i>		
<i>Patersonia occidentalis</i> var. <i>occidentalis</i>		
<i>Petrophile striata</i>		
<i>Phyllanthus calycinus</i>		
<i>Synaphea spinulosa</i> subsp. <i>spinulosa</i>		
<i>Xanthorrhoea preissii</i>	12	2

Site: COR13
Described: CvdB & LD **Date:** 10/07/2014 **Type:** Releve
MGA Zone: 50 403244mE; 6514681mN
Habitat: Top of a rocky rise
Soil: Black brown coarse loamy sand
Rock Type: laterite
Vegetation: *Corymbia calophylla* and *Nuytsia floribunda* mid sparse woodland over *Banksia sessilis* var. *sessilis* tall sparse shrubland over *Xanthorrhoea preissii* mid open shrubland over *Calothamnus sanguineus* and *Hibbertia hypericoides* low open shrubland
Condition: Very Good - Excellent
Fire Age: >5 years
Notes: Leaf Litter (%): 21
 Rock Size (cm): 1-11
 Exposed Rock (%): 2
 Rock Cover (%): 3



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Acacia extensa</i>		
<i>Acacia preissiana</i>		
<i>Banksia dallanneyi</i> var. <i>dallanneyi</i>		
<i>Banksia sessilis</i> var. <i>sessilis</i>	3	4.5
<i>Boronia ramosa</i> subsp. <i>anethifolia</i>		
<i>Bossiaea eriocarpa</i>		
<i>Calothamnus sanguineus</i>	9	0.6
<i>Calytrix variabilis</i>		
<i>Cassytha pomiformis</i>		Creeper
<i>Corymbia calophylla</i>	3	11
<i>Desmodcladus flexuosus</i>		
<i>Drosera pallida</i>		Creeper
<i>Gompholobium marginatum</i>		
<i>Hakea lissocarpha</i> (forma)		
<i>Hakea ruscifolia</i>		
<i>Hibbertia hibbertioides</i>		
<i>Hibbertia hypericoides</i>	2	0.3
<i>Isopogon linearis</i>		
<i>Lepidosperma pubisquameum</i> (flat form)		
<i>Lomandra sericea</i>		
<i>Nuytsia floribunda</i>	1	8
<i>Patersonia occidentalis</i> var. <i>occidentalis</i>		
<i>Petrophile striata</i>		
<i>Phyllanthus calycinus</i>		
<i>Stirlingia latifolia</i>		
<i>Stylidium cygnorum</i>		
<i>Synaphea spinulosa</i> subsp. <i>spinulosa</i>		
<i>Xanthorrhoea preissii</i>	5	2

Site: COR14
Described: CvdB & LD **Date:** 9/07/2014 **Type:** Releve
MGA Zone: 50 402445mE; 6514595mN
Habitat: Depression on mid slope of a consolidated dune
Soil: Brown grey white coarse-grained sand
Rock Type: N/A
Vegetation: *Banksia attenuata* mid sparse woodland over *Kunzea glabrescens* and *Banksia menziesii* tall shrubland over *Macrozamia riedlei* and *Xanthorrhoea preissii* mid sparse shrubland over various sparse herbs
Condition: Very Good
Fire Age: >5 years
Notes: Leaf Litter (%):



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Acacia huegelii</i>		
<i>Banksia attenuata</i>	10	12
<i>Banksia menziesii</i>	1	3.5
<i>Conostephium preissii</i>		
<i>Desmocladius flexuosus</i>		
<i>Dianella revoluta</i>		
<i>Drosera ? erythrorhiza</i>		
<i>Eremaea pauciflora</i> var. <i>pauciflora</i>		
<i>Eucalyptus tottiana</i>	1	10
<i>Kunzea glabrescens</i>	25	4
<i>Macrozamia riedlei</i>	2	1.7
<i>Pterostylis sanguinea</i>		
<i>Xanthorrhoea preissii</i>	1	2

Site: COR15
Described: CvdB & LD **Date:** 9/07/2014 **Type:** Releve
MGA Zone: 50 402651mE; 6515634mN
Habitat: Mid slope of a consolidated dune facing west
Soil: Grey brown coarse sand
Rock Type: N/A
Vegetation: *Corymbia calophylla* and *Eucalyptus marginata* mid sparse woodland over *Banksia attenuata* and *B. menziesii* tall sparse shrubland over *Xanthorrhoea preissii* and *Macrozamia riedlei* mid sparse shrubland over *Hibbertia hypericoides*, *Conostephium pendulum* and *Stirlingia latifolia* low open shrubland over *Mesomelaena pseudostygia* low sparse sedgeland
Condition: Very Good - Excellent
Fire Age: >5 years
Notes: Leaf Litter (%): 30



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Acacia pulchella</i> var. <i>pulchella</i>		
<i>Allocasuarina humilis</i>		
<i>Banksia attenuata</i>	3	7
<i>Banksia dallanneyi</i> var. <i>dallanneyi</i>		
<i>Banksia menziesii</i>	1	4
<i>Conostephium pendulum</i>		
<i>Corymbia calophylla</i>	7	15
<i>Desmocladius flexuosus</i>		
<i>Drosera pallida</i>		
<i>Eremaea pauciflora</i> var. <i>pauciflora</i>		
<i>Eucalyptus marginata</i>	2	15
<i>Hakea lissocarpha</i> (forma)		
<i>Hibbertia hypericoides</i>	4	0.5
<i>Hovea trisperma</i>		
<i>Hypochaeris glabra</i>		
<i>Isopogon linearis</i>		
<i>Lagenophora huegelii</i>		
<i>Lyginia imberbis</i>		
<i>Macrozamia riedlei</i>	1	1.9
<i>Mesomelaena pseudostygia</i>	1	0.4
<i>Phyllanthus calycinus</i>		
<i>Stirlingia latifolia</i>	1	1
<i>Synaphea spinulosa</i> subsp. <i>spinulosa</i>		
<i>Xanthorrhoea preissii</i>	3	2

Site: COR16
Described: CvdB & LD **Date:** 10/07/2014 **Type:** Releve
MGA Zone: 50 403124mE; 6516352mN
Habitat: Upper consolidated dune
Soil: Yellow brown coarse-grained sand
Rock Type: N/A
Vegetation: *Eucalyptus todtiana* mid isolated mallee trees over *Banksia attenuata* and *Nuytsia floribunda* tall sparse woodland over *Xanthorrhoea preissii* tall sparse shrubland over *Allocasuarina humilis* mid open shrubland over *Hibbertia hypericoides*, *H. racemosa* and *Calothamnus sanguineus* low sparse shrubland over *Mesomelaena pseudostygia* low isolated sedges and *Lyginia imberbis* low isolated rushes
Condition: Excellent
Fire Age: >5 years
Notes: Leaf Litter (%): 10



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Acacia extensa</i>		
<i>Acacia sessilis</i>		
<i>Allocasuarina humilis</i>	20	1.9
<i>Banksia attenuata</i>	2	7
<i>Banksia dallanneyi</i> var. <i>dallanneyi</i>		
<i>Calothamnus sanguineus</i>	3	0.5
<i>Cassytha pomiformis</i>		
<i>Conostylis teretifolia</i> subsp. <i>teretifolia</i>		
<i>Drosera</i> ? <i>erythrorhiza</i>		
<i>Drosera pallida</i>		
<i>Eucalyptus todtiana</i>	1	7
<i>Hakea lissocarpha</i> (forma)		
<i>Hibbertia hypericoides</i>	5	0.4
<i>Hibbertia racemosa</i>	2	0.3
<i>Hibbertia subvaginata</i>		
<i>Isopogon linearis</i>		
<i>Isopogon linearis</i>		
<i>Lomandra sericea</i>		
<i>Lyginia imberbis</i>		
<i>Mesomelaena pseudostygia</i>	2	0.3
<i>Nuytsia floribunda</i>		5
<i>Petrophile macrostachya</i>		
<i>Stylidium cygnorum</i>		
<i>Synaphea spinulosa</i> subsp. <i>spinulosa</i>		
<i>Xanthorrhoea preissii</i>	1	2.6

Site: COR17
Described: CvdB & LD **Date:** 10/07/2014 **Type:** Revele
MGA Zone: 50 402519mE; 6516931mN
Habitat: Consolidated dune, upper to mid gently sloping Northwest facing slope
Soil: Brown white coarse-grained sand
Rock Type: N/A
Vegetation: *Corymbia calophylla* mid sparse woodland over *Xanthorrhoea preissii* and *Daviesia divaricata* subsp. *divaricata* tall sparse shrubland over *Hakea trifurcata* mid sparse shrubland over *Conostephium preissii* low sparse shrubland
Condition: Very Good
Fire Age: >5 years
Notes: Leaf Litter (%): 10



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Acacia celastrifolia</i>		
<i>Anigozanthos humilis</i>		
<i>Babingtonia camphorosmae</i>		
<i>Banksia dallanneyi</i>		
<i>Beaufortia elegans</i>		
<i>Bossiaea eriocarpa</i>		
<i>Calothamnus sanguineus</i>		
<i>Calytrix sylvana</i>		
<i>Cheilanthes austrotenuifolia</i>		
<i>Conostephium preissii</i>	1	0.9
<i>Corymbia calophylla</i>	7	12
<i>Daviesia divaricata</i> subsp. <i>divaricata</i>	1	5
<i>Daviesia physodes</i>		
<i>Hakea lissocarpha</i> (forma)	1	1.4
<i>Hakea trifurcata</i>	1	2
<i>Hypochaeris glabra</i>		
<i>Isopogon linearis</i>		
<i>Lechenaultia biloba</i>		
<i>Melaleuca systema</i>		
<i>Persoonia saccata</i>		
<i>Pimelea</i> sp. 1		
<i>Scholtzia involucrata</i>		
<i>Xanthorrhoea preissii</i>	7	3

Site: COR18
Described: CvdB & LD **Date:** 10/07/2014 **Type:** Releve
MGA Zone: 50 403130mE; 6517291mN
Habitat: Consolidated dune, lower north facing slope
Soil: Grey brown coarse-grained sand
Rock Type: N/A
Vegetation: *Banksia attenuata*, *B. menziesii* and *Nuytsia floribunda* mid woodland over *Xanthorrhoea preissii* and *Allocasuarina humilis* mid sparse shrubland over *Hibbertia subvaginata*, *Phlebocarya ciliata*, *Eremaea pauciflora* var. *pauciflora* and *Leucopogon conostephioides* low sparse shrubland
Condition: Excellent
Fire Age: >5 years
Notes: Leaf Litter (%): 24



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Acacia huegelii</i>		
<i>Allocasuarina humilis</i>		
<i>Banksia attenuata</i>	8	10
<i>Banksia menziesii</i>	4	8
<i>Bossiaea eriocarpa</i>		
<i>Calytrix sylvana</i>		
<i>Daviesia triflora</i>		
<i>Eremaea pauciflora</i> var. <i>pauciflora</i>		
<i>Hibbertia subvaginata</i>	1	0.3
<i>Isopogon linearis</i>		
<i>Lepidosperma pubisquameum</i> (flat form)		
<i>Leucopogon conostephioides</i>	12	0.3
<i>Lyginia imberbis</i>		
<i>Melaleuca systema</i>		
<i>Nuytsia floribunda</i>	1	12
<i>Phlebocarya ciliata</i>	1	0.4
<i>Stirlingia latifolia</i>		
<i>Synaphea spinulosa</i> subsp. <i>spinulosa</i>		
<i>Xanthorrhoea preissii</i>	2	1.5

Site: COR19
Described: CvdB & LD **Date:** 10/07/2014 **Type:** Releve
MGA Zone: 50 403985mE; 6516766mN
Habitat: Mid slope of a consolidated dune
Soil: Grey brown coarse-grained sandy loam
Rock Type: N/A
Vegetation: *Banksia attenuata* and *B. menziesii* low sparse woodland over *Adenanthos cygnorum* subsp. *cygnorum* tall open shrubland over *Xanthorrhoea preissii* and *Beaufortia elegans* mid sparse shrubland over *Hibbertia hypericoides*, *Scholtzia involucrata* and *Calothamnus sanguineus* low sparse shrubland over *Mesomelaena pseudostygia* low sparse sedgeland
Condition: Excellent
Fire Age: >5 years
Notes: Leaf Litter (%): 15



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Adenanthos cygnorum</i> subsp. <i>cygnorum</i>	14	3.5
<i>Allocasuarina humilis</i>		
<i>Banksia attenuata</i>	2	6
<i>Banksia menziesii</i>	1	5.5
<i>Beaufortia elegans</i>	1.5	1.3
<i>Calothamnus sanguineus</i>	1	0.8
<i>Calytrix flavescens</i>		
<i>Calytrix sylvana</i>		
<i>Calytrix variabilis</i>		
<i>Conospermum crassinervium</i>		
<i>Conospermum stoechadis</i>		
<i>Daviesia triflora</i>		0.6
<i>Drosera ? erythrorhiza</i>		
<i>Drosera pallida</i>		
<i>Hibbertia hypericoides</i>	3	
<i>Hibbertia racemosa</i>		
<i>Hibbertia racemosa</i>		
<i>Hibbertia subvaginata</i>		
<i>Hypocalymma xanthopetalum</i>		
<i>Hypolaena robusta</i>		
<i>Isopogon linearis</i>	1	0.4
<i>Jacksonia floribunda</i>		3.2
<i>Lyginia imberbis</i>	1	0.4
<i>Mesomelaena pseudostygia</i>	1	0.4
<i>Scholtzia involucrata</i>	2	0.6
<i>Stirlingia latifolia</i>	1	0.7
<i>Stylidium cygnorum</i>		
<i>Synaphea spinulosa</i> subsp. <i>spinulosa</i>		0.4
<i>Xanthorrhoea preissii</i>		6

Site: COR20
Described: CvdB & LD **Date:** 10/07/2014 **Type:** Relevé
MGA Zone: 50 404709mE; 6516428mN
Habitat: Consolidated dune, upper slope
Soil: Yellow brown coarse-grained sand
Rock Type: N/A
Vegetation: *Corymbia calophylla* mid Isolated trees over *Banksia attenuata* tall sparse shrubland over *Allocasuarina humilis* and *Xanthorrhoea preissii* mid sparse shrubland over *Eremaea pauciflora* var. *pauciflora*, *Calothamnus sanguineus* and *Stirlingia latifolia* low open shrubland over *Mesomelaena pseudostygia* low sparse sedgeland
Condition: Excellent
Fire Age: >5 years
Notes: Leaf Litter (%): 5



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Acacia sessilis</i>		
<i>Allocasuarina humilis</i>	2	1.8
<i>Banksia attenuata</i>	1	4
<i>Banksia dallanneyi</i> var. <i>dallanneyi</i>		
<i>Banksia menziesii</i>	1	4.5
<i>Calothamnus sanguineus</i>	2	0.5
<i>Calytrix sylvana</i>		
<i>Conostephium pendulum</i>		
<i>Conostylis teretifolia</i> subsp. <i>teretifolia</i>		
<i>Corymbia calophylla</i>	1	14
<i>Daviesia physodes</i>		
<i>Drosera</i> ? <i>erythrorhiza</i>		
<i>Eremaea pauciflora</i> var. <i>pauciflora</i>	9	0.6
<i>Gladiolus caryophyllaceus</i>		
<i>Hakea ruscifolia</i>		
<i>Hibbertia hypericoides</i>		
<i>Hibbertia racemosa</i>		
<i>Hypocalymma xanthopetalum</i>		
<i>Leptospermum spinescens</i>		
<i>Lomandra purpurea</i>		
<i>Lomandra sericea</i>		
<i>Mesomelaena pseudostygia</i>	3	0.3
<i>Nuytsia floribunda</i>		
<i>Patersonia occidentalis</i> var. <i>occidentalis</i>		
<i>Stirlingia latifolia</i>	1	0.7
<i>Xanthorrhoea preissii</i>	1	2

Site: COR21
Described: CvdB & LD **Date:** 9/07/2014 **Type:** Releve
MGA Zone: 50 404111mE; 6515797mN
Habitat: Low consolidated dune
Soil: Grey white coarse sand
Rock Type: N/A
Vegetation: *Eucalyptus marginata* mid sparse woodland over *Xanthorrhoea preissii* mid sparse shrubland over *Hibbertia hypericoides*, *Calothamnus sanguineus* and *Conostephium pendulum* low sparse heath shrubland over *Lepidosperma pubisquameum* (flat form), *Lepidosperma squamatum* and *Mesomelaena pseudostygia* low sparse sedgeland
Condition: Excellent
Fire Age: >5 years
Notes: Leaf Litter (%): 20



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Acacia applanata</i>		
<i>Banksia dallanneyi</i> var. <i>dallanneyi</i>		
<i>Bossiaea eriocarpa</i>		
<i>Burchardia congesta</i>		
<i>Calothamnus sanguineus</i>	1	0.5
<i>Calytrix sylvana</i>		
<i>Calytrix variabilis</i>		
<i>Cassytha pomiformis</i>		
<i>Conostephium pendulum</i>	1	0.4
<i>Conostylis teretifolia</i> subsp. <i>teretifolia</i>		
<i>Drosera</i> ? <i>erythrorhiza</i>		
<i>Eucalyptus marginata</i>	8	12
<i>Gompholobium marginatum</i>		
<i>Haemadorum</i> sp.		
<i>Hibbertia hypericoides</i>	8	0.3
<i>Hibbertia racemosa</i>		
<i>Isopogon linearis</i>		
<i>Lagenophora huegelii</i>		
<i>Lepidosperma pubisquameum</i> (flat form)	1	0.2
<i>Lepidosperma squamatum</i>	+	
<i>Leucopogon gracillimus</i>		
<i>Lomandra hermaphrodita</i>		
<i>Lomandra sericea</i>		
<i>Macrozamia riedlei</i>		
<i>Mesomelaena pseudostygia</i>	1	0.3
<i>Nuytsia floribunda</i>		
<i>Patersonia occidentalis</i> var. <i>occidentalis</i>		
<i>Stirlingia latifolia</i>		
<i>Styphelia tenuiflora</i>		
<i>Synaphea spinulosa</i> subsp. <i>spinulosa</i>		
<i>Xanthorrhoea preissii</i>	3	2
<i>Xanthosia huegelii</i>		

Site: COR22
Described: CvdB & LD **Date:** 10/07/2014 **Type:** Releve
MGA Zone: 50 403666mE; 6516114mN
Habitat: Consolidated dune, very gently sloping north
Soil: Brown white coarse-grained sand
Rock Type: N/A
Vegetation: *Eucalyptus todtiana* mid isolated mallee trees over *Banksia attenuata*, *B. menziesii* and *Adenanthos cygnorum* subsp. *cygnorum* tall sparse shrubland over *Allocasuarina humilis* and *Xanthorrhoea preissii* mid open shrubland over *Hibbertia hypericoides*, *Calothamnus sanguineus* and *Conostephium pendulum* low open shrubland
Condition: Excellent
Fire Age: >5 years
Notes: Leaf Litter (%): 8



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Adenanthos cygnorum</i> subsp. <i>cygnorum</i>	+	4
<i>Allocasuarina humilis</i>	2	1.6
<i>Banksia attenuata</i>	3	5
<i>Banksia dallanneyi</i> var. <i>dallanneyi</i>		
<i>Banksia menziesii</i>	1	4.5
<i>Calothamnus sanguineus</i>	3	1
<i>Calytrix flavescens</i>		
<i>Calytrix variabilis</i>		
<i>Cassytha pomiformis</i>		
<i>Conostephium pendulum</i>	+	0.4
<i>Conostylis teretifolia</i> subsp. <i>teretifolia</i>		
<i>Daviesia nudiflora</i> subsp. <i>nudiflora</i>		
<i>Daviesia physodes</i>		
<i>Drosera</i> ? <i>erythrorhiza</i>		
<i>Drosera pallida</i>		
<i>Eucalyptus todtiana</i>	1	8
<i>Gladiolus caryophyllaceus</i>		
<i>Hibbertia hypericoides</i>	10	0.4
<i>Hibbertia racemosa</i>		
<i>Hibbertia subvaginata</i>		
<i>Isopogon linearis</i>		
<i>Jacksonia floribunda</i>		
<i>Leucopogon conostephioides</i>		
<i>Lyginia imberbis</i>		
<i>Melaleuca systema</i>		
<i>Mesomelaena pseudostygia</i>		0.3
<i>Nuytsia floribunda</i>		
<i>Patersonia occidentalis</i> var. <i>occidentalis</i>		
<i>Scholtzia involucrata</i>		
<i>Stirlingia latifolia</i>	1	0.6
<i>Synaphea spinulosa</i> subsp. <i>spinulosa</i>		
<i>Xanthorrhoea preissii</i>	2	1.5

Site: COR23
Described: CvdB & LD **Date:** 10/07/2014 **Type:** Releve
MGA Zone: 50 403043mE; 6515985mN
Habitat: Upper consolidated dune
Soil: Yellow brown coarse-grained sand
Rock Type: N/A
Vegetation: *Eucalyptus todtiana* mid isolated mallee trees over *Nuytsia floribunda* low isolated trees over *Banksia attenuata* and *B. menziesii* tall sparse shrubland over *Allocasuarina humilis* and *Xanthorrhoea preissii* mid open shrubland over *Hibbertia hypericoides* and *Calothamnus sanguineus* low open shrubland over *Mesomelaena pseudostygia* low sparse sedgeland
Condition: Excellent
Fire Age: >5 years
Notes: Leaf Litter (%):



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Acacia pulchella</i> var. <i>pulchella</i>		
<i>Acacia sessilis</i>		
<i>Allocasuarina humilis</i>	10	1.7
<i>Banksia attenuata</i>	3	7
<i>Banksia dallanneyi</i> var. <i>dallanneyi</i>		
<i>Banksia menziesii</i>		5
<i>Calothamnus sanguineus</i>		
<i>Calytrix variabilis</i>		
<i>Cassytha pomiformis</i>		
<i>Conostephium pendulum</i>		
<i>Daviesia nudiflora</i> subsp. <i>nudiflora</i>		
<i>Drosera</i> ? <i>erythrorhiza</i>		
<i>Drosera pallida</i>		
<i>Eucalyptus todtiana</i>	1	8
<i>Gladiolus caryophyllaceus</i>		
<i>Gompholobium marginatum</i>		
<i>Grevillea pilulifera</i>		
<i>Hakea lissocarpha</i> (forma)		
<i>Hakea ruscifolia</i>		
<i>Hibbertia hypericoides</i>	3	0.3
<i>Hibbertia racemosa</i>		
<i>Isopogon linearis</i>		
<i>Jacksonia floribunda</i>		
<i>Lomandra sericea</i>		
<i>Lyginia imberbis</i>		
<i>Lysinema pentapetalum</i>		
<i>Mesomelaena pseudostygia</i>	2	0.3
<i>Nuytsia floribunda</i>		6
<i>Petrophile macrostachya</i>		
<i>Pimelea imbricata</i> var. <i>piligera</i>		
<i>Xanthorrhoea preissii</i>	2	1.9

Site: COR24
Described: CvdB & LD **Date:** 17/07/2014 **Type:** Releve
MGA Zone: 50 402604mE; 6516405mN
Habitat: Consolidated dune
Soil: Black/grey coarse grained sand
Rock Type: N/A
Vegetation: *Eucalyptus todtiana* mid isolated mallee trees over *Banksia attenuata*, *B. menziesii* and *Adenanthos cygnorum* subsp. *cygnorum* tall open shrubland over *Beaufortia elegans* and *Jacksonia floribunda* mid sparse shrubland over *Scholtzia involucrata*, *Leucopogon conostephioides* and *Eremaea pauciflora* var. *pauciflora* low open shrubland over *Mesomelaena pseudostygia* low isolated sedges over *Lyginia imberbis* low isolated rushes
Condition: Excellent
Fire Age: >5 years
Notes: None



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Acacia pulchella</i> var. <i>glaberrima</i>		0.50
<i>Adenanthos cygnorum</i> subsp. <i>cygnorum</i>	1	4
<i>Alexgeorgea nitens</i>		0.10
<i>Astroloma xerophyllum</i>		0.60
<i>Banksia attenuata</i>	8	5
<i>Banksia menziesii</i>	2	5
<i>Beaufortia elegans</i>	1	1.7
<i>Boronia ramosa</i> subsp. <i>ramosa</i>		0.40
<i>Calytrix flavescens</i>		.20
<i>Calytrix variabilis</i>		0.40
<i>Cassytha pomiformis</i>		Creeper
<i>Conospermum crassinervium</i>		1
<i>Eremaea pauciflora</i> var. <i>pauciflora</i>	1	0.80
<i>Eucalyptus todtiana</i>	1	6
<i>Gompholobium tomentosum</i>		0.20
<i>Hibbertia hypericoides</i>		0.30
<i>Hibbertia racemosa</i>		
<i>Hibbertia subvaginata</i>		0.20
<i>Isopogon linearis</i>		0.40
<i>Jacksonia floribunda</i>	+	2
<i>Leucopogon conostephioides</i>	2	0.50
<i>Lyginia imberbis</i>	1	0.50
<i>Mesomelaena pseudostygia</i>	+	0.30
<i>Nuytsia floribunda</i>		0.50
<i>Scholtzia involucrata</i>	7	0.50
<i>Stirlingia latifolia</i>		1.4
<i>Stylidium cygnorum</i>		0.10
<i>Xanthorrhoea preissii</i>		1.3

Site: COR25
Described: CvdB & LD **Date:** 17/07/2014 **Type:** Releve
MGA Zone: 50 405045mE; 6517238mN
Habitat: Consolidated dune. Upper crest
Soil: Grey/white coarse grain sand
Rock Type: N/A
Vegetation: *Eucalyptus marginata* mid woodland over *Banksia attenuata* and *B. menziesii* tall sparse shrubland over *Eremaea pauciflora* var. *pauciflora*, *Hibbertia hypericoides* and *Daviesia triflora* low open shrubland over *Mesomelaena pseudostygia* low isolated sedges over *Lyginia imberbis* low isolated rushes
Condition: Excellent
Fire Age: > 5 years
Notes: None



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Astroloma xerophyllum</i>		0.60
<i>Banksia attenuata</i>	5	4
<i>Banksia dallanneyi</i> var. <i>dallanneyi</i>		0.10
<i>Banksia menziesii</i>	2	3.5
<i>Burchardia congesta</i>		0.40
<i>Calytrix flavescens</i>		0.30
<i>Conostephium pendulum</i>		0.40
<i>Conostylis teretifolia</i> subsp. <i>teretifolia</i>		0.10
<i>Daviesia physodes</i>		0.50
<i>Daviesia triflora</i>	2	0.40
<i>Drosera</i> ? <i>erythrorhiza</i>		Prostrate
<i>Eremaea pauciflora</i> var. <i>pauciflora</i>	5	0.60
<i>Eucalyptus marginata</i>	3	12
<i>Hibbertia hypericoides</i>	5	0.50
<i>Hibbertia hypericoides</i>		0.20
<i>Hibbertia racemosa</i>		0.20
<i>Hypolaena exsulca</i>		0.30
<i>Isopogon linearis</i>		0.50
<i>Jacksonia floribunda</i>		1.8
<i>Lyginia imberbis</i>	1	0.40
<i>Melaleuca systema</i>		0.40
<i>Mesomelaena pseudostygia</i>	1	0.40
<i>Patersonia occidentalis</i> var. <i>occidentalis</i>		0.30
<i>Stirlingia latifolia</i>		0.40
<i>Synaphea spinulosa</i> subsp. <i>spinulosa</i>		0.20
<i>Xanthorrhoea preissii</i>		1.5

Site: COR26
Described: CvdB & LD **Date:** 17/07/2014 **Type:** Releve
MGA Zone: 50 405772mE; 6517198mN
Habitat: Swale-consolidated dune. Low slope gently towards the south
Soil: Yellow/brown coarse grain sand
Rock Type: N/A

Vegetation: *Banksia attenuata*, *B. menziesii* and *Nuytsia floribunda* tall sparse shrubland over *Xanthorrhoea preissii* mid sparse shrubland over *Allocasuarina humilis*, *Eremaea pauciflora* var. *pauciflora* and *Melaleuca systema* low open shrubland over *Mesomelaena pseudostygia* and *Schoenus efoliatus* low sparse sedgeland

Condition: Excellent

Fire Age: >5 years

Notes: Dead Banksia - Dieback?



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Alexgeorgea nitens</i>		0.10
<i>Allocasuarina humilis</i>	12	1
<i>Austrodanthonia</i> sp.		0.50
<i>Banksia attenuata</i>	1	3
<i>Banksia dallanneyi</i> var. <i>dallanneyi</i>		0.10
<i>Banksia menziesii</i>	+	3
<i>Bossiaea eriocarpa</i>		0.10
<i>Calectasia narragara</i>		0.20
<i>Caustis dioica</i>		0.30
<i>Conostephium pendulum</i>		0.30
<i>Daviesia physodes</i>		0.30
<i>Daviesia triflora</i>		0.40
<i>Eremaea pauciflora</i> var. <i>pauciflora</i>	10	0.60
<i>Gladiolus caryophyllaceus</i>		0.30
<i>Hibbertia hypericoides</i>		0.30
<i>Hovea trisperma</i> var. <i>trisperma</i>		0.20
<i>Isopogon linearis</i>		0.10
<i>Leptospermum spinescens</i>		0.40
<i>Lyginia imberbis</i>		0.30
<i>Melaleuca systema</i>	2	0.50
<i>Mesomelaena pseudostygia</i>	1	0.30
<i>Nuytsia floribunda</i>	+	4.5
<i>Patersonia occidentalis</i> var. <i>occidentalis</i>		0.30
<i>Pimelea imbricata</i> var. <i>piligera</i>		0.20
<i>Schoenus efoliatus</i>	2	0.40
<i>Synaphea spinulosa</i> subsp. <i>spinulosa</i>		0.20
<i>Xanthorrhoea preissii</i>	1	2

Site: COR27
Described: CvdB & LD **Date:** 17/07/2014 **Type:** Releve
MGA Zone: 50 406089mE; 6516591mN
Habitat: Consolidated dune, mid slope gently sloping to south-east
Soil: Black/grey coarse grain sand
Rock Type: N/A

Vegetation: *Allocasuarina humilis*, *Banksia attenuata* and *B. menziesii* tall sparse shrubland over *Allocasuarina humilis* and *Xanthorrhoea preissii* mid sparse shrubland over *Eremaea pauciflora* var. *pauciflora* and *Melaleuca systema* low open shrubland over *Mesomelaena pseudostygia* low sparse sedgeland

Condition: Excellent

Fire Age: > 5 years

Notes: Dieback?



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Allocasuarina humilis</i>	8	1.8
<i>Amphipogon turbinatus</i>		0.20
<i>Banksia attenuata</i>	1	4
<i>Banksia dallanneyi</i> var. <i>dallanneyi</i>		0.10
<i>Banksia menziesii</i>	1	4
<i>Bossiaea eriocarpa</i>		0.40
<i>Conospermum stoechadis</i>		0.50
<i>Conostephium pendulum</i>		0.40
<i>Daviesia physodes</i>		0.50
<i>Daviesia triflora</i>		0.40
<i>Eremaea pauciflora</i> var. <i>pauciflora</i>	15	0.70
<i>Hibbertia racemosa</i>		0.30
<i>Hovea trisperma</i> var. <i>trisperma</i>		0.30
<i>Isopogon linearis</i>		0.20
<i>Jacksonia floribunda</i>		1.3
<i>Lepidosperma</i> sp. Inland Scabrid (R. Barrett)		0.60
<i>Leucopogon gracillimus</i>		0.40
<i>Lomandra sericea</i>		0.30
<i>Lyginia imberbis</i>		0.30
<i>Melaleuca systema</i>	2	0.40
<i>Mesomelaena pseudostygia</i>	2	0.30
<i>Nuytsia floribunda</i>	+	7
<i>Patersonia occidentalis</i> var. <i>occidentalis</i>		0.40
<i>Petrophile macrostachya</i>		0.80
<i>Stirlingia latifolia</i>		0.60
<i>Xanthorrhoea preissii</i>	3	2

Site: COR28
Described: CvdB & LD **Date:** 17/07/2014 **Type:** Releve
MGA Zone: 50 405613mE; 6515861mN
Habitat: Consolidated dune, upper to mid gentle slope to south - east
Soil: Yellow / brown coarse –grained sand
Rock Type: NIL
Vegetation: *Corymbia calophylla* mid isolated trees over *Eucalyptus todtiana* mid isolated mallee trees over *Banksia attenuata*, *B. menziesii* and *Daviesia divaricata* subsp. *divaricata* tall sparse shrubland over *Eremaea pauciflora* var. *pauciflora*, *Calothamnus sanguineus* and *Hibbertia hypericoides* low sparse heath shrubland over *Mesomelaena pseudostygia* low sparse sedgeland
Condition: Excellent
Fire Age: > 5 years
Notes: none



SPECIES LIST

Name	Cover	Height
<i>Allocasuarina humilis</i>		1.2
<i>Banksia attenuata</i>	+	3
<i>Banksia dallanneyi</i> var. <i>dallanneyi</i>		0.20
<i>Banksia menziesii</i>	+	3
<i>Calothamnus sanguineus</i>	2	0.40
<i>Calytrix sylvana</i>		0.50
<i>Calytrix variabilis</i>		0.40
<i>Conospermum stoechadis</i>		0.50
<i>Conostephium pendulum</i>		0.50
<i>Conostylis teretifolia</i> subsp. <i>teretifolia</i>		0.10
<i>Corymbia calophylla</i>	+	11
<i>Daviesia divaricata</i> subsp. <i>divaricata</i>	+	3
<i>Daviesia physodes</i>		0.80
<i>Daviesia triflora</i>		0.30
<i>Drosera</i> ? <i>erythrorhiza</i>		Prostrate
<i>Eremaea pauciflora</i> var. <i>pauciflora</i>	15	0.60
<i>Eucalyptus todtiana</i>	1	7
<i>Grevillea pilulifera</i>		0.20
<i>Hakea ruscifolia</i>		2
<i>Hibbertia hypericoides</i>	2	0.40
<i>Hibbertia racemosa</i>		0.30
<i>Isopogon linearis</i>		0.40
<i>Jacksonia floribunda</i>		1.8
<i>Leucopogon racemosus</i>		0.40
<i>Lomandra purpurea</i>		0.30
<i>Lyginia imberbis</i>		0.40
<i>Lysinema pentapetalum</i>		0.40
<i>Melaleuca systema</i>		0.30
<i>Mesomelaena pseudostygia</i>	2	0.30
<i>Nuytsia floribunda</i>		4
<i>Patersonia occidentalis</i> var. <i>occidentalis</i>		0.30
<i>Stirlingia latifolia</i>		0.70
<i>Synaphea spinulosa</i> subsp. <i>spinulosa</i>		0.50
<i>Xanthorrhoea preissii</i>		2

Site: COR29
Described: CvdB & LD **Date:** 17/07/2014 **Type:** Releve
MGA Zone: 50 404188mE; 6516321mN
Habitat: Consolidated dune. Upper slope to south-east
Soil: Yellow/brown coarse-grained sand
Rock Type: N/A
Vegetation: *Eucalyptus todtiana* mid isolated mallee trees over *Banksia attenuata*, *B. menziesii* and *Nuytsia floribunda* tall sparse shrubland over *Allocasuarina humilis*, *Xanthorrhoea preissii* and *Jacksonia floribunda* mid open shrubland over *Eremaea pauciflora* var. *pauciflora*, *Hibbertia hypericoides* and *Melaleuca systema* low sparse shrubland over *Mesomelaena pseudostygia* low sparse sedgeland.
Condition: Excellent
Fire Age: > 5 years
Notes: None



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Allocasuarina humilis</i>	20	1.8
<i>Amphipogon turbinatus</i>		0.40
<i>Anigozanthos</i> sp.		0.10
<i>Banksia attenuata</i>	1	6
<i>Banksia dallanneyi</i> var. <i>dallanneyi</i>		0.20
<i>Banksia menziesii</i>	1	5
<i>Bossiaea eriocarpa</i>		0.20
<i>Calectasia narragara</i>		0.40
<i>Calytrix flavescens</i>		0.30
<i>Conospermum stoechadis</i>		0.60
<i>Conostephium pendulum</i>		0.40
<i>Daviesia nudiflora</i> subsp. <i>nudiflora</i>		0.60
<i>Daviesia physodes</i>		0.50
<i>Daviesia preissii</i>		0.60
<i>Drosera</i> ? <i>erythrorhiza</i>		Pro
<i>Eremaea pauciflora</i> var. <i>pauciflora</i>	4	0.60
<i>Eucalyptus todtiana</i>	+	7
<i>Hakea ruscifolia</i>		1.1
<i>Hibbertia hypericoides</i>	2	0.30
<i>Hibbertia racemosa</i>		0.20
<i>Isopogon linearis</i>		0.30
<i>Jacksonia floribunda</i>	+	2
<i>Lomandra sericea</i>		0.20
<i>Melaleuca systema</i>	1	0.40
<i>Mesomelaena pseudostygia</i>	2	0.30
<i>Nuytsia floribunda</i>	1	6
<i>Patersonia occidentalis</i> var. <i>occidentalis</i>		0.20
<i>Petrophile macrostachya</i>		0.60
<i>Stirlingia latifolia</i>		0.60
<i>Synaphea spinulosa</i> subsp. <i>spinulosa</i>		0.30
<i>Xanthorrhoea preissii</i>	1	1.8

Site: COR30
Described: CvdB & LD **Date:** 17/07/2014 **Type:** Releve
MGA Zone: 50 402497mE; 6517323mN
Habitat: Swale. Low swale, depression
Soil: Grey/brown coarse-grained organic sand
Rock Type: NIL
Vegetation: *Banksia attenuata* and *B. menziesii* low woodland over *Melaleuca preissiana* and *Adenanthos cygnorum* subsp. *cygnorum* tall sparse shrubland over *Calytrix angulata* and *Xanthorrhoea preissii* mid sparse shrubland over *Leucopogon conostephioides* and *Hibbertia subvaginata* low sparse shrubland
Condition: Excellent
Fire Age: > 5 years
Notes: None



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Adenanthos cygnorum</i> subsp. <i>cygnorum</i>	2	5
<i>Allocasuarina humilis</i>		1.8
<i>Banksia attenuata</i>	20	9
<i>Banksia menziesii</i>	1	6
<i>Bossiaea eriocarpa</i>		0.30
<i>Calytrix angulata</i>		1.4
<i>Calytrix angulata</i>	5	1.6
<i>Conospermum crassinervium</i>		1.1
<i>Conostephium pendulum</i>		0.50
<i>Drosera ? erythrorhiza</i>		Pros
<i>Eremaea pauciflora</i> var. <i>pauciflora</i>		1.3
<i>Gladiolus caryophyllaceus</i>		0.30
<i>Hibbertia subvaginata</i>	+	0.30
<i>Isopogon linearis</i>		0.40
<i>Leucopogon conostephioides</i>	1	0.40
<i>Lyginia imberbis</i>		0.30
<i>Macrozamia riedlei</i>		1.4
<i>Melaleuca preissiana</i>	1	6
<i>Nuytsia floribunda</i>		0.50
<i>Phlebocarya ciliata</i>		0.30
<i>Phlebocarya ciliata</i>		0.50
<i>Scholtzia involucrata</i>		0.10
<i>Stylidium cygnorum</i>		1.5
<i>Xanthorrhoea preissii</i>	1	1.5



APPENDIX G

Vascular Plant Taxa Recorded



VASCULAR PLANT TAXA RECORDED

29 **PTERIDACEAE**

Cheilanthes austrotenuifolia

42 **ZAMIACEAE**

Macrozamia riedlei

80 **LAURACEAE**

Cassytha pomiformis

82 **ARACEAE**

* *Zantedeschia aethiopica* (**Declared Pest**)

109 **COLCHICACEAE**

Burchardia congesta

115 **ORCHIDACEAE**

Leporella fimbriata

Orchidaceae sp.

Pterostylis sanguinea

Pterostylis vittata

124 **IRIDACEAE**

* *Gladiolus caryophyllaceus*

Patersonia occidentalis var. *occidentalis*

126 **XANTHORRHOACEAE**

Xanthorrhoea preissii

128 **ASPARAGACEAE**

Laxmannia sessiliflora

Lomandra hermaphrodita

Lomandra preissii

Lomandra purpurea

Lomandra sericea


130 **HEMEROCALLIDACEAE**

Dianella revoluta

138 **HAEMODORACEAE**

Anigozanthos humilis

Anigozanthos sp.



Conostylis aculeata subsp. *cygnorum*
Conostylis aurea
Conostylis teretifolia subsp. *teretifolia*
Haemodorum sp.
Phlebocarya ciliata

147 DASYPOGONACEAE

Calectasia narragara

156 CYPERACEAE

Caustis dioica
Lepidosperma pubisquameum (flat form)
Lepidosperma sp. Inland Scabrid (R. Barrett)
Lepidosperma sp. Northern Sandplains (R. Barrett)
Lepidosperma squamatum
Mesomelaena pseudostygia
Mesomelaena tetragona
Schoenus efoliatus

157 ANARTHRIACEAE

Lyginia imberbis

159 RESTIONACEAE


Alexgeorgea nitens
Desmocladius flexuosus
Hypolaena exsulca
Hypolaena robusta (Priority 4)
Lepidobolus preissianus

163 POACEAE

Amphipogon turbinatus
Austrodanthonia sp.
* *Briza maxima*

175 PROTEACEAE

Adenanthos cygnorum
Adenanthos cygnorum subsp. *cygnorum*
Banksia attenuata
Banksia bipinnatifida subsp. *multifida*
Banksia dallanneyi
Banksia dallanneyi var. *dallanneyi*
Banksia grandis
Banksia menziesii
Banksia sessilis var. *sessilis*
Conospermum crassinervium
Conospermum stoechadis
Grevillea pilulifera



Grevillea synapheae subsp. *synapheae*
Hakea amplexicaulis
Hakea costata
Hakea lissocarpha (forma)
Hakea prostrata
Hakea ruscifolia
Hakea stenocarpa
Hakea trifurcata
Isopogon linearis
Persoonia saccata
Petrophile divaricata
Petrophile macrostachya
Petrophile serruriae
Petrophile striata
Stirlingia latifolia
Synaphea spinulosa subsp. *spinulosa*

181 **DILLENIACEAE**


Hibbertia hibernioides
Hibbertia hypericoides
Hibbertia racemosa
Hibbertia subvaginata

196 **HALORAGACEAE**

Gonocarpus cordiger

201 **FABACEAE**

Acacia applanata
Acacia celastriifolia
Acacia drummondii subsp. *drummondii*
Acacia extensa
Acacia huegelii
Acacia nervosa
Acacia preissiana
Acacia pulchella var. *glaberrima*
Acacia pulchella var. *pulchella*
Acacia sessilis
Bossiaea eriocarpa
Daviesia divaricata subsp. *divaricata*
Daviesia incrassata subsp. *incrassata*
Daviesia nudiflora subsp. *nudiflora*
Daviesia physodes
Daviesia preissii
Daviesia triflora
Gompholobium marginatum
Gompholobium tomentosum
Hovea trisperma



Hovea trisperma var. *trisperma*

Jacksonia floribunda

Jacksonia sternbergiana

Kennedia prostrata

* *Lupinus* sp.

208 **RHAMNACEAE**

Cryptandra scoparia

217 **CASUARINACEAE**

Allocasuarina humilis

247 **PHYLLANTHACEAE**

Phyllanthus calycinus

261 **VIOLACEAE**

Hybanthus calycinus

281 **MYRTACEAE**

Babingtonia camphorosmae

Beaufortia elegans

Calothamnus sanguineus

Calytrix angulata

Calytrix flavescens

Calytrix sylvana

Calytrix variabilis

Chamelaucium sp. Gingin (N.G. Marchant 6) (**Threatened**)

Corymbia calophylla

Eremaea pauciflora var. *pauciflora*

Eucalyptus marginata

Eucalyptus todtiana

Hypocalymma xanthopetalum

Kunzea glabrescens

Leptospermum spinescens

Melaleuca preissiana

Melaleuca systema

Scholtzia involucrata

Verticordia nitens

300 **RUTACEAE**


Boronia ramosa subsp. *anethifolia*

Boronia ramosa subsp. *ramosa*

311 **THYMELAEACEAE**

Pimelea imbricata var. *piligera*

Pimelea sp. 1



Pimelea sp.2

332 BRASSICACEAE

* *Brassica tournefortii*

338 SANTALACEAE

Leptomeria cunninghamii

339 LORANTHACEAE

Amyema miquelii

Nuytsia floribunda

346 DROSERACEAE

Drosera ? erythrorhiza

Drosera pallida

403 ERICACEAE

Andersonia lehmanniana subsp. *lehmanniana*

Astroloma pallidum

Astroloma stomarrhena

Astroloma xerophyllum

Conostephium pendulum

Conostephium preissii

Leucopogon conostephioides

Leucopogon gracillimus

Leucopogon racemulosus

Lysinema ciliatum

Lysinema pentapetalum

Styphelia tenuiflora

452 STYLIDIACEAE

Stylidium cygnorum

Stylidium sp.

458 GOODENIACEAE

Lechenaultia biloba

460 ASTERACEAE

* *Hypochaeris glabra*

Lagenophora huegelii

Olearia lehmanniana

474 APIACEAE

Xanthosia huegelii






APPENDIX H

Fauna Habitat Assessment Data

Appendix H
Habitat Assessments

Site		HA1	HA2	HA3	HA4	HA5	HA6
Coordinates	Eastings	406165	405432	405160	405741	404966	405619
	Northings	6515785	6515940	6516520	6516293	6517284	6517059
Describer		JT	JT	JT	JT	JT	JT
Date		08-Jul-14	08-Jul-14	08-Jul-14	08-Jul-14	08-Jul-14	08-Jul-14
Seasonal Conditions		Raining weather conditions	Raining weather conditions	Raining weather conditions	Raining weather conditions	Raining weather conditions	Raining weather conditions
Habitat	Type	Eucalypt Woodland	Eucalypt Woodland	Eucalypt Woodland	Eucalypt Woodland	Eucalypt Woodland	Eucalypt Woodland
	Quality	High habitat quality	High habitat quality	High habitat quality	High habitat quality	High habitat quality	High habitat quality
Tree Denisty		27 p/ha - Jarrah - DBH 500-100mm - Height 6-9 m	30 p/ha - Jarrah - DBH 600-1200mm - Height 6-9m	35 p/ha - Jarrah- DBH 600-1000mm - Height 7-9m	16 p/ha - Jarrah - DBH 500-1000mm - Height 7-10m	12 p/ha - Jarrah - DBH 500-900mm - Height 6-8m	15 p/ha - Jarrah - DBH 500-900mm - Height 6-9m
Litter Cover		> 50%	> 50%	> 50%	> 50%	> 50%	> 50%
Fire Age (years)		> 5	> 5	> 5	> 5	> 5	> 5
Disturbance Levels		low	low	low	low	low	low
Photo Number							


Site		HA7	HA8	HA9	HA10	HA11	HA12
Coordinates	Eastings	406105	404333	404335	404275	404658	404000
	Northings	6517107	6517198	6517202	6516847	6515703	6515715
Describer		JT	JT	JT	JT	JT	JT
Date		08-Jul-14	09-Jul-14	09-Jul-14	09-Jul-14	09-Jul-14	09-Jul-14
Seasonal Conditions		Raining weather conditions	Fine weather conditions	Fine weather conditions	Fine weather conditions	Fine weather conditions	Fine weather conditions
Habitat	Type	Eucalypt Woodland	Eucalypt Woodland	Eucalypt Woodland	Eucalypt Woodland	Eucalypt Woodland	Eucalypt Woodland
	Quality	High habitat quality	High habitat quality	High habitat quality	High habitat quality	High habitat quality	High habitat quality
Tree Denisty		26 p/ha - Jarrah - DBH 500-1000mm - Height 6-9m	13 p/ha - Jarrah - DBH 600-1000mm - Height 7-10m	21 p/ha - Jarrah - DBH 500-900mm - Height 6-9m	22 p/ha - Jarrah /Marri - DBH 600-1400 - Height 7-12m	23 p/ha - Jarrha/Marri - DBH 600-1000mm - Height 7-9m	8 p/ha - Jarrah - DBH 500-900mm - Height 6-8m
Litter Cover		> 50%	> 50%	> 50%	> 50%	> 50%	> 50%
Fire Age (years)		> 5	> 5	> 5	> 5	> 5	> 5
Disturbance Levels		low	low	low	low	low	low
Photo Number							

Appendix H
Habitat Assessment

Site		HA13	HA14	HA15	HA16	HA17	HA18
Coordinates	Eastings	402784	402353	402517	403251	404433	403595
	Northings	651715	6516674	6516918	6517153	6515552	6515122
Describer		JT	JT	JT	JT	JT	JT
Date		09-Jul-14	09-Jul-14	09-Jul-14	09-Jul-14	10-Jul-14	10-Jul-14
Seasonal Conditions		Fine weather conditions	Fine weather conditions	Fine weather conditions	Fine weather conditions	Fine weather conditions	Fine weather conditions
Habitat	Type	Eucalypt Woodland	Eucalypt Woodland	Eucalypt Woodland	Eucalypt Woodland	Eucalypt Woodland	Eucalypt Woodland
	Quality	High habitat quality	High habitat quality	High habitat quality	High habitat quality	High habitat quality	High habitat quality
Tree Denisty		22 p/ha - Jarrah/Marri - DBH 600-1000mm - Height 7-10m	11 p/ha - Marri/Jarrah - DBH 500-900mm - Height 7-9m	18 p/ha - Marri - DBH 500-1000mm - Height 7-10m	16 p/ha - Jarrah/Marri - DBH 500-900mm - Height 6-8m	20p/ha - Jarrah - DBH 500-900mm - Height 6-8m	11 p/ha - Jarrah/Marri - DBH 500-1000mm - Height 7-10m
Litter Cover		> 50%	> 50%	> 50%	> 50%	> 50%	> 50%
Fire Age (years)		> 5	> 5	> 5	> 5	> 5	> 5
Disturbance Levels		low	low	low	low	low	low
Photo Number							

Site		HA19	HA20	HA21	HA22	HA23	Dampland
Coordinates	Eastings	403088	403088	402649	402913	404778	402280
	Northings	6515273	6515275	6414895	6514657	6514842	6514574
Describer		JT	JT	JT	JT	JT	JT
Date		09-Jul-14	10-Jul-14	10-Jul-14	10-Jul-14	10-Jul-14	10-Jul-14
Seasonal Conditions		Fine weather conditions	Fine weather conditions	Fine weather conditions	Fine weather conditions	Fine weather conditions	Fine weather conditions
Habitat	Type	Eucalypt Woodland	Eucalypt Woodland	Eucalypt Woodland	Eucalypt Woodland	Eucalypt Woodland	Damlands
	Quality	High habitat quality	High habitat quality	High habitat quality	High habitat quality	High habitat quality	Moderate quality
Tree Denisty		23 p/ha - Jarrah/Marri - DBH 600-1000mm - 8-10m	24 p/ha - Jarrah/Marri - DBH 500-1000mm - Height 7-9m	21p/ha - Jarrah/Marri - DBH 600-1100mm - Height 8-11m	10 p/ha - Marri - DBH 500-1000mm - 7-9m	16 p/ha - Jarrah - DBH 600-1000mm - Height 7-10m	N/A
Litter Cover		> 50%	> 50%	> 50%	> 50%	> 50%	> 50%
Fire Age (years)		> 5	> 5	> 5	> 5	> 5	> 5
Disturbance Levels		low	low	low	low	low	low
Photo Number							

Appendix H
Habitat Assessment

Site		BW1	BW2
Coordinates	Eastings	403327	402989
	Northings	6516329	6515567
Describer		JT	JT
Date		10-Jul-14	10-Jul-14
Seasonal Conditions		Fine weather conditions	Fine weather conditions
Habitat	Type	Banksia Woodland	Banksia Woodland
	Quality	Moderate habitat	Moderate habitat
Tree Denisty		N/A	N/A
Litter Cover		> 50%	> 50%
Fire Age (years)		> 5	> 5
Disturbance Levels		low	low
Photo Number			



APPENDIX I

Black Cockatoo Breeding Trees



APPENDIX J

Vertebrate Fauna Predicted to Occur within the Study Area

Appendix J
Previously recorded fauna

SPECIES	VERNACULAR	Conservation Status	EPBC Search	DPAW Search	NatureMap	Birddata	Tingay, 1994	Burbridge et al, 1996	ATA, 2007	GHD, 2014	Current Survey
Amphibians											
<i>Litoria adelaidensis</i>	Slender Tree Frog				X						
<i>Litoria moorei</i>	Motorbike Frog				X						
<i>Heleioporus eyrei</i>	Moaning Frog				X		X	X	X		
<i>Heleioporus psammophilus</i>	Sand Frog				X						
<i>Limnodynastes dorsalis</i>	Western Banjo Frog				X		X	X	X		
<i>Neobatrachus pelobatoides</i>	Humming Frog				X						
<i>Crinia georgiana</i>	Quacking Frog				X		X				X
<i>Crinia glauerti</i>	Clicking Frog				X		X				
<i>Crinia insignifera</i>	Squelching Froglet				X		X				
<i>Geocrinia leai</i>	Ticking Frog				X						
<i>Myobatrachus gouldii</i>	Turtle Frog							X	X	X	
<i>Pseudophryne guentheri</i>	Crawling Toadlet				X						
Reptiles											
<i>Ctenophorus adelaidensis</i>	Western Heath Dragon				X			X			
<i>Pogona minor</i>	Dwarf Bearded Dragon				X		X	X	X	X	
<i>Strophurus spinigerus</i>	Soft Spiny-tailed Gecko				X		X			X	
<i>Underwoodisaurus milii</i>	Southern Barking Gecko				X						
<i>Christinus marmoratus</i>	Marbled Gecko									X	
<i>Ctenadactylus ocellatus</i>								X			
<i>Gehyra variegata</i>					X						
<i>Hemidactylus frenatus</i>	Asian House Gecko	In	X								
<i>Aprasia pulchella</i>					X						
<i>Aprasia repens</i>	Sand-plain Worm Lizard				X			X		X	
<i>Delma fraseri</i>								X			
<i>Lialis burtonis</i>	Burton's Legless Lizard				X				X	X	
<i>Pygopus lepidopodus</i>	Common Scaly Foot				X			X			
<i>Pletholax gracilis</i>								X	X		
<i>Cryptoblepharus buchananii</i>	Buchanan's Snake-eyed Sink				X					X	X
<i>Cryptoblepharus plagioccephalus</i>					X		X	X	X		
<i>Ctenotus australis</i>	West Coast Long-tailed Ctenotus				X				X	X	
<i>Ctenotus fallens</i>								X	X	X	X
<i>Egernia napoleonis</i>					X		X				
<i>Hemiernis initialis</i>									X		
<i>Hemiernis quadrilineata</i>					X		X		X	X	
<i>Lerista christinae</i>					X						
<i>Lerista distinguenda</i>								X		X	
<i>Lerista elegans</i>					X		X		X	X	
<i>Lerista lineopunctulata</i>					X						
<i>Lerista praepedita</i>					X		X	X		X	
<i>Menetia greyii</i>	Common Dwarf Skink				X		X		X	X	
<i>Morethia lineoocelatta</i>										X	
<i>Morethia obscura</i>	Dusky Morethia				X			X	X	X	
<i>Tiliqua occipitalis</i>	Western Bluetongue								X	X	
<i>Tiliqua rugosa</i>	Bobtail Skink							X	X	X	
<i>Varanus gouldii</i>	Bungarra or Sand Monitor								X	X	
<i>Ramphotyphlops australis</i>					X				X	X	
<i>Ramphotyphlops braminus</i>	Flowerpot Blind Snake	In	X								

Appendix J
Previously recorded fauna

SPECIES	VERNACULAR	Conservation Status	EPBC Search	DPAW Search	NatureMap	Birddata	Tingay, 1994	Burbridge et al, 1996	ATA, 2007	GHD, 2014	Current Survey
<i>Ramphotypholops pinguis</i>										X	
<i>Ramphotypholops waitii</i>										X	
<i>Antaresia stimsoni</i>	Stimson's Python				X						
<i>Morelia spilota imbricata</i>	Western Carpet Python	S4								X	
<i>Brachyuropsis semifasciatus</i>	Southern Shovel-nosed Snake				X			X		X	X
<i>Echiopsis curta</i>	Bardick				X				X		
<i>Elapognathus coronatus</i>	Crowned Snake				X						
<i>Neelaps bimaculatus</i>	Black-naped Snake							X			
<i>Neelaps calonotos</i>	Black-striped Snake	P3		X	X			X			
<i>Notechis scutatus</i>	Tiger Snake				X		X	X			
<i>Parasuta gouldii</i>					X				X		
<i>Pseudonaja affinis</i>	Dugite							X	X	X	
<i>Simoselaps bertholdi</i>	Jan's Banded Snake				X				X	X	
Birds											
<i>Dromaius novaehollandiae</i>	Emu				X	X	X	X	X	X	X
<i>Coturnix pectoralis</i>	Stubble Quail				X	X					
<i>Coturnix ypsilophora</i>	Brown Quail					X				X	
<i>Phasianus colchicus</i>	Common Pheasant (Domestic Pheasant)	In				X					
<i>Elanus caeruleus</i>	Black-shouldered Kite				X		X	X			
<i>Hamirostra isura</i>	Square-tailed Kite					X					
<i>Haliastur sphenurus</i>	Whistling Kite				X	X		X		X	
<i>Accipiter fasciatus</i>	Brown Goshawk				X	X			X	X	
<i>Accipiter cirrocephalus</i>	Collared Sparrowhawk				X	X		X	X		
<i>Aquila morphnoides</i>	Little Eagle				X	X					X
<i>Aquila audax</i>	Wedge-tailed Eagle					X	X	X		X	
<i>Circus assimilis</i>	Spotted Harrier					X					
<i>Circus approximans</i>	Swamp Harrier				X	X					
<i>Falco berigora</i>	Brown Falcon				X	X		X			
<i>Falco cenchroides</i>	Australian Kestrel				X	X		X			
<i>Falco longipennis</i>	Australian Hobby				X	X		X		X	
<i>Falco peregrinus</i>	Peregrine Falcon	S4		X	X	X			X		
<i>Turnix varia</i>	Painted Button-quail					X			X		
<i>Turnix velox</i>	Little Button-quail				X	X					
<i>Burhinus grallarius</i>	Bush Stone curlew	P4				X					
<i>Vanellus tricolor</i>	Banded Lapwing					X					
<i>Columba livia</i>	Domestic Pigeon	In	X			X				X	
<i>Streptopelia senegalensis</i>	Laughing Turtle-Dove	In	X		X	X	X		X		
<i>Streptopelia chinensis</i>	Spotted Turtle-Dove	In	X			X					
<i>Phaps chalcoptera</i>	Common Bronzewing				X	X		X	X	X	
<i>Phaps elegans</i>	Brush Bronzewing	P4				X					
<i>Ocyphaps lophotes</i>	Crested Pigeon				X	X		X	X	X	X
<i>Calyptorhynchus banksii naso</i>	Forest Red-tailed Black Cockatoo	Vu,S1			X	X					
<i>Calyptorhynchus latirostris</i>	Carnaby's Cockatoo	En, S1	X	X	X	X		X	X	X	
<i>Calyptorhynchus baudinii</i>	Baudin's Cockatoo	Vu,S1		X	X	X					
<i>Cacatua roseicapilla</i>	Galah					X	X	X	X	X	X
<i>Cacatua tenuirostris</i>	Eastern Long-billed Corella				X	X					
<i>Cacatua pastinator</i>	Western Long-billed Corella				X	X	X				
<i>Cacatua sanguinea</i>	Little Corella				X	X			X	X	

Appendix J
Previously recorded fauna

SPECIES	VERNACULAR	Conservation Status	EPBC Search	DPAW Search	NatureMap	Birddata	Tingay, 1994	Burbridge et al, 1996	ATA, 2007	GHD, 2014	Current Survey
<i>Cacatua galerita</i>	Sulphur-crested Cockatoo				X	X					
<i>Nymphicus hollandicus</i>	Cockatiel					X					
<i>Trichoglossus haematodus</i>	Rainbow Lorikeet					X				X	
<i>Glossopsitta porphyrocephala</i>	Purple-crowned Lorikeet				X	X		X		X	
<i>Polytelis anthopeplus</i>	Regent Parrot					X					
<i>Platycercus zonarius</i>	Australian Ringneck (Ring-necked Parrot)				X	X	X	X	X	X	X
<i>Platycercus spurius</i>	Red-capped Parrot				X	X		X	X	X	X
<i>Platycercus icterotis</i>	Western Rosella				X	X					
<i>Neophema elegans</i>	Elegant Parrot								X		
<i>Neophema petrophila</i>	Rock Parrot					X					
<i>Melopsittacus undulatus</i>	Budgerigar				X						
<i>Cuculus pallidus</i>	Pallid Cuckoo				X	X		X			X
<i>Cacomantis flabelliformis</i>	Fan-tailed Cuckoo				X	X	X	X		X	
<i>Chrysococcyx osculans</i>	Black-eared Cuckoo										X
<i>Chrysococcyx basalis</i>	Horsfield's Bronze Cuckoo					X		X	X	X	X
<i>Chrysococcyx lucidus</i>	Shining Bronze Cuckoo				X	X	X	X			
<i>Ninox connivens</i>	Barking Owl	P2				X					
<i>Ninox novaeseelandiae</i>	Boobook Owl				X	X		X	X	X	X
<i>Tyto alba</i>	Barn Owl								X	X	
<i>Podargus strigoides</i>	Tawny Frogmouth				X	X		X	X	X	
<i>Aegotheles cristatus</i>	Australian Owlet-nightjar				X			X		X	
<i>Apus pacificus</i>	Fork-tailed Swift	S3	X			X					
<i>Dacelo novaeguineae</i>	Laughing Kookaburra				X	X	X	X	X	X	X
<i>Todiramphus sanctus</i>	Sacred Kingfisher				X	X		X	X	X	
<i>Merops ornatus</i>	Rainbow Bee-eater	S3	X	X	X	X	X	X	X	X	
<i>Climacteris rufa</i>	Rufous Treecreeper					X					
<i>Malurus splendens</i>	Splendid Fairy-wren				X	X	X	X	X	X	X
<i>Malurus lamberti</i>	Variiegated Fairy-wren				X	X					
<i>Malurus pulcherrimus</i>	Blue-breasted Fairy-wren				X	X					
<i>Malurus elegans</i>	Red-winged Fairy-wren					X					
<i>Malurus leucopterus</i>	White-winged Fairy-wren				X	X		X			
<i>Stipiturus malachurus</i>	Southern Emu-wren					X					
<i>Pardalotus punctatus</i>	Spotted Pardalote				X	X					
<i>Pardalotus striatus</i>	Striated Pardalote				X	X		X	X	X	X
<i>Sericornis frontalis</i>	White-browed Scrubwren				X	X					
<i>Calamanthus campestris</i>	Rufous Fieldwren					X					
<i>Smicrornis brevirostris</i>	Weebill				X	X		X	X	X	
<i>Gerygone fusca</i>	Western Gerygone				X	X	X	X	X	X	X
<i>Acanthiza apicalis</i>	Broad-tailed Thornbill (Inland Thornbill)				X	X	X	X	X		X
<i>Acanthiza inornata</i>	Western Thornbill				X	X		X	X	X	
<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill				X	X		X		X	
<i>Lichmera indistincta</i>	Brown Honeyeater				X	X	X	X	X	X	X
<i>Lichenostomus virescens</i>	Singing Honeyeater					X		X		X	X
<i>Lichenostomus ornatus</i>	Yellow-plumed Honeyeater					X		X			
<i>Lichenostomus leucotis</i>	White-eared Honeyeater					X					
<i>Melithreptus brevirostris</i>	Brown-headed Honeyeater				X	X		X		X	
<i>Phylidonyris novaehollandiae</i>	New Holland Honeyeater				X	X		X			
<i>Phylidonyris nigra</i>	White-cheeked Honeyeater					X	X		X	X	

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Previously recorded fauna

SPECIES	VERNACULAR	Conservation Status	EPBC Search	DPAW Search	NatureMap	Birddata	Tingay, 1994	Burbridge et al, 1996	ATA, 2007	GHD, 2014	Current Survey
<i>Phylidonyris albifrons</i>	White-fronted Honeyeater					X					
<i>Phylidonyris melanops</i>	Tawny-crowned Honeyeater					X		X			
<i>Acanthorhynchus superciliosus</i>	Western Spinebill				X	X	X	X	X		X
<i>Manorina flavigula</i>	Yellow-throated Miner				X	X		X			
<i>Acanthagenys rufogularis</i>	Spiny-cheeked Honeyeater					X					
<i>Anthochaera lunulata</i>	Western Little Wattlebird				X	X		X		X	
<i>Anthochaera carunculata</i>	Red Wattlebird				X	X	X	X	X	X	X
<i>Epthianura albifrons</i>	White-fronted Chat				X	X		X			
<i>Epthianura tricolor</i>	Crimson Chat					X					
<i>Microeca fascinans</i>	Jacky Winter					X				X	
<i>Petroica multicolor</i>	Scarlet Robin					X		X	X	X	X
<i>Petroica goodenovii</i>	Red-capped Robin				X	X		X			X
<i>Petroica cucullata</i>	Hooded Robin					X		X			
<i>Eopsaltria australis</i>	Yellow Robin					X				X	
<i>Eopsaltria georgiana</i>	White-breasted Robin					X					
<i>Daphoenositta chrysoptera</i>	Varied Sittella				X	X		X	X	X	X
<i>Oreoica gutturalis</i>	Crested Bellbird					X					
<i>Pachycephala pectoralis</i>	Golden Whistler				X	X		X		X	
<i>Pachycephala rufiventris</i>	Rufous Whistler				X	X	X	X	X	X	X
<i>Colluricincla harmonica</i>	Grey Shrike-thrush				X	X	X	X	X	X	X
<i>Rhipidura fuliginosa</i>	Grey Fantail				X	X	X	X	X	X	X
<i>Rhipidura leucophrys</i>	Willie Wagtail				X	X	X	X	X	X	
<i>Grallina cyanoleuca</i>	Magpie-lark				X	X	X	X		X	
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike				X	X	X		X	X	X
<i>Lalage tricolor</i>	White-winged Triller					X		X		X	
<i>Artamus personatus</i>	Masked Woodswallow					X					
<i>Artamus cinereus</i>	Black-faced Woodswallow				X	X		X			
<i>Artamus cyanopterus</i>	Dusky Woodswallow				X	X		X			X
<i>Cracticus torquatus</i>	Grey Butcherbird				X	X		X	X	X	X
<i>Cracticus nigrogularis</i>	Pied Butcherbird				X	X					
<i>Cracticus tibicen</i>	Australian Magpie				X	X		X	X	X	X
<i>Strepera versicolor</i>	Grey Currawong				X	X				X	
<i>Corvus coronoides</i>	Australian Raven				X	X		X	X	X	X
<i>Ptilonorhynchus maculatus</i>	Spotted Bowerbird					X					
<i>Sturnus vulgaris</i>	Common Starling	In	X								
<i>Acridotheres tristis</i>	Common Myna	In	X								
<i>Cheramoeca leucosternus</i>	White-backed Swallow					X		X			
<i>Hirundo neoxena</i>	Welcome Swallow				X	X		X		X	X
<i>Hirundo nigricans</i>	Tree Martin				X	X		X		X	
<i>Hirundo ariel</i>	Fairy Martin					X					X
<i>Zosterops lateralis</i>	Grey-breasted White-eye (Silvereye)				X	X	X	X	X	X	
<i>Acrocephalus australis</i>	Australian Reed Warbler				X	X	X				
<i>Megalurus gramineus</i>	Little Grassbird				X	X					
<i>Cincloramphus mathewsi</i>	Rufous Songlark				X	X		X			
<i>Cincloramphus cruralis</i>	Brown Songlark				X	X					
<i>Dicaeum hirundinaceum</i>	Mistletoebird				X			X		X	
<i>Passer domesticus</i>	House Sparrow	In	X								
<i>Passer montanus</i>	Eurasian Tree Sparrow	In	X								

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Previously recorded fauna

SPECIES	VERNACULAR	Conservation Status	EPBC Search	DPAW Search	NatureMap	Birdata	Tingay, 1994	Burbridge et al, 1996	ATA, 2007	GHD, 2014	Current Survey
<i>Stagonopleura oculata</i>	Red-eared Firetail					X					
<i>Lonchura castaneothorax</i>	Chestnut-breasted Mannikin					X					
<i>Anthus australis</i>	Australian Pipit					X					
<i>Carduelis carduelis</i>	Goldfinch (European Goldfinch)	In	X			X					
Mammals											
<i>Tachyglossus aculeatus</i>	Echidna				X			X		X	
<i>Dasyurus geoffroii</i>	Western Quoll, Chuditch	Vu,S1	X	X	X						
<i>Sminthopsis griseoventer</i>	Grey-bellied Dunnart							X			
<i>Isoodon obesulus fusciventer</i>	Southern Brown Bandicoot	P5		X	X		X			X	
<i>Macropus fuliginosus</i>	Western Grey Kangaroo				X		X	X		X	X
<i>Macropus irma</i>	Western Brush Wallaby	P4						X			X
<i>Macropus robustus</i>	Euro, Biggada				X						
<i>Trichosurus vulpecula</i>	Common Brushtail Possum									X	
<i>Cercartetus concinnus</i>	Western Pygmy-possum, Mundarda				X						
<i>Tarsipes rostratus</i>	Honey Possum, Noolbenger						X	X	X		
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat				X			X		X	
<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat				X			X		X	
<i>Nyctophilus gouldi</i>	Gould's Long-eared Bat				X			X			
<i>Vespadelus regulus</i>	Southern Forest Bat							X			
<i>Tadarida australis</i>	White-striped Freetail-bat									X	
<i>Mus musculus</i>	House Mouse	In	X		X		X	X	X	X	
<i>Pseudomys albocinereus</i>	Ash-grey Mouse				X			X			
<i>Rattus norvegicus</i>	Brown Rat	In	X								
<i>Rattus rattus</i>	Black Rat	In	X		X		X			X	
<i>Funambulus pennanti</i>	Indian Palm Squirrel	In	X								
<i>Oryctolagus cuniculus</i>	Rabbit	In	X				X	X		X	
<i>Canis lupus</i>	Dog	In	X							X	
<i>Vulpes vulpes</i>	Red Fox	In	X				X	X		X	X
<i>Felis catus</i>	Cat	In	X		X			X		X	
<i>Sus scrofa</i>	Pig	In	X								
<i>Bos taurus</i>	European Cattle	In	X								
<i>Capra hircus</i>	Goat	In	X								
<i>Cervus elaphus</i>	Red Deer	In	X								

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Main Roads Western Australia

Hill River Offset Property
Biological Survey

September 2016

Executive summary

Introduction

Main Roads Western Australia is currently constructing Stage 1 of the Mitchell Freeway Extension. Stage 1 of the project was referred to the DotE under the EPBC Act and was determined to be a 'controlled action' due to the likely significant impacts on Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*). The impact is clearing of 88.7 ha of native vegetation that provides known and potential foraging, roosting and breeding habitat for Carnaby's Black Cockatoo.

Condition 3 of EPBC approval 2013/7091 stipulated that Main Roads must provide an offset property with suitable environmental values to be transferred to the Conservation and Parks Commission of Western Australian and managed by Department of Parks and Wildlife, to be reserved for conservation in perpetuity.

Main Roads has acquired an offset property (Lot 1, 1395 Banovich Road, Hill River), which is the subject of this report. A biological survey ('Ecological Values Assessment'), including a Black Cockatoo habitat assessment to determine the environmental values of the property was undertaken. The property (survey area) consists of 1,993 ha.

Key results

- Four vegetation types were considered to resemble conservation significant ecological communities, including:
 - VT01 is associated with the Lesueur-Coomallo Floristic Community D1 TEC, listed as Critically Endangered under the WC Act
 - VT03 is associated with the Lesueur-Coomallo Floristic Community M2 (*Melaleuca preissiana* woodland) Priority 1 PEC
 - VT04 is associated with the Lesueur-Coomallo Floristic Community DFGH Priority 1 PEC, in particular 'D' heath and woodlands on gravelly hills and slopes
 - VT02 is associated with the *Petrophile chrysantha* low heath on Lesueur dissected uplands (Gp200-170) Priority 2 PEC
- Fourteen vegetation types were described from the survey area. 1746.81 ha of native vegetation, ranging from Pristine to Completely Degraded condition
- The native vegetation within the survey area is considered significant vegetation as defined by the EPA and DPaW (2015) as the majority of the survey area is in a Pristine condition that is a refuge for a number of conservation significant flora that occur throughout the survey area in a variety of vegetation types
- The survey area contained a diverse range of flora with 344 taxa (including subspecies and varieties) representing 51 families and 149 genera recorded from the survey area
- Nine conservation significant flora were recorded from the survey area including:
 - *Hakea megalosperma* (listed as Vulnerable under both the EPBC Act and WC Act)
 - *Acacia retrorsa* (Priority 2)
 - *Grevillea delta* (Priority 2)
 - *Thelymitra variegata* (Priority 2)
 - *Hensmania stoniella* (Priority 3)

- *Lepidobolus quadratus* (Priority 3)
 - *Stylidium ?hymenocraspedum* (Priority 3)
 - *Stylidium ?torticarpum* (Priority 3)
 - *Hakea neurophylla* (Priority 4).
- The Likelihood of Occurrence assessment post-field survey concluded that seven taxa are known to occur, two are likely to occur, 152 may possibly occur and the remaining 29 taxa are unlikely or highly unlikely to occur within the survey area. The large number of conservation significant taxa that are considered possibly to occur is due to the survey area comprising of a varied landscape with a range of soils and landforms that align with the habitat considered suitable for the species
 - No introduced species listed as a Declared Pest under Section 22 of the BAM Act or as a Weed of National Significance were recorded within the survey area
 - Seven fauna habitat types were recorded during the field survey, which broadly aligned with the vegetation types and include, Wandoo Woodlands, Marri Woodland, *Eucalyptus todtiana*, *Banksia attenuata/menziesii* low Open Woodland, Minor Drainage lines and Seasonally Inundated Areas and Dams, Heathlands on Sandy Soils, Heathlands on Lateritic Soils and Scattered Trees of Wandoo and Marri in Paddock
 - One hundred and seven fauna species were recorded within or in close proximity to the survey area including 72 birds, 18 mammals (6 introduced), 12 reptiles and five frogs
 - The EPBC Act listed Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*), Endangered Schedule 1 and Priority 4 listed Western Brush Wallaby (*Macropus irma*) were recorded during the survey
 - The Likelihood of Occurrence assessment post-field survey concluded that six additional conservation significant fauna taxa may likely occur within the survey area and these are: Western Ground Parrot (*Pezoporus flaviventris*), Chuditch (*Dasyurus geoffroi*), Peregrine Falcon (*Falco peregrinus*), Woma Python (*Aspidites ramsayi* SW pop.), Southern Brown Bandicoot (*Isodon obesulus* subsp. *fusciventer*) and Black-striped Snake (*Neelaps calonotos*). Some of these species are considered rare in Western Australia, however few fauna studies have occurred in this region and their presence could not be excluded.

Summary of offset calculator inputs

The EPBC Act Offsets Assessment Guide has been used to determine the required offsets for impacts to Carnaby's Black Cockatoo for Stage 1 of the Mitchell Freeway Extension, Burns Beach to Hester Avenue, and the geotechnical trace lines. A summary of the inputs into the Offsets Calculator section of the EPBC Act Offsets Assessment Guide for the proposed offset site (the survey area) is provided in the table below.

The outcome accounts for greater than 100% (106.57%) direct offset for the impact of clearing 88.7 ha of Carnaby's Black Cockatoo habitat for Stage 1 of the project.

Summary of inputs into Offset Calculator

Offset calculator attribute	Input value
Proposed offset	Portion of Lot 1, 1395 Banovich Road, Hill River Area: 1993 ha including 1771.5 ha native vegetation and 27.5 ha of highly modified vegetation
Time horizon (years)	
Time over which loss is averted	20 years

Offset calculator attribute	Input value
Time until ecological benefit	10 years
Start area (ha)	564 ha
Start quality (scale of 1-10)	9
Future area and quality with and without offset (%)	
Risk of loss (%) without offset	15%
Future quality without offset (scale 1-10)	8
Risk of loss (%) with offset	2%
Future quality with offset (scale 1-10)	9
Confidence in result (%)	
Averted loss component input	80%
Change in habitat quality component input	80%
Output	
Net present value (adjusted hectares)	75.63

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1. Introduction

1.1 Background

Main Roads Western Australia (Main Roads) is currently constructing Stage 1 of the Mitchell Freeway Extension (project). The ultimate works for the project have been divided in to three stages, of which Stage 1 includes the works associated with the extension from Burns Beach Road to Hester Avenue and the connecting roads (Neerabup Road and Hester Avenue).

Stage 1 was referred to the Department of the Environment (DotE¹) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and was determined to be a 'controlled action' due to the likely significant impacts on Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*). The impact is clearing of 88.7 hectares (ha) of native vegetation that provides known and potential foraging, roosting and breeding habitat for Carnaby's Black Cockatoo.

Condition 3 of EPBC approval 2013/7091 stipulated that Main Roads must provide an offset property with suitable environmental values to be transferred to the Conservation and Parks Commission of Western Australian and managed by Department of Parks and Wildlife, to be reserved for conservation in perpetuity.

Main Roads acquired a potential offset property (Lot 1, 1395 Banovich Road, Hill River). A biological survey ('Ecological Values Assessment') including a Black Cockatoo habitat assessment was commissioned to determine the environmental values of the property. The property consists of 1,993 ha (survey area) of bushland in the locality of Hill River (near the town of Jurien), situated approximately 170 kilometres (km) from the project.

1.1 Purpose of this report

The purpose of the assessment was to delineate key flora, vegetation, fauna, soil values within the survey area. The outcomes of the assessment will be used to determine the suitability of the property being used as an offset for the project and for future Main Roads offsets.

1.2 Location

1.2.1 Study area

A study area was defined for the desktop based searches of the survey area and includes a 20 km buffer around the survey area.

1.2.2 Biological survey area

The survey area is located west of Banovich Road and north of Jurien Road, approximately 20 km east northeast of Jurien town site, in the Shire of Dandaragan. The location of the survey area is mapped in Figure 1, Appendix A.

1.3 Scope of works

The scope of works, as detailed in the Main Roads Consultants Brief was to undertake a desktop assessment and Level 1 flora, vegetation and fauna survey, including targeted Black Cockatoo habitat assessment for the project. The following actions were undertaken:

¹ The Department of the Environment is now the Department of the Environment and Energy (DotEE)

- Complete a desktop assessment of the study area prior to the field survey work to identify all biological features and constraints, which may be in, or nearby the survey area
- Identify and review any existing and relevant environmental reports
- Identify significant flora, vegetation/ecological communities, fauna, soil, groundwater and surface water values and potential sensitivity to impact
- Identify broad pre-European vegetation type(s) using Beard (various)
- Conduct a Level 1 field survey (to be done by an environmental specialist in accordance with regulatory expectation for years of experience in the relevant bioregion) to verify/ground truth the desktop assessment findings through targeted and comprehensive survey
- Undertake vegetation condition mapping using an appropriate condition scale for the bioregion (as per Environmental Protection Agency (EPA) and DPaW 2015)
- Undertake ecological community mapping to a scale appropriate for the bioregion and described according to the National Vegetation Information System (NVIS) structure and floristics
- Undertake targeted Black Cockatoo habitat assessment and mapping
- Undertake relevant environmental constraints mapping using GIS mapping software (e.g. ArcMap)
- Assess the project areas plant species diversity, density, composition, structure and weed cover, recording the percentage of each in 20 flora sampling quadrats.

The biological survey aspects that relate to flora were undertaken having regard to the EPA and DPaW (2015) Technical Guide and those aspects that relate to fauna were undertaken having regard to EPA Guidance Statement No.56 (EPA 2004) and the subsequent Technical Guide (EPA and Department of Environment and Conservation (DEC) 2010).

1.4 Relevant legislation, conservation codes and background information

In Western Australia some ecological communities, flora and fauna are protected under both Federal and State Government legislation. In addition, regulatory authorities also provide a range of guidance and information on expected standards and protocols for environmental surveys.

An overview of key legislation and guidelines, conservation codes and background information relevant to this biological survey is provided in Appendix B.

1.5 Report limitations and assumptions

This report has been prepared by GHD for Main Roads and may only be used and relied on by Main Roads for the purpose agreed between GHD and the Main Roads as set out in section 1.3 of this report.

GHD otherwise disclaims responsibility to any person other than Main Roads arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report (including species listings). GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Main Roads and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of access tracks, operational works, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

This report has assessed the flora and fauna within the survey area (Figure 1, Appendix A). Should the survey area change or be refined, further assessment may be required.

2. Methodology

2.1 Desktop assessment

Prior to the commencement of the field survey, a desktop assessment was undertaken to identify relevant environmental information pertaining to the study area and to assist in survey design. The search parameters used were a 20 km radius of a point at 30° 11' 31" S, 115° 14' 11" E. This included a review of:

- The DotEE Protected Matters Search Tool (PMST) to identify communities and species listed under the EPBC Act potentially occurring within the study area (DotEE 2016a) (Appendix C)
- The DPaW Threatened Ecological Communities (TECs) and Priority Ecological Communities (PECs) database (Reference Number: 14-0716EC) to determine the potential for TECs or PECs to be present within the study area
- The *NatureMap* database for flora and fauna species previously recorded within the study area (DPaW 2016) (Appendix C)
- The DPaW Threatened (Declared Rare) and Priority Flora (TPFL) database² (Reference Number: 02-0816FL), the DPaW Threatened and Priority Fauna database (Reference Number: FAUNA#5265), and the WA Herbarium database for Threatened flora and fauna species listed under the *Wildlife Conservation Act 1950* (WC Act) and listed as Priority by the DPaW, previously recorded within the study area
- Existing datasets including previous vegetation mapping of the survey area (Beard 1979), aerial photography, geology/soils and hydrology information to provide background information on the variability of the environment, likely vegetation units and fauna habitats and to identify areas with potential to contain TECs, PECs, and Threatened and Priority listed flora and fauna species.

2.2 Field survey

2.2.1 Vegetation and flora

As part of the biological survey, a Level 1 single season vegetation and flora assessment of the survey area was conducted by botanists Mathew Gannaway (SL011729) and Joshua Foster (SL011812) from the 1 to 5 August 2016. The field survey was undertaken to verify the results of the desktop assessment, identify and describe the dominant vegetation units where possible, assess vegetation condition and identify and record vascular flora taxa present at the time of survey. Searches for conservation significant ecological communities and flora taxa were also undertaken.

The survey methodology employed was undertaken with reference to the EPA and DPaW *Technical Guide – Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA and DPaW 2015).

Data collection

Field survey methods involved a combination of sampling quadrats located in identified vegetation units and traversing the survey area by foot. Twenty pegged quadrats (measuring 10 metres (m) x 10 m) were recorded in the survey area. To sample all the apparent vegetation

² DPAW would only supply data for a 5 km radius search of the survey area for the DPAW TPFL database search.

units across the survey area, the location of quadrats was made primarily on the basis of aerial photographic maps. The locations of TECs and PECs were previously recorded within the survey area were targeted. Additional sites were selected in situ, based on observations of vegetation units during the field assessment.

Field data for each quadrat were recorded on a pro-forma data sheet and included the parameters detailed in Table 1. Quadrat data are provided to Main Roads in Excel format.

Table 1 Data collected during the flora and vegetation field survey

Aspect	Measurement
Collection attributes	Personnel/recorder; date, quadrat dimensions, photograph of the quadrat.
Physical features	Aspect, soil attributes, ground surface cover, leaf and wood litter.
Location	Coordinates recorded in GDA94 datum using a hand-held Global Positioning System (GPS) tool to accuracy approximately ± 10 m. Location recorded at the north-west corner peg.
Vegetation condition	The vegetation condition of the survey area was assessed and mapped in accordance with the vegetation condition rating scale for the South West and Interzone Botanical Provinces (EPA and DPaW 2015).
Disturbance	Level and nature of disturbances (e.g. weed presence, fire and time since last fire, impacts from grazing, exploration activities).
Flora	List of dominant flora from each structural layer List of all species within the quadrat including average height, number and cover (using a modified Braun-Blanquet scale).

A flora inventory was compiled from taxa listed in described quadrats and from opportunistic floristic records throughout the survey area.

Vegetation units

Vegetation units were identified and boundaries delineated using a combination of aerial photography, topographical features and field data/observations.

Vegetation units were described based on structure, dominant taxa and cover characteristics as defined by quadrat data and field observations. Vegetation unit descriptions follow the National Vegetation Information System (NVIS) framework and are consistent with NVIS Level V (Association). At Level V, three (or occasionally more) taxa per stratum are used to describe the association (Executive Steering Committee for Australian Vegetation Information (ESCAVI) 2003).

Vegetation condition

The vegetation condition of the survey area was assessed and mapped in accordance with the vegetation condition rating scale for the South West and Interzone Botanical Provinces (EPA and DPaW 2015). The scale recognises the intactness of vegetation and consists of six rating levels as outlined in Appendix B.

Flora identification and nomenclature

Species well known to the survey botanists were identified in the field; all other species were collected and assigned a unique collection number to facilitate tracking. All plant specimens collected during the field assessment were dried and processed in accordance with the requirements of the WA Herbarium. Plant species were identified by the use of taxonomic literature, electronic keys and online electronic databases. Where necessary, plant taxonomists considered to be authorities on particular plant groups were consulted.

The conservation status of all recorded flora was compared against the current lists available on *FloraBase* (WA Herbarium 2016) and the EPBC Act List of Threatened Flora (DotEE 2016b).

Conservation significant flora that could not be confidently identified at the WA Herbarium by the field botanist were submitted to the WA Herbarium for formal identification (Accession Number: 6917).

Nomenclature used in this report follows that used by the WA Herbarium as reported on *FloraBase* (WA Herbarium 2016).

Surveys for conservation significant flora

Prior to the field survey, information from the desktop assessments (e.g. aerial photography, geology, soils and topography data, EPBC Act PMST, TPFL and *NatureMap*) was reviewed to determine conservation significant flora taxa potentially present within the survey area. Additionally, ecological information (e.g. habitat, associated flora taxa and phenology) was sourced from *FloraBase* (WA Herbarium 2016) and other relevant publications where available, to provide further details.

Potential habitats were searched for the presence of conservation significant flora. Locations within the survey area with differing hydrology, fire or disturbance history to the surrounding areas were also searched where identified.

When any known or potential Threatened, Priority or significant flora was located, the following data was collected: GPS location, height (m), number of plants and corresponding area of population, reproductive state and plant condition.

2.2.2 Fauna

Zoologists (Glen Gaikhorst and Craig Grabham) undertook a single season Level 1 fauna survey (reconnaissance survey) of the survey area from the 1 to 5 August 2016. The fauna survey was undertaken concurrently with the vegetation and flora assessment and with reference to the EPA Guidance Statement No. 56 *Terrestrial Fauna Survey for Environmental Impact Assessment in Western Australia* (EPA 2004). The purpose of the reconnaissance survey was to verify the accuracy of the desktop study, and delineate and characterise the fauna assemblages present in the survey area.

The majority of the survey area was traversed on foot and by vehicle over the course of five days to identify and describe the dominant fauna habitat types and their condition, assess habitat connectivity, identify and record fauna species within the survey area. A Likelihood of Occurrence assessment for conservation significant fauna and their habitats occurring within the survey area was also undertaken.

Habitat assessment

Fauna habitats were assessed in-situ and comprised visual assessment of the following:

- Habitat structure (e.g. vegetation type, presence/absence of structural layers such as ground cover and mid storey)
- Presence/absence of refuge including: density of ground covers, fallen timber, hollow-bearing trees and stags and rocks/boulder piles, and the type and extent of each refuge
- Presence/absence of waterways including type, extent and habitat quality within waterways
- Location of the habitat within the survey area in comparison to the habitat within the surrounding landscape

- Habitat connectivity and identification of wildlife corridors within and immediately adjacent to the survey area
- Current land use and disturbance history
- Identification and evaluation of key habitat features and types identified during the desktop assessment relevant to fauna of conservation significance
- Evaluation of the Likelihood of Occurrence of conservation significant fauna within the habitat (based on presence of suitable habitat and observations)
- A representative photograph of each habitat type.

Opportunistic fauna searches

Opportunistic fauna searches were also conducted across the survey area. The majority of opportunistic searches were undertaken at habitat assessment locations and focussed on the following:

- Searching the survey area for tracks, scats, bones, diggings and feeding areas for both native and feral fauna
- Searching through microhabitats including turning over rocks and ground debris (e.g. leaf litter) and examining tree hollows and hollow logs for reptile and other small vertebrate fauna
- Visual and aural surveys. This accounted for many bird species potentially utilising the survey area. The *Michael Morcombe eGuide to Australian Birds* – phone application (Morcombe 2014) and binoculars were used to assist visual observations. Pre-recorded calls (Morcombe 2014) were used to assist with aural identification of bird species
- A visual assessment of the water bodies to identify any fish species observed
- Recording GPS locations of any conservation significant fauna species.

Camera traps

Remote sensor cameras (15 x Reconyx-Hyperfire and 5 x ScoutGuard DTC 560K) were deployed for 15 nights each at 20 locations within the survey area. Cameras were positioned in areas where key habitat features were present or potential activity of species was recorded. Cameras were baited with cereal laced with peanut butter and honey to attract fauna. For each camera location the time and date deployed and recovered, a GPS coordinate, and brief habitat description were recorded (as seen in Table 2). Camera locations are displayed in Figure 5, Appendix A. Data from the cameras was downloaded to a computer and analysed for the presence of animals following the field survey.

Table 2 Camera trap locations and effort undertaken

Sites	Easting	Northing	Deployed	Collected	Total Nights	Comments
SG2	329377	6659242	3 Aug	19 Aug	15	Wandoo Woodland
SG7	329354	6659348	3 Aug	19 Aug	15	Wandoo Woodland
R16	331296	6660200	3Aug	19 Aug	15	Wandoo Woodland
R16b	331280	6660051	3 Aug	19 Aug	15	Wandoo Woodland
SG10	329356	6659374	3 Aug	19 Aug	15	Wandoo Woodland

Sites	Easting	Northing	Deployed	Collected	Total Nights	Comments
R20	331319	6656593	3 Aug	19 Aug	15	On dam edge
R8	331362	6656589	3 Aug	19 Aug	15	On dam edge
RA	331394	6656519	3 Aug	19 Aug	15	Wandoo Woodland
R14c	331441	6656539	3 Aug	19 Aug	15	Wandoo Woodland
R12	331464	6656549	3 Aug	19 Aug	15	Wandoo Woodland
R13b	331292	6660127	3 Aug	19 Aug	15	<i>Kingia</i> Heath on lateritic Ridge
SG6	329363	6659313	3 Aug	19 Aug	15	<i>Kingia</i> Heath on lateritic Ridge
R31	331285	6660101	3 Aug	19 Aug	15	<i>Kingia</i> Heath on lateritic Ridge
SG9	329361	6659278	3 Aug	19 Aug	15	<i>Kingia</i> Heath on lateritic Ridge
R6	331248	6659981	3 Aug	19 Aug	15	<i>Kingia</i> Heath on lateritic Ridge
R14	328641	6660175	3 Aug	19 Aug	15	Low Heath with <i>Banksia</i>
R3	328609	6660146	3 Aug	19 Aug	15	Low Heath with <i>Banksia</i>
R21	328579	6660119	3 Aug	19 Aug	15	Low Heath with <i>Banksia</i>
R27	328699	6660166	3 Aug	19 Aug	15	On isolated Rock Boulder
R15	328654	6660175	3 Aug	19 Aug	15	Low Heath with <i>Banksia</i>

Bat survey

Two Songmeter SM2BAT+ recorder (Wildlife Acoustics Inc., USA) and one Anabat Express recorder (Titley Scientific) was deployed at three locations. The three units were deployed for a combined total of 26 nights to record ultrasonic echolocation calls emitted by microchiropteran bats. Figure 5, Appendix A displays the detector locations within the survey area.

Data from the detector were downloaded to a computer and analysed for the presence of bat calls by Craig Grabham of GHD following the field survey (see Appendix E).

Fauna species identification

Fauna species were identified in the field using available field and electronic guides (e.g. Morcombe 2014). Where identification was not possible, photographs of specimens were collected to be later identified.

Nomenclature follows that used by the WA Museum (as shown on *NatureMap*), as it is deemed to contain the most up-to-date species information for WA, with the exception of birds, where Christidis and Boles (2008) was used.

Targeted survey for Black Cockatoo

The aim of the habitat assessment was to assess the presence, quality and extent of habitat for Carnaby's Black Cockatoo within the survey area based on their modelled distribution (Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC 2012a). Carnaby's Black Cockatoo is the only Black Cockatoo in this region with both Forest Red-tailed Black Cockatoo and Baudin's Black Cockatoo not modelled to be present (DSEWPaC 2012a). The survey involved visual and aural assessment of the survey area identifying breeding habitat (presence/absence of actual and potential breeding trees), foraging habitat, roosting areas, current activity and any other signs of use by Carnaby's Black Cockatoo. For the purpose of this assessment, the DSEWPaC (2012a) Black Cockatoo referral guideline was used to define breeding, foraging and night roosting habitat.

Information collected during the field survey included:

- Foraging habitat – the location and extent of suitable Black Cockatoo species foraging habitat was identified and mapped for the survey area, based on the vegetation associations and presence/absence of known foraging species. During the field surveys any direct or indirect evidence of foraging by Black Cockatoos was recorded via GPS
- Breeding habitat - suitable breeding habitat for Black Cockatoos is defined by DSEWPaC (2012a) as trees of species known to support breeding within the range of the species which either have a suitable nest hollow or are of a suitable diameter at breast height (DBH) to develop a nest hollow. For most tree species, suitable DBH is 500 millimetres (mm). For Salmon Gum and Wandoo, suitable DBH is 300 mm (DSEWPaC 2012a). Breeding habitat was identified and mapped according to the presence of suitable woodland habitat. Individual trees for the entire survey area were not mapped however 10 (50 x 50 m) plots were undertaken in Wandoo Woodland and four in Marri Woodland to ascertain tree densities within these habitats. For each breeding tree, details of the tree species, size and number of hollows observed, evidence of use and any other significant observations were recorded. On average, Carnaby's Black Cockatoos are known to nest in hollows with an entrance diameter greater than 200-300 mm (Johnstone and Storr 1998; Groom 2011). Therefore, during the field survey a suitable nesting hollow currently able to support breeding was defined as a tree hollow with an entrance diameter of 200 mm or greater
- Night roosting habitat - suitable roosting habitat is defined by DSEWPaC (2012a). Suitable roosting habitat was identified based on the presence of suitable tall trees, proximity of known roosting sites and the presence of suitable foraging habitat
- Opportunistic observations (both visual and aural) for the presence of Black Cockatoos within the survey area and surrounding areas were also noted during the survey.

This information was used to map and calculate the amount of foraging habitat, breeding, potential breeding habitat and night roosting sites within the survey area. Any area containing known foraging species or potential nesting trees was considered as habitat for Black Cockatoos.

2.3 Limitations

2.3.1 Desktop limitations

The EPBC Act PMST is based on bioclimatic modelling for the potential presence of species. As such, this does not represent actual records of the species within the area. The records from the DPaW searches of Threatened flora and fauna provide more accurate information for the general area. However, some collection, sighting or trapping records cannot be dated and often misrepresent the current range of Threatened species.

2.3.2 Field survey limitations

The EPA and DPaW (2015) Technical Guide and Guidance Statement No. 56 (EPA 2004) states that flora and fauna survey reports for environmental impact assessment in WA should contain a section describing the limitations of the survey methods used. The limitations and constraints associated with this field survey are discussed in Table 3.

Table 3 Survey limitations

Aspect	Constraint	Comment
Sources of information and availability of contextual information.	Nil	Adequate information is available for the survey area; this includes: <ul style="list-style-type: none"> • Broad scale (1:250,000) vegetation mapping by Beard (1979) and digitised by Shepherd <i>et al.</i> (2002) • Regional biogeography (Desmond and Chant 2001) • Regional vegetation (Department of Conservation and Land Management (CALM) 1995; Bell <i>et al.</i> 1984).
Scope (what life forms were sampled etc.)	Nil	Vascular flora and terrestrial vertebrate fauna were sampled during the survey. Non-vascular flora, invertebrate and aquatic fauna were not assessed as part of survey, although opportunistic records were taken of invertebrate and aquatic fauna during the survey.
Proportion of flora collected and identified (based on sampling, timing and intensity) Proportion of fauna identified, recorded and/or collected	Moderate	<p>The vegetation and flora survey was a single season survey only and was undertaken in early August 2016. The optimal time to undertake flora and vegetation surveys in the Northern Sandplains region is in Spring from September to November (EPA and DPaW 2015). The majority of the conservation significant flora identified in the desktop assessment flower from September to October and therefore the survey timing was a little early with many of the observed species either budding or not in flower. The proportion of flora collected and identified was considered low for the region; with annuals representing only 6.12 % of species recorded. Orchids represented only 3.79 % of species while grasses and daisies combined also only represented 4.66 % of species.</p> <p>The fauna survey was undertaken in early August 2016 and was a reconnaissance survey only. The fauna assessment sampled those species that can be easily seen, heard or have distinctive signs, such as tracks, scats, diggings, etc. Twenty remote cameras were deployed for 15 days in Wandoo woodlands and healthlands to gather additional data on some nocturnal species. Many cryptic (e.g. invertebrate species) and localised nocturnal species would not have been identified during a reconnaissance survey and seasonal variation within species often requires targeted surveys at a particular time of the year.</p> <p>The fauna assessment was aimed at identifying habitat types and terrestrial vertebrate fauna utilising the survey area. No sampling for invertebrates or aquatic species occurred. Where terrestrial invertebrate fauna was recorded opportunistically, these findings were mentioned in this report. However, this report is limited to an assessment of terrestrial vertebrate fauna, as the information available on the identification, distribution and conservation status of invertebrates is generally less extensive than that of vertebrate species.</p>
Flora determination	Moderate	<p>Flora determination was undertaken by Mathew Gannaway and Joshua Foster in the field and by Mathew Gannaway at the WA Herbarium.</p> <p>Fifty-six taxa could only be identified to genus and nine taxa could only be identified to family due to lack of flowering and fruiting material required for identification. With no flowering or fruiting material, positive identification of these collections and their resemblance to conservation significant flora identified in the desktop assessment could not occur. Additionally, some species, particularly small herbs and annuals were unable to be identified due to only cotyledons present or insufficient material available for identification.</p>

Aspect	Constraint	Comment
		The taxonomy and conservation status of the WA flora is dynamic. This report was prepared with reliance on taxonomy and conservation status current at the time report development, but it should be noted this may change in response to ongoing research and review of International Union for Conservation of Nature criteria.
Completeness and further work which might be needed (e.g. was the relevant area fully surveyed)	Minor	<p>The survey area is large (approximately 1993 ha) and was surveyed through the use of a vehicle, surveying only those areas accessible with vehicle tracks. Information gained from the survey was extrapolated across the sections of the survey area not easily accessed by vehicle to assist with determining the extent of vegetation and habitat types for the survey area. As the survey area is in a dynamic landscape with varied low heath formations that are not easily discernible from aerial imagery, extrapolation of the vegetation and habitat carries a small degree of uncertainty. In addition, the flora is very complex in the survey area with some species unable to be distinguished from similar species due to insufficient flowering and fruiting material.</p> <p>As the survey area is not proposed for clearing but rather for retention as conservation estate, lack of comprehensive coverage is not a true constraint for this project.</p>
Mapping reliability	Nil	<p>High resolution Environmental Systems Research Institute aerial imagery was available.</p> <p>Data were recorded in the field using hand-held GPS tools (e.g. Tablet using the Collector Application and Garmin GPS). Certain atmospheric factors and other sources of error can affect the accuracy of GPS receivers. The Garmin GPS units used for this survey are accurate to within +/-10 m on average. Therefore the data points consisting of coordinates recorded from the GPS may be imprecise.</p>
Timing/weather/season/cycle	Moderate	The field survey was conducted in early August 2016. In the four months prior to the survey (April to July), Jurien Bay weather station (No. 0091316, Bureau of Meteorology (BoM) 2016) recorded a total of 401.7 millimetres (mm) of rainfall. This rainfall is well above the long term average (LTA) for the same period (April to July; 328.2 mm) (BoM 2016). While sufficient rainfall was received within the survey area, an assessment of the flowering times of conservation significant flora taxa shows that September to October is the optimum time to capture a majority of the conservation significant flora in flower (Appendix D) as plant flowering is linked to both rainfall and temperature. It was noted during the field survey that a majority of taxa had either just started to bud or showed no flowering or fruiting material, suggesting the survey was too early to capture flowering times for a majority of species. In addition, annuals only represented 6.12 % of species recorded.
Disturbances (e.g. fire, flood, accidental human intervention)	Minor	The majority of the survey area has been exposed to a mosaic of historical fire regimes with a variety of burn ages recorded. Most of the disturbances throughout the survey area were associated with historical coal drilling activity with a number of wells located throughout the northern part of the property, and associated vehicle tracks. Around the homestead and paddock area pasture species, in particular <i>*Arctotheca calendula</i> was prevalent. Feral pig activity was noted throughout the survey area, in particular along drainage lines.
Intensity (in retrospect, was the intensity adequate)	Moderate	<p>The vascular flora of the survey area was sampled in accordance with the EPA and DPaW (2015) Technical Guide and terrestrial fauna sampled in accordance to EPA (2004a) as required by the scope of works.</p> <p>The survey area is large (approximately 1993 ha), which meant the survey area could only be covered efficiently through the use of a vehicle, surveying only those areas accessible with vehicle tracks. Certain areas of the</p>

Aspect	Constraint	Comment
		survey area were unable to be accurately assessed due to insufficient vehicle tracks and time constraints limiting the ability to traverse the survey area on foot. Information gained from along the vehicles tracks were extrapolated across the areas not accessed by vehicle.
Resources	Nil	Adequate resources were employed during the field survey. Sixteen person days were spent undertaking the survey using two dedicated botanists and two zoologists (1 botanist and 1 zoologist for five days each and 1 botanist and 1 zoologist for 3 days each).
Access restrictions	Nil	No access problems were encountered during the survey. The survey area was accessed by vehicle and only time constraints limited the accessibility of the survey area on foot.
Experience levels	Nil	The ecologists who executed the survey were practitioners suitably qualified in their respective fields. Glen Gaikhorst (zoologist) is a Senior Ecologist with over 20 years' experience in undertaking ecological surveys, most of which is undertaking surveys in Western Australia, including projects in the Northern Sandplains. Craig Grabham (zoologist) is a Senior Ecologist with over 16 years' experience in undertaking ecological surveys, including 4 years' experience undertaking surveys in Western Australia. Joshua Foster is a Principal Ecologist (botanist) with over 18 years' experience in undertaking ecological surveys in Western Australia, including extensive experience in the Northern Sandplains. Mathew Gannaway is an Ecologist (botanist) with 8 years' experience in undertaking ecological surveys in Western Australia, including projects in the Northern Sandplains.

3. Desktop assessment

3.1 Climate

The survey area is located in the Northern Sandplains Region of WA and experiences a dry, warm Mediterranean climate with winter precipitation ranging from 300-500 mm with seven to eight dry months per year (Beard 1990).

The BoM Jurien Bay station (site number: 009131) is the nearest active weather station to the study area with continuous long-term data (approximately 20 km south west from the study area). Climatic data from this site indicates the mean maximum temperature of the area ranges from 19.5 degrees Celsius (°C) in July to 30.9 °C in February, and the mean minimum temperature of the area ranges from 9.3 °C in July to 18.0 °C in February. The LTA annual rainfall is 551.7 mm, with an average of 71.4 rain days per year (BoM 2016).

Rainfall and temperature data for Jurien Bay in the 12 months preceding the survey are summarised in Plate 1 (BoM 2016). In the four months prior to the survey (April to July), Jurien Bay weather station recorded a total of 401.7 mm of rainfall. This rainfall total is higher than the LTA for the same period (April to July; 328.4 mm) (BoM 2016). The weather conditions recorded during the field survey included (BoM 2016):

- Maximum temperature range: 18.0 °C - 21.5 °C
- Minimum temperature range: 5.0 °C - 13.0 °C
- Rainfall 2.7 mm.

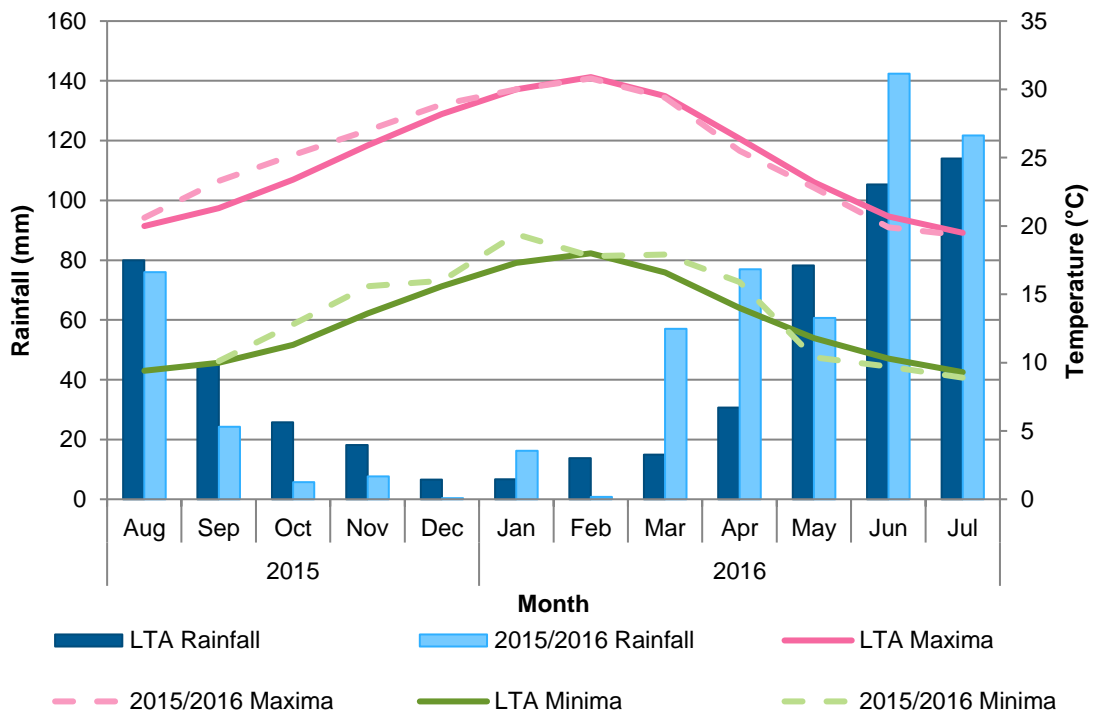


Plate 1 Rainfall and temperature data for Jurien Bay (BoM 2016)

3.2 Regional biogeography

The survey area is situated in the Southwest Botanical Province of WA (Beard 1990), within the Geraldton Sandplains Bioregion and Lesueur Sandplain Sub-region as described by the Interim Biogeographic Regionalisation of Australia (IBRA) (DotEE 2016c).

The Geraldton Sandplains Bioregion comprises the central and northern Perth Basin, the Pinjarra Orogen, and the south end of the Carnarvon Basin. Outcrops of Jurassic siltstones and sandstones can be heavily lateralised. Extensive proteaceous heaths and scrub-heaths often with emergent mallees, *Banksia* and *Actinostrobus*, occur on an undulating, lateritic sandplain mantling Permian to Cretaceous strata. These heaths are rich in endemics (CALM 2002).

The Lesueur Sandplain Subregion comprises coastal Aeolian and limestone soils, Jurassic siltstones and sandstones (often heavily lateralised) of the central Perth Basin. Alluvial soils are associated with drainage systems. There are extensive yellow sandplains in the south-eastern parts of the Subregion, especially where the Subregion overlaps the western edge of the Pilbara Craton. Shrub-heaths rich in endemics occur on a mosaic of lateritic mesas, sandplains, coastal sands and limestone soils (Desmond and Chant 2001).

3.3 Landforms and soils

The survey area is located within the Arrowsmith Zone of the Greenough Province. The Greenough Province is characterised by a lateritised plateau developed on Jurassic and Permian sediments and Proterozoic granites; dissected at fringes. There is a narrow coastal plain with Quaternary sands and calcarenite on the western margin. The Arrowsmith Zone is characterised by a dissected lateritic sandplain on Cretaceous and Jurassic sediments and is bounded in the east by the Dandaragan Scarp and in the south and west by the Gingin Scarp. The sandy and gravelly soils were formed in colluvium and the rock weathered in-situ (Schoknecht *et al.* 2004).

The Australian Soil Resource Information System (ASRIS) (2016) mapping indicates that one soil landscape type occurs within the survey area:

- Wd10 – Broad valleys and undulating interfluvial areas; some evenly sloping pediments with exposure of sandstone and shale. Chief soils are sandy acidic yellow mottled soils, containing much ironstone gravel in the A horizons and forming a complex pattern with lateritic sandy gravels. Associated are leached sands underlain by lateritic gravels, and mottled clays that occur about three feet in depth. Other soils include yellow duplex soils as well as podzol soils on the pediments; and red duplex soils in areas where country rock has been exposed.

3.4 Hydrology

A summary of the Department of Water (DoW) Geographic Data Atlas (DoW 2016) results for the survey area is provided in Table 4. The study area is located within the Jurien Groundwater Area and the Hill River and Tributaries Catchment Surface Water Area as listed under the *Rights in Water and Irrigation Act 1914* (RIWI Act). Murbinea Creek and associated minor tributaries flow through the western portion of the survey area (Figure 2; Appendix A).

Table 4 Department of Water geographic atlas queries for the survey area

Aspect	Details	Result
Groundwater areas	Groundwater areas proclaimed under the RIWI Act.	Jurien
Surface water areas	Surface water areas proclaimed under the RIWI Act.	Hill River and Tributaries Catchment
Irrigation district	Irrigation Districts proclaimed under the RIWI Act.	None present
Rivers	Rivers proclaimed under the RIWI Act.	None present
Public Drinking Water Source Areas (PDWSA)	PDWSAs is a collective term used for the description of Water Reserves, Catchment Areas and Underground Pollution Control Areas declared (gazetted) under the provisions of the <i>Metropolitan Water Supply, Sewage and Drainage Act 1909</i> or the <i>Country Area Water Supply Act 1947</i> .	None present
Waterway Management Areas	Areas proclaimed under the <i>Waterway Conservation Act 1976</i> .	None present

3.5 Land use

3.5.1 Conservation reserves and estate

There are a number of DPaW-managed conservation areas located within the study area including: Drovers Cave National Park, Beekeepers Nature Reserve, Hill River Nature Reserve, South Eneabba Nature Reserve and a number of smaller Crown reserves for the conservation of flora and fauna. The closest DPaW-managed conservation areas are located immediately adjacent to the survey area, including the Coomallo Nature Reserve (Class C) to the east and Lesueur National Park (Class A) to the north. No DPaW-managed conservation areas are located within the survey area.

3.5.2 Environmentally Sensitive Areas

A number of Environmentally Sensitive Areas (ESAs) are located within the study area, primarily associated with the presence of TECs and Threatened flora locations. Two ESAs located adjacent to the survey area include the Coomallo Nature Reserve located to the east and Lesueur National Park located to the north. A ESA associated with the TEC 'Lesueur-Coomallo Floristic Community D1' is located within the survey area (Figure 2, Appendix A).

3.5.3 Important bird areas

In a project managed by BirdLife Australia, thirteen Important Bird Areas (IBAs) have been designated specifically for Carnaby's Black Cockatoo (Dutson *et al.* 2009). IBAs are sites of global bird conservation importance and are considered a priority for bird conservation. The criteria used for the designation of IBAs for Carnaby's Black Cockatoo are sites supporting at least 20 breeding pairs, or 1% of the population regularly utilising an area in the non-breeding part of the range. Coomallo IBA is within 5 km of the survey area, with the actual Coomallo Reserve lying adjacent to the eastern boundary of the survey area. This IBA supports populations of Carnaby's Black Cockatoo (up to 40 breeding pairs), and is identified as an important breeding area for the species (Dutson *et al.* 2009). In addition to Carnaby's Black Cockatoo, the Coomallo IBA is known to maintain five other bird species recognised as globally important populations. These are the Western Long-billed Corella, Regent Parrot, Rufous Treecreeper, Blue-breasted Fairywren and Western Spinebill.

3.5.4 Pre-European vegetation associations and extent

Broad scale (1:250,000) pre-European vegetation mapping of the Geraldton Sandplains area was completed by Beard (1979) at an association level. The mapping indicates that three vegetation associations are present within the survey area:

- Medium woodland; marri & wandoo (association 4)
- Mosaic: Shrublands; hakea scrub-heath / Shrublands; dryandra heath (association 1031)
- Mosaic: Medium woodland; marri, wandoo, powder bark / Shrublands; dryandra heath (association 1032).

The pre-European mapping was adapted and digitised by Shepherd *et al.* (2002). The extents of the vegetation associations have been determined by the State-wide vegetation remaining extent calculations maintained by DPaW (latest update May 2016 – Government of Western Australia (GoWA) 2015). The current extent remaining of vegetation association 1032 is greater than 30 % of the pre-European extent at all scales (e.g. State, IBRA Bioregion, IBRA Sub-region and Local Government Area (LGA), and is therefore above the 30 % threshold level³.

Vegetation association 4 has less than 30 % of its pre-European extent remaining as the State level, however is greater than 30 % at the IBRA Bioregion, IBRA Sub-region and Local Government Area (LGA) level. Vegetation association 1031 has less than 30 % of its pre-European extent remaining as the LGA level, however is greater than 30 % at the State, IBRA Bioregion and IBRA Sub-region level. The extent remaining for each association is summarised in Table 5.

Table 5 Pre-European vegetation extents (Beard 1979, GoWA 2015)

Vegetation association	Scale	Pre-European extent (ha)	Current extent (ha)	Remaining (%)	% Current extent in all DPaW managed lands
4	State: Western Australia	1,054,279.89	293,916,.91	27.88	22.74
	IBRA Bioregion: Geraldton Sandplains	5,336.70	2,130.04	39.91	18.87
	IBRA Sub-region: Lesueur Sandplain	5,336.70	2,130.04	39.91	18.87
	LGA: Shire of Dandaragan	6,476.43	2,777.00	42.88	21.28
1031	State: Western Australia	269,490.91	88,606.02	32.88	42.30
	IBRA Bioregion: Geraldton Sandplains	241,349.97	83,154.99	34.45	44.13
	IBRA Sub-region: Lesueur Sandplain	241,349.97	83,154.99	34.45	44.13
	LGA: Shire of Dandaragan	230,488.23	67,978.55	29.49	52.13
1032	State: Western Australia	8,317.21	6,472.06	77.82	79.23

³ The 30 % threshold level is the level below which species loss appears to accelerate exponentially at an ecosystem level (EPA 2000).

Vegetation association	Scale	Pre-European extent (ha)	Current extent (ha)	Remaining (%)	% Current extent in all DPaW managed lands
	IBRA Bioregion: Geraldton Sandplains	8,317.21	6,472.06	77.82	79.23
	IBRA Sub-region: Lesueur Sandplain	8,317.21	6,472.06	77.82	79.23
	LGA: Shire of Dandaragan	3,075.84	2,653.17	86.26	78.06

3.6 Conservation significant ecological communities

A search of the EPBC Act PMST database did not identify any Commonwealth listed TECs within the study area. However, a search of the DPaW TEC database identified the presence of two TECs within the study area. The two TECs include:

- Lesueur-Coomallo Floristic Community A1.2, listed as Endangered under the WC Act. This community is described as species-rich heath with emergent *Hakea obliqua* on sand with faithful species of *Hakea obliqua* and *Beaufortia* aff. *elegans* and constant species of *Dasyogon bromeliifolius* and *Stirlingia latifolia* over well-drained grey sand over pale yellow sand on lateritic uplands. Associated species include *Allocasuarina humilis*, *Calothamnus sanguineous*, *Hibbertia hypericoides*, *Hypocalymma xanthopetalum* and *Schoenus subflavus*. This community is found north of the survey area, within Lesueur National Park
- Lesueur-Coomallo Floristic Community D1, listed as Critically Endangered under the WC Act. This community comprises a species-rich low heath, on moderately to well-drained lateritic gravels on lower slopes and low rises, dominated by *Allocasuarina microstachya* with *A. ramosissima*, *A. humilis*, *Baeckea grandiflora*, *Borya nitida*, *Calytrix flavescens*, *Calothamnus sanguineous*, *Conostylis androstemma*, *Cryptandra pungens*, *Banksia armata*, *Gastrolobium polystachyum*, *Hakea auriculata*, *H. incrassata*, *H. aff. erinacea*, *Hibbertia hypericoides*, *Hypocalymma xanthopetalum*, *Melaleuca trichophylla*, *Petrophile chrysantha*, *Schoenus subflavus* and *Xanthorrhoea drummondii*. This community has previously been recorded within the survey area.

The database search also identified the presence of three PECs within the study area. The three PECs have all previously been recorded within the survey area and include:

- Lesueur-Coomallo Floristic Community DFGH (Priority 1) is described as mixed species-rich heath on lateritic gravel with *Hakea erinacea*, *Melaleuca platycalyx* and *Petrophile seminuda*: a fine scale mixture of four floristically-defined communities occurring on lateritic slopes. The four communities include 'D' Heath and woodlands on gravelly hills and slopes, 'F', 'G' and 'H' Heath on duplex soils, on benched slopes and broad valleys. Community 'D' comprises of five subtypes. D1: *Allocasuarina microstachya* Heath, D2: *Hakea undulata* Heath (Gravel type), D3: *Leucopogon* Heath, D4: *Darwinia neildiana* Heath and D5: *Petrophile chrysantha* Heath. Community 'F' comprises of *Hakea erinacea* Heath, Community 'G' of *Melaleuca platycalyx* Heath and 'H' of *Petrophile seminuda* heath
- Lesueur-Coomallo Floristic Community M2 (*Melaleuca preissiana* woodland) (Priority 1) is described as a *Melaleuca preissiana* woodland along sandy drainage lines with faithful

species of *Anigozanthos pulcherrimus* and constant species of *Chamaescilla corymbosa*, *Petrophile brevifolia* and *Xanthorrhoea reflexa*

- *Petrophile chrysantha* low heath on Lesueur dissected uplands (Gp200-170) (Priority 2) is described as a *Petrophile chrysantha* low heath on Lesueur dissected uplands. Associated species include *Banksia armata* and *Hakea undulata*.

3.7 Flora

3.7.1 Flora diversity

A search of the *NatureMap* database identified 1,595 plant taxa, representing 91 families and 371 genera, which have previously been recorded within the study area. This total comprised 1,506 native flora taxa and 89 naturalised (non-native) flora taxa. Dominant families include Myrtaceae (228 taxa), Proteaceae (185 taxa), Fabaceae (167 taxa) and Asteraceae (77 taxa). The *NatureMap* database search is provided in Appendix C.

3.7.2 Conservation significant flora

Desktop searches of the EPBC Act PMST database, *NatureMap* database, and the DPaW TPFL and WA Herbarium databases identified the presence/potential presence of 190 conservation significant flora taxa within the study area.

The desktop searches recorded:

- 36 taxa listed as Threatened under either the EPBC Act and/or the WC Act
- 14 Priority 1 taxa listed by the DPaW
- 47 Priority 2 taxa
- 64 Priority 3 taxa
- 29 Priority 4 taxa.

The locations of conservation significant flora registered on the DPaW databases are provided in Figure 2, Appendix A. A Likelihood of Occurrence assessment for the conservation significant flora is provided in Appendix D.

3.7.3 Introduced flora (weeds)

A search of the *NatureMap* (DPaW 2016) database identified 89 introduced flora taxa previously recorded within the study area. One is listed as a Declared Pest (s22) under the *Biosecurity and Management Act 2007* (BAM Act), **Asparagus asparagoides*, with C3 management required in the whole of state. None are listed as a Weed of National Significance (WoNS) (DotEE 2016d).

3.8 Fauna

3.8.1 Fauna diversity

A search of *NatureMap* identified 187 vertebrate native fauna taxa previously recorded within 20 km of the survey area. This total included 17 mammals (three introduced), 10 amphibians, 111 birds, 47 reptiles and 2 fish. The EPBC Act PMST indicated the potential presence of nine additional fauna taxa within 20 km of the survey area.

3.8.2 Conservation significant fauna

Searches of the EPBC Act PMST and *NatureMap* database identified the presence/potential presence of 16 conservation significant fauna species (Appendix E). Species identified by the PMST as marine and migratory marine were excluded from this assessment as no marine

habitats were present within or nearby the survey area, however species identified by the PMST as migratory terrestrial and wetland were considered as part of this assessment.

In addition to the 16 species identified by the database searches, five additional species were also considered for this assessment as a result of a review of the species listed under Schedules 1-3 and 5-7 of the WC Act (revised 20 November 2015) to occur within the DPaW Swan region (DPaW 2015).

4. Field results

4.1 Vegetation




4.1.1 Vegetation types




Fourteen vegetation types (VT) were identified and described from the survey area (Table 6 and Figure 3, Appendix A). The soil type varied throughout the survey area from white/grey sandy soils on slopes and plains to heavy brown/light brown clay loam soils in drainage lines. Sandy loam soils were also found throughout the survey area on slopes and plains. The varying soil types also had varying degrees of lateritic gravel present, from no gravel through to lateritic boulders. The survey area is dominated by woodlands comprising of either *Eucalyptus wandoo* (VT10), *Corymbia calophylla* (VT09) or a mixed woodland of *Eucalyptus todtiana*, *Banksia attenuata* and *B. menziesii* (VT05) (27.61%, 30.99% and 11.02% of the survey area respectively). VT01 is the most restricted vegetation type and occurs on light brown clay/sandy loam soils on slopes with lateritic gravel occupying only 0.11 ha of the survey area. VT03 and VT07 are associated with *Melaleuca* species along drainage lines, with VT10 also occurring in the valleys between low rises. The remaining seven vegetation types are all heathlands with the vegetation rarely exceeding 1500 mm and comprised of a range of species at varying densities. The areas recovering from previous material extraction activities along the eastern boundary of the survey area is comprised of a similar species composition as the surrounding vegetation and has not been mapped as a separate vegetation type. Areas identified as cleared/highly disturbed (VT14) are areas that have been cleared for pasture species with emergent/isolated *Corymbia calophylla*, *Eucalyptus wandoo* and *Melaleuca raphiophylla* trees.




4.1.2 Other significant vegetation




All of the native vegetation within the survey area is considered significant vegetation as defined by the EPA and DPaW (2015) due to the majority of the survey area being classified in a Pristine condition that contains different combinations of taxa associated with a variety of heathlands and provides a linkage between Lesueur National Park and Coomallo Nature Reserve. In addition, the vegetation is a refuge for a number of conservation significant flora that occur throughout the survey area in a variety of vegetation types.



Table 6 Vegetation associations recorded during the field survey

Vegetation types	Description	Landform and substrate	Extent (ha) and Locality	Representative photograph
<i>Allocasuarina microstachya</i> heathland (VT01)	Heathland of <i>Allocasuarina microstachya</i> with <i>A. humilis</i> , <i>Banksia armata</i> , <i>Hakea incrassata</i> , <i>Hibbertia hypericoides</i> , <i>Hypocalymma xanthopetalum</i> and <i>Melaleuca ?trichophylla</i> over sparse rushland <i>Schoenus ?nanus/latitans</i> , <i>S. subflavus</i> and isolated sedges of <i>Lepidobolus quadratus</i> (P3) over isolated grasses <i>Neurachne alopecuroidea</i> with <i>Xanthorrhoea drummondii</i> .	Light brown clay/sandy loam soils on slopes with lateritic gravel.	0.11 ha Quadrat: HR01	
<i>Petrophile chrysantha</i> heathland (VT02)	Heathland of <i>Petrophile chrysantha</i> with <i>Banksia armata</i> , <i>Calothamnus sanguineus</i> , <i>Daviesia nudiflora</i> , <i>Hakea anadenia</i> , <i>Hakea erinacea</i> and <i>Hibbertia hypericoides</i> over sparse rushland <i>Schoenus ?nanus/latitans</i> , and isolated sedge <i>Lepidosperma squamatum</i> with isolated herbs <i>?Craspedia</i> sp., <i>Burchardia</i> sp., <i>Tetrateca paucifolia</i> and <i>Anigozanthos humilis</i> over isolated grasses <i>Neurachne alopecuroidea</i> .	Grey sandy clay soils on slopes with lateritic gravel.	4.26 ha Quadrat: HR04	
<i>Melaleuca preissiana</i> open woodland (VT03)	<i>Melaleuca preissiana</i> open woodland over sparse shrubland <i>M. ?delta</i> and <i>Acacia saligna</i> over open heathland <i>Verticordia</i> sp., <i>Calothamnus quadrifidus</i> and <i>Hakea varia</i> over isolated herbs <i>Drosera ?macrantha</i> , <i>Chamaescilla corymbosa</i> , <i>Trachymene pilosa</i> and <i>Tricoryne elatior</i> .	Grey sandy drainage lines.	3.64 ha Quadrat: HR02	

Vegetation types	Description	Landform and substrate	Extent (ha) and Locality	Representative photograph
<i>Melaleuca platycalyx</i> heathland and <i>Eucalyptus wandoo</i> subsp. <i>pulverea</i> woodland (VT04)	<i>Eucalyptus wandoo</i> subsp. <i>pulverea</i> woodland over <i>Melaleuca platycalyx</i> heathland with <i>Gastrolobium polystachyum</i> , <i>Banksia armata</i> , <i>Calothamnus sanguineus</i> , <i>G. spinosum</i> , <i>Hakea neospathulata</i> and <i>Hibbertia hypericoides</i> over isolated herbs <i>Tetratheca paucifolia</i> and <i>Opercularia vaginata</i> with sparse grassland of <i>Neurachne alopecuroidea</i> and <i>Xanthorrhoea drummondii</i> .	Orange sandy clay soils on hill crest and slopes with lateritic pebbles.	29.27 ha Quadrat: HR03	
<i>Eucalyptus todtiana</i> , <i>Banksia attenuata</i> and <i>B. menziesii</i> woodland (VT05)	<i>Eucalyptus todtiana</i> , <i>Banksia attenuata</i> and <i>Banksia menziesii</i> woodland over heathland <i>Adenanthos cygnorum</i> subsp. <i>cygnorum</i> , <i>Eremaea</i> spp., <i>Hibbertia</i> spp., <i>Banksia candolleana</i> and <i>Jacksonia floribunda</i> over sparse herbland <i>Blancoa canescens</i> , <i>Conostylis</i> spp., <i>Drosera</i> spp. and <i>Johnsonia pubescens</i> subsp. <i>pubescens</i> .	White sandy plain.	219.93 ha Quadrat: HR10; HR12	
<i>Xanthorrhoea</i> and <i>Kingia</i> heathland (VT06)	<i>Xanthorrhoea</i> spp. and <i>Kingia australis</i> heathland with <i>Banksia</i> spp., <i>Calothamnus</i> spp., <i>Cryptandra</i> spp., <i>Hakea</i> spp., <i>Hibbertia</i> spp. over isolated rushes <i>Caustis dioica</i> and <i>Schoenus</i> spp. and sparse herbland of <i>Conostylis</i> spp., <i>Drosera</i> spp. and <i>Stylidium</i> spp.	White sandy soils on slopes and plains with lateritic gravel.	160.24 ha Quadrat: HR09; HR11; HR14; HR16; HR18	

Vegetation types	Description	Landform and substrate	Extent (ha) and Locality	Representative photograph
<i>Melaleuca raphiophylla</i> woodland (VT07)	<i>Melaleuca raphiophylla</i> woodland with <i>Eucalyptus rudis</i> over open shrubland <i>Pimelea argentea</i> , <i>M. viminea</i> , <i>Calothamnus quadrifidus</i> and <i>Trymalium odoratissimum</i> over open heathland <i>Hypocalymma angustifolium</i> , <i>M. platycalyx</i> and <i>Acacia</i> spp. over open herbland * <i>Lysimachia arvensis</i> , * <i>Romulea rosea</i> and * <i>Ursinia anthemoides</i> .	Brown clayey loam soils on drainage lines and seasonally wet flats.	31.67 ha Quadrat: HR08; HR15	
<i>Ecdeiocolea monostachya</i> herbland (VT08)	<i>Ecdeiocolea monostachya</i> herbland with <i>Drosera</i> spp. and <i>Burchardia</i> sp. with open heathland <i>Allocasuarina microstachya</i> , <i>Banksia armata</i> , <i>B. shuttleworthiana</i> , <i>Daviesia nudiflora</i> , <i>Hibbertia hypericoides</i> and <i>Opercularia vaginata</i> over isolated rushes <i>Schoenus ?nanus/latitans</i> .	Grey sandy soils on slopes.	24.01 ha Quadrat: HR13	
<i>Corymbia calophylla</i> woodland (VT09)	<i>Corymbia calophylla</i> woodland over heathland <i>Acacia</i> spp., <i>Banksia shuttleworthiana</i> , <i>Conospermum</i> sp., <i>Hibbertia hypericoides</i> and <i>Hakea</i> spp. over isolated rushes <i>Lepidosperma</i> sp., <i>Mesomelaena pseudostygia</i> and <i>Schoenus ?clandestinus</i> with isolated grasses <i>Neurachne alopecuroidea</i> and <i>Xanthorrhoea preissii</i> .	Grey sandy soils on slopes and plains.	618.12 ha Quadrat: HR06; HR19	

Vegetation types	Description	Landform and substrate	Extent (ha) and Locality	Representative photograph
<i>Eucalyptus wandoo</i> subsp. <i>pulverea</i> woodland (VT10)	<i>Eucalyptus wandoo</i> subsp. <i>pulverea</i> woodland over isolated heath <i>Banksia armata</i> , <i>Acacia pulchella</i> , <i>Hakea lissocarpha</i> , <i>Hypocalymma angustifolium</i> and <i>Macrozamia fraseri</i> over sparse herbland <i>Drosera</i> spp., * <i>Romulea rosea</i> , <i>Trachymene pilosa</i> and <i>Lagenophora huegelii</i> with sparse grassland <i>Neurachne alopecuroidea</i> , <i>Rytidosperma</i> sp. and <i>Xanthorrhoea drummondii</i> .	Brown clay loam soils on slopes and drainage lines.	550.73 ha Quadrat: HR05	
<i>Banksia attenuata</i> open heathland (VT11)	<i>Banksia attenuata</i> open heathland over <i>Eremaea asterocarpa</i> , <i>Hibbertia hypericoides</i> , <i>Hypocalymma xanthopetalum</i> , <i>Melaleuca ?tinkeri</i> , <i>Stirlingia latifolia</i> and <i>Strangea cynanchicarpa</i> over sparse rushland <i>Mesomelaena pseudostygia</i> and <i>Schoenus</i> spp. with isolated herbs <i>Conostylis</i> spp., <i>Drosera</i> spp. and <i>Stylidium</i> spp.	White sandy soils on slopes.	16.64 ha Quadrat: HR20	
Mixed heath with isolated clumps of mallee (VT12)	Heathland of <i>Allocasuarina humilis</i> , <i>Cryptandra pungens</i> , <i>Hakea anadenia</i> , <i>Hibbertia hypericoides</i> , <i>Conostephium preissii</i> and <i>Hypocalymma xanthopetalum</i> with isolated clumps of mallee <i>Eucalyptus drummondii</i> , <i>E. wandoo</i> subsp. <i>pulverea</i> and <i>Corymbia calophylla</i> over sparse rushland <i>Lepidosperma</i> spp. and <i>Schoenus</i> spp. with isolated herbs <i>Conostylis</i> spp., <i>Drosera</i> spp. and <i>Stylidium</i> spp. and sparse grassland <i>Neurachne alopecuroidea</i> , and <i>Xanthorrhoea drummondii</i> .	Orange sandy loam soils on slopes with occasional lateritic pebbles.	85.04 ha Quadrat: HR07	

Vegetation types	Description	Landform and substrate	Extent (ha) and Locality	Representative photograph
<i>Melaleuca</i> ? <i>concreta</i> heathland (VT13)	<i>Melaleuca</i> ? <i>concreta</i> heathland with <i>Calothamnus quadrifidus</i> , <i>Hakea lissocarpa</i> , <i>M. platycalyx</i> and <i>Verticordia</i> sp. over isolated herbs <i>Borya sphaerocephala</i> , <i>Drosera</i> spp. and <i>Stylidium</i> sp. with isolated rushes <i>Ficinia nodosa</i> and <i>Mesomelaena pseudostygia</i> .	Brown sandy loam soils on slopes with occasional lateritic pebbles.	3.14 ha Quadrat: HR17	
Pasture with emergent trees (VT14)	Pasture species with emergent/isolated <i>Corymbia calophylla</i> , <i>Eucalyptus wandoo</i> subsp. <i>pulverea</i> and <i>Melaleuca raphiophylla</i> trees.	-	247.94 ha	

4.1.3 Vegetation condition

The vegetation condition within the survey area was rated as between Pristine and Completely Degraded. The majority of vegetation throughout the survey area was rated as Pristine; in these areas the vegetation was pristine, or nearly so with no obvious signs of disturbance when removed from the access tracks. Areas mapped as Excellent appeared to be affected by more recent fires, with the occasional weed species present. The areas mapped as Very Good are largely restricted to creeklines and bordering previously cleared areas. These areas have a higher density of herbaceous introduced species present in the understorey with numerous diggings and grazing by feral pigs. The areas mapped as Degraded are areas that have been historically cleared for material extraction where a few native species are recovering. The area mapped as Completely Degraded is largely restricted to the area surrounding the homestead and the cleared paddock area within the central eastern boundary of the survey area. These areas are comprised of isolated native trees over predominantly *Arctotheca calendula*.

The extents of the vegetation condition ratings mapped within the survey area are provided in Table 7 with the vegetation condition of the survey area mapped in Figure 4, Appendix A.

Table 7 Extent of vegetation condition ratings within the survey area

Vegetation Condition	Extent (ha)
Pristine	1220.51 ha
Excellent	502.69 ha
Very Good	19.06 ha
Degraded	4.54 ha
Completely Degraded	247.94 ha
Total	1994.74 ha

4.2 Conservation significant ecological communities

The known location of the TEC 'Lesueur-Coomallo Floristic Community D1' and the three PECs ('Lesueur-Coomallo Floristic Community DFGH'; 'Lesueur-Coomallo Floristic Community M2 (*Melaleuca preissiana* woodland)'; '*Petrophile chrysantha* low heath on Lesueur dissected uplands (Gp200-170)') that were identified during the desktop search as occurring within the survey area (See Section 3.6.2) were targeted during the field survey. The conservation significant ecological communities identified within the survey area and the associated vegetation types are described below:

- Lesueur-Coomallo Floristic Community D1, listed as Critically Endangered under the WC Act. VT01 is associated with this TEC. Quadrat data from HR01 contain most of the species that are identified with this TEC. In addition, the density of the *Allocasuarina* within this vegetation type stands out in the landscape amongst the heath
- VT03 is associated with the Lesueur-Coomallo Floristic Community M2 (*Melaleuca preissiana* woodland) Priority 1 PEC. Quadrat data from HR02 contains all the species identified in the community description from DPAW, with the exception of *Anigozanthos pulcherrimus* which may have been missed during the survey due to the species not being in flower. No other areas identified within the survey area contained the density of *Melaleuca preissiana* along the drainage lines
- VT04 is associated with the Lesueur-Coomallo Floristic Community DFGH Priority 1 PEC, in particular 'D' heath and woodlands on gravelly hills and slopes. The woodland is characterised with *Eucalyptus wandoo* with the quadrat and observational data from HR03 containing all five species identified within the subtypes. Locally, *Melaleuca platycalyx* was one of the more dominant shrubs

- VT02 is associated with the *Petrophile chrysantha* low heath on Lesueur dissected uplands (Gp200-170) Priority 2 PEC. Quadrat data from HR04 contains the three species identified in the community description from DPAW. In addition, no other heath areas within the survey area contained similar species composition.

4.2.1 Flora diversity

The field survey recorded 344 taxa (including subspecies and varieties) representing 51 families and 149 genera within the survey area. This total comprised 330 native species and 13 introduced (exotic) species. Due to the absence of adequate flowering parts and/or fruiting bodies required for identification, nine taxa could only be tentatively identified to family and 56 taxa could only be tentatively identified to genera. Due to the high floral diversity of the survey area and the numerous conservation significant taxa previously recorded within the study area (See section 3.6.4), there is no certainty that collections without flowering or fruiting material are common or conservation significant flora identified in the desktop assessment.

Dominant families recorded from the survey area included:

- Proteaceae (59 taxa)
- Fabaceae (45 taxa)
- Myrtaceae (39 taxa)
- Haemodoraceae (18 taxa)
- Cyperaceae (13 taxa)
- Orchidaceae (13 taxa).

Annual species represented 6.12 % of all recorded plant species within the survey area. The average species richness for the 20 quadrats was 38.55 +/- 1.74 (mean +/- standard error of the mean), with a range of 25 to 53 species per quadrat.

A flora species list for the survey area is provided in Appendix D.

4.2.2 Conservation significant flora

The location of conservation significant flora recorded during the survey is presented in Figure 3, Appendix A.

EPBC Act and WC Act

One EPBC Act and WC Act listed flora taxa was recorded within the survey area during the 2016 survey, *Hakea megalosperma* (listed as Vulnerable under both the EPBC Act and WC Act). *Hakea megalosperma* (Plate 2) is known from 91 records (DPaW 2016). Most of the records are located within the region surrounding Jurien Bay, with a single record located north of Albany near the Stirling Ranges. This species was recorded from two locations within the survey area (Figure 3) with up to 12 shrubs (including juveniles) recorded within 20 m at each location.



Plate 2 *Hakea megalosperma* recorded within survey area (J Foster)

DPaW Priority Listed Flora Taxa

Eight Priority flora taxa were recorded from the survey area:

- *Acacia retrorsa* (Priority 2)
- *Grevillea delta* (Priority 2)
- *Thelymitra variegata* (Priority 2)
- *Hensmania stoniella* (Priority 3)
- *Lepidobolus quadratus* (Priority 3)
- *Stylidium ?hymenocraspedum* (Priority 3)
- *Stylidium ?torticarpum* (Priority 3)
- *Hakea neurophylla* (Priority 4).

Acacia retrorsa (Plate 3) is known from 33 records (DPaW 2016). All of the records are located within the region surrounding Jurien Bay. This species was recorded from three locations within the survey area on slopes and in drainage lines (Figure 3). Species confirmed by Michael Hislop from the WA Herbarium (Accession Number 6917).



Plate 3 *Acacia retrorsa* recorded within survey area (M Gannaway)

Grevillea delta (Plate 4) is known from 22 records (DPaW 2016). All of the records are located within the region surrounding Jurien Bay. This species was recorded from a single location

within the survey area on the lower slope, adjacent to a drainage line (Figure 3). Species confirmed by Michael Hislop from the WA Herbarium (Accession Number 6917).



Plate 4 *Grevillea delta* recorded within survey area (J Foster)

Thelymitra variegata (Plate 5) is known from 52 records (DPaW 2016). Records are mainly scattered along the coastal areas from Perth to Albany, with two records located in the Wheatbelt. A single record is located north of Perth near Lesueur National Park. This species was recorded from a single location within the survey area on a white sandy plain (Figure 3).



Plate 5 *Thelymitra variegata* recorded within survey area (J Foster)

Hensmania stoniella (Plate 6) is known from 44 records (DPaW 2016). All of the records are located within the region surrounding Jurien Bay. This species was recorded from a single location within the survey area on the upper slope of a low rise with white sandy soil (Figure 3). Species confirmed by Michael Hislop from the WA Herbarium (Accession Number 6917).



Plate 6 *Hensmania stoniella* recorded within survey area (J Foster)

Lepidobolus quadratus (Plate 7) is known from 46 records (DPaW 2016). All of the records are located within the region surrounding Jurien Bay. This species was recorded from two locations within the survey area on the mid and upper slopes of a low rise with clayey sandy soil (Figure 3). Species confirmed by Michael Hislop from the WA Herbarium (Accession Number 6917).



Plate 7 *Lepidobolus quadratus* recorded within survey area (J Foster)

Stylidium ?hymenocraspedum (Plate 8) is known from 27 records (DPaW 2016). All of the records are located within the region between Jurien Bay and Lancelin. This species was recorded from two locations within the survey area on grey sandy slopes of a low rise (Figure 3). This species had insufficient flowering material to confirm to species, however the basal leaves and labellum align with the description for this species.



Plate 8 *Stylidium ?hymenocraspedum* recorded within survey area (J Foster)

Stylidium ?torticarpum (Plate 9) is known from 59 records (DPaW 2016). The records are spread along the coast from the north of Geraldton to the south of Lancelin. This species was recorded from a single location within the survey area on brown clay loam soils within a drainage line (Figure 3). This species had insufficient flowering material to confirm to species, however the basal leaves and seed capsule align with the description for this species.



Plate 9 *Stylidium ?torticarpum* recorded within survey area (J Foster)

Hakea neurophylla (Plate 10) is known from 33 records (DPaW 2016). The records are spread along the coast from the north of Geraldton to the south of Lancelin. This species was recorded from two locations within the survey area on grey sandy soils on slopes (Figure 3). This species had sufficient flowering material to positively identify at the WA Herbarium.



Plate 10 *Hakea neurophylla* recorded within survey area (J Foster)

Likelihood of Occurrence

A Likelihood of Occurrence assessment was conducted post-field survey for all conservation significant flora taxa identified in the desktop assessment (Appendix D). This assessment took into account previous records, habitat requirements, efficacy of the survey, intensity of the survey, flowering times and the cryptic nature of species.

The Likelihood of Occurrence assessment post-field survey concluded that seven taxa are known to occur, two are likely to occur, 152 may possibly occur and the remaining 29 taxa are unlikely or highly unlikely to occur within the survey area. A summary of the outcomes of species considered as known or likely to occur is provided below (Table 8). The large number of conservation significant taxa that are considered possibly to occur is due to the survey area comprising of a varied landscape with a range of soils and landforms that align with the habitat considered suitable for the species. In addition, most of the conservation significant taxa have been recorded in the adjacent Lesueur National Park and Coomallo Nature Reserve.

Table 8 **Summary of Likelihood of Occurrence Assessment**

Species	State (WC Act/ DPaW listing)	Federal (EPBC Act listing)	Likelihood of Occurrence
<i>Hakea megalosperma</i>	VU	VU	Known – species was recorded from within the survey area.
<i>Acacia retrorsa</i>	P2	-	Known – species recorded within the survey area.
<i>Grevillea delta</i>	P2	-	Known – species was recorded within the survey area.
<i>Thelymitra variegata</i>	P2	-	Known – species was recorded from within the survey area.
<i>Hensmania stoniella</i>	P3	-	Known – species was recorded from within the survey area.

Species	State (WC Act/ DPaW listing)	Federal (EPBC Act listing)	Likelihood of Occurrence
<i>Lepidobolus quadratus</i>	P3	-	Known – species was recorded from within the survey area.
<i>Stylidium ?hymenocraspedum</i>	P3	-	Likely – infertile specimen of this species was potentially recorded from within the survey area.
<i>Stylidium ?torticarum</i>	P3	-	Likely – infertile specimen of this species was potentially recorded from within the survey area.
<i>Hakea neurophylla</i>	P4	-	Known – species was recorded from within the survey area.

4.2.3 Introduced flora

The majority of the survey area is in a Pristine condition with the presence of introduced species generally restricted to the cleared paddock area, along creeklines and the borders of vegetation adjacent to previously cleared areas (see Section 4.1.3). Thirteen introduced taxa were recorded within the survey area during the field survey (Appendix D). The most commonly recorded weed species in the survey area include **Arctotheca calendula*, **Hypochaeris glabra* and **Romulea rosea*.

Weeds of National Significance and Declared Pests

No introduced species listed as a Declared Pest plant under Section 22 of the BAM Act or a WoNS (DotEE 2016d), was recorded within the survey area.

4.2.4 Other significant flora

No other significant flora as defined by the EPA and DPaW (2015) was identified within the survey area during the field survey.

4.3 Fauna

4.3.1 Fauna habitat

Seven main fauna habitat types were recorded during the field survey, which broadly aligned with the vegetation associations described in section 4.1.1 and mapped in Figure 3, Appendix A and include:

- Wandoo Woodlands
- Marri Woodland
- *Eucalyptus tottiana*, *Banksia attenuata/menziesii* low Open Woodland
- Minor drainage lines and seasonally inundated areas and dams
- Heathlands on sandy soils
- Heathlands on lateritic soils
- Scattered trees of Wandoo and Marri in paddock.

The topography of survey area is undulating ranging from gentle to steep slopes with valleys and small hills present. Several creek lines (from three drainage systems) drain to the east and south, dividing the undulating terrain and low hills within the survey area. Soils were predominantly sandy-clay grey loams in the valleys or white to orange sands in the heaths, with some heaths along elevated areas having lateritic gravels or capping. Occasional exposed lateritic ridgelines were also recorded on small hills.

The habitat types for the survey area are described in Table 9.

Habitat connectivity

The fauna habitats of the survey area are part of a contiguous largely intact area of remnant vegetation within the local area and greater study area. To the north west of the survey area lies Mount Lesueur National Park (26,987 ha) and Beekeeper Nature Reserve (120,000 ha) and to the east Coomallo Nature Reserve (9,200 ha) with numerous areas of vegetated remnant (freehold) lands surrounding. Outside of the reserved remnant areas the land has been extensively cleared for agriculture and is part of the Western Australian Wheatbelt, with portions of the western boundary of the survey area abutting cleared agricultural land. Within the survey area a portion (248 ha) of land has previously been cleared. This area has some large habitat trees scattered throughout, which could be utilised by some fauna species.

The ephemeral drainage lines are part of a larger network of watercourses ultimately draining into the much larger tributaries of the Hill River and Coomallo Creek linking the survey area to surrounding environments.

The southern boundary of the survey area borders Jurien Road and provides a barrier to some fauna moving south through the landscape. Apart from the cleared area within the survey area, a portion of agricultural land to the west and Jurien Road (and other minor access tracks) fauna movement is largely unrestricted. Overall, the habitats within the survey area are largely contiguous through the local area and mostly well connected with habitats through the greater study area.

Disturbance

Portions of the habitats within the survey area have been impacted to some degree by past disturbances including land clearing, dams, minor roads, fire and grazing. Minor roads make up a very small area of impact and were probably maintained by farmers for access and fire control. A small dwelling and associated infrastructure is present north of the large cleared area. Cattle and horse grazing is evident in portions of the survey area, particularly in the cleared areas or bushland adjacent to the cleared area. Feral pest disturbance was also present in selected areas with pig activity most prevalent in the north and west and evidence of rabbits also recorded in the survey area.

There were only small areas impacted by recent fire (less than 5 years) with the majority of the survey area being longer unburnt (> 20 years) or a mosaic of old fire scars. Most of the recent fire scars were in close proximity to the dwelling and infrastructure near the centre of the survey area.

Habitat value


The survey area provides significant habitat diversity for many native fauna species, including species of conservation significance. This is due to the diversity and quality of habitat types (e.g. good to excellent structural and floristic diversity within each habitat type), good connectivity and for supporting known and potential habitat values for conservation significant fauna species (see Table 9). The habitats within the survey area are mostly intact, variable in composition and well connected with habitats within the local area and greater study area.


Aerial photography indicates the habitats of the survey area are well represented within the local area and are probably well represented within the greater study area. The adjoining Mt Lesueur National Park (and Beekeepers Nature Reserve) and Coomallo Nature Reserve are also known to have high value (e.g. habitat quality) habitats for conservation significant fauna, with the survey area linking these two highly important areas. The survey area plus the national park and reserve create an area of approximately 158,187 ha of continuous habitat.


Important Bird Areas

Five avian species considered important populations were recorded during the field survey and include the Western Long-billed Corella (*Cacatua pastinator*), Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*), Blue-breasted Fairy Wren (*Malurus pulcherrimus*), Western Spinebill (*Acanthorhynchus superciliosus*) and Rufous Treecreeper (*Climacteris rufa*). They are all considered to be part of "Globally Important Bird Populations" in this region (Dutson *et al.* 2009). Of these species, the Western Long-billed Corella and Carnaby's Black Cockatoo were recorded breeding in Wandoo in the survey area.

Table 9 Fauna habitat types within survey area

Description	Indicative photograph
<p>Wandoo Woodland – 580 ha Vegetation association: VT10 (550.73 ha), VT04 (29.27 ha)</p> <p>This habitat type occurs across a large portion of the survey area in the valleys or areas of low rises and is mostly dominated by Wandoo (<i>Eucalyptus wandoo</i>) with little understorey, however some areas had an understorey of <i>Melaleuca platycalyx</i> heath of 30% cover. The overstorey consist of open woodland of Wandoo trees (DBH >300 mm) at approximately 26 trees per hectare. These trees were often large (to 20 m) and provided small, medium and large hollows. Large hollows were present in approximately three trees per hectare (based on stem density counts of trees with DBH > 300 mm). The shrub/midstorey layer was sparse but sometimes moderate to dense in small patches and consisted of <i>Acacia</i>, <i>Banksia</i> and <i>Hakea</i> species.</p> <p>The soils consisted of brown clay loam with small areas of gravel incursion. Stony areas are present around valley crests and in some areas formed small breakaways however these were small and scattered.</p> <p>The majority of the Wandoo Woodland area appeared long unburnt (> 20 years) given the lack of historical fire scar evidence. Some small areas (particularly those woodlands closest to the homestead) had more recent burn scars (<5 years).</p> <p>The woodland provides good denning and breeding opportunities for small native ground mammals, birds and reptiles. Seven species of bird were recorded nesting in this habitat. The Western Long-billed Corella, Ringneck Parrot (<i>Barnardius zonarius semitorquatus</i>), Tree Martins (<i>Petrochelidon nigricans</i>), Galah (<i>Eolophus roseicapilla</i>) and Carnaby’s Black Cockatoo were all recorded nesting in hollows while Australian Raven (<i>Corvus coronoides</i>) and Whistling Kite (<i>Haliastur sphenurus</i>) were nesting in large trees. Animal tracks, digs and occasional small burrows were recorded in this habitat type, most of which were from Echidna (<i>Tachyglossus aculeatus</i>).</p> <p>Fallen branches and logs were common in this habitat type with many having a range of hollow sizes. The persistence of logs is probably an artefact of the lack of fire history. Leaf-litter and other forms of non-vascular ground cover (dead plant material) was common beneath trees and shrubs.</p> <p><u>Habitat value for fauna species of conservation significance</u></p> <p>High value</p> <p>Part of a larger area of contiguous remnant vegetation extending throughout the survey area. This habitat provides breeding, foraging and roosting habitat for Carnaby’s Black Cockatoo where at least 10 breeding events were recorded. The Peregrine Falcon (<i>Falco peregrinus</i>) may also utilise selected hollows for breeding but would also utilise the area for hunting and loafing. Chuditch (<i>Dasyurus geoffroyi</i>) could utilise the hollow bearing fallen logs and low hollows for denning and breeding purposes. The Woma python</p>	

Description	Indicative photograph
<p>(<i>Aspidites ramsayi</i>) may also utilise logs for resting. Western Brush Wallaby (<i>Macropus irma</i>) were recorded on camera in the area and known to utilise woodlands.</p>	
<p>Marri Woodland – 618 ha</p> <p>Vegetation association: VT09</p> <p>This habitat type occurs across the survey area mostly between the Wandoo Woodland and heathlands on plain or upper slopes. This habitat is patchy or thin corridors surrounding Wandoo and comprises areas of large Marri trees and smaller mallees in area suppositively where soils limit growth.</p> <p>The overstorey consists of an open woodland of trees including <i>Corymbia</i> and scattered <i>Eucalyptus</i> species (either Wandoo or Jarrah) to 30 m. The density of trees in this habitat was 12 trees per hectare (base on trees with DBH > 500 mm) and provided few small, medium and large hollows. Large hollows were present in approximately 1 tree per hectare with fewer large hollows being recorded in Marri woodland compared to Wandoo woodland habitat. The understorey is a dense mix of <i>Acacia</i>, <i>Banksia</i> and <i>Melaleuca</i> and other native shrubs which thins as you move into more densely clumped Marri areas.</p> <p>Fallen timber, hollow bearing logs were very occasionally recorded in this habitat type, which is probably an artefact of the open nature of this habitat. Leaf-litter and other forms of non-vascular ground cover was dense beneath trees and shrubs.</p> <p>The majority of the habitat was not recently burnt (> 5 years) given the lack of fire evidence recorded.</p> <p>The woodland provides good foraging opportunities for native mammals and birds such as possums, honey eaters, parrots and Cockatoos.</p> <p>Animal tracks and digs were recorded in this habitat type, most of which were Echidna and Western Grey Kangaroo browsing or using the dense foliage as cover. This habitat was also well utilised by pigs for the same purpose.</p> <p><u>Habitat value for fauna species of conservation significance</u></p> <p>High value</p> <p>Part of a larger area of contiguous remnant vegetation extending throughout the survey area. This habitat provides some breeding habitat for Carnaby's Black Cockatoo however no breeding events were recorded. Additionally, numerous observations of loafy/resting were observed and potential roosting could occur in large Marri. This habitat provides potential hunting and foraging opportunities for the Peregrine Falcon. Some of the very large Marri could also be utilised for breeding purposes. Chuditch could utilise the hollow bearing fallen logs and low hollows for denning and breeding purposes. The Woma python may also utilise logs for refuge. The dense understorey on the Marri Woodland could also be utilised by Quenda (<i>Isoodon</i></p>	

Description	Indicative photograph
<p><i>obesulus</i> subsp. <i>fusciventer</i>) and Western Brush Wallaby.</p>	
<p>Low heathlands on sandy soils – 128.83 ha Vegetation association: VT08 (24.01 ha), VT11 (16.64 ha), VT12 (85.04 ha), VT13 (3.14 ha) This habitat type occurs across the survey area and is associated with other heathlands on sandy soils. The low heathlands on sandy soils are a mosaic of vegetation associations in the survey area but are dominated by a dense coverage of <i>Ecdeiocolea monostachya</i>, <i>Melaleuca</i> sp., <i>Banksia</i> sp. (including <i>B. attenuata</i>), <i>Xanthorrhoea</i> sp. and Mallee (<i>Eucalyptus drummondii</i>). The majority of the heathland area appeared long unburnt (> 20 years) given the size and density of the habitat, however some areas were a mosaic of burn ages particularly in heathlands surrounding the homestead. The dense heathland provides good foraging and breeding opportunities for small native ground mammals, birds and reptiles. Small skinks, geckos and snakes were raked from sandy spoil heaps along the track during the survey. Animal tracks (including species run ways), digs and occasional small burrows were recorded in this habitat type, most of which were Echidna, Western Grey Kangaroo (<i>Macropus fuliginosus</i>), some varanid burrows and invertebrates (scorpions/spiders) digs/burrows. Fallen timber was not present however clumps of dead shrubs and <i>Xanthorrhoea</i> were scattered in this habitat type and provide good cover for ground dwelling species. The odd Mallee stump was also present but scattered throughout this habitat. Leaf-litter was scattered and densest in long unburnt areas. Litter was absent from those areas where fauna had created runways through the heathland.</p> <p><u>Habitat value for fauna species of conservation significance</u> High value A large portion of habitat that is part of a larger area of continuous remnant vegetation extending within and beyond the survey area (in both Mount Lesueur and Coomallo). This habitat provides potential hunting and foraging opportunities for the Peregrine Falcon and excellent foraging habitat for Carnaby’s Black Cockatoo where observations of feeding were observed on <i>Banksia attenuata</i>. Chuditch could utilise the heathlands for foraging. The Woma python and Black-striped Snake (<i>Neelaps calonotus</i>) could utilise the sandy soils for housing/denning and this habitat would be considered core habitat for these species. The dense heathland could also be utilised by Western Ground Parrot (<i>Pezoporus flaviventris</i>), Quenda and Western Brush Wallaby and would be considered core habitat.</p>	

Description

Indicative photograph

Low heathlands on lateritic soils – 164.61 ha

Vegetation association: VT01 (0.11 ha), VT02 (4.26 ha), VT06 (160.24 ha)

This habitat type occurs across the survey area and is associated with heathlands on lateritic soils. The low heathlands on lateritic soils are a mosaic of vegetation associations in the survey area but are dominated by a dense coverage of *Allocasuarina microstachya*, *Petrophile chrysantha*, and species of *Xanthorrhoea*, *Kingia* and *Banksia*. In some areas small outcrops or lateritic ridgelines were present but not large enough to be regarded as a stand along habitat. The majority of the heathland area appeared long unburnt (> 20 years) given the size and density of the habitat, however some areas were a mosaic of burn ages particularly in heathlands surrounding the homestead and on the lateritic hill in the north west of the survey area.

The dense heathland provides good foraging and breeding opportunities for small native ground mammals, birds and reptiles. Few small reptiles were recorded in this habitat during the survey and was probably a reflection of the lack of spoil heaps available in this habitat area searched. Animal tracks (including species run ways) and digs, most of which were Echidna, Western Grey Kangaroo and invertebrates (scorpions/spiders) digs/burrows.

Fallen timber was not present however clumps of dead shrubs and *Xanthorrhoea* were scattered in this habitat type and provide good cover for ground dwelling species. Leaf-litter was scattered and densest in long unburnt areas. Litter was absent from those areas where fauna had created runways through the heathland.

Habitat value for fauna species of conservation significance

High value

A large portion of habitat that is part of a larger area of continuous remnant vegetation extending within and beyond the survey area (in both Mount Lesueur and Coomallo). This habitat provides potential hunting and foraging opportunities for the Peregrine Falcon and excellent foraging habitat for Carnaby's Black Cockatoo. Chuditch could utilise the heathlands for foraging. The Woma python and Black-striped Snake may utilise areas of sand incursion for housing/denning and this habitat would be considered habitat for these species. The dense heathland could also be utilised by Western Ground Parrot and Quenda if present and would be considered core habitat. One Western Brush Wallaby was recorded on camera in this habitat type.



Description

Minor drainage lines and seasonally inundated areas and dams – 35.31 ha

Vegetation association: VT03 (3.64 ha), VT07 (31.67 ha)

This habitat type occurs across a small portion of the survey area and comprises ephemeral drainage lines that support a overstorey of Wandoo (*Eucalyptus wandoo*), Flooded Gum (*E. rudis*) and mid storey *Melaleuca preissiana* and *M. raphiophylla*. Sedges and mixed shrubs line portions of some drainage line banks. Dams for stock watering dug/placed within some drainage lines may have impacted flows in these areas. These habitat areas appeared long unburnt (> 20 years).

The drainage lines and seasonally inundated areas and dams provides habitat and breeding environments for frogs with five species recorded in these areas. Pobblebonks (*Lymnodynastes dorsalis*) and Bleating Froglet (*Crinia pseudinsignifera*) were recorded breeding in the survey area. The water bodies would also be utilised by most fauna species as a water source.

Fallen timber was present in this habitat type and consisted of wandoo logs, some with hollows. Non-vascular ground clover was mostly localised under vegetation and uncommon in areas of high water flow.

Habitat value for fauna species of conservation significance

High value

Part of a contiguous remnant vegetation extending beyond the survey area. This habitat provides a water resource for most fauna species in particular the Carnaby's Black Cockatoo that is breeding on site and would require a local water source. The Peregrine Falcon would utilise this area for hunting and if suitable breeding in large Wandoo. Chuditch, Quenda and Western Brush Wallaby may utilise this habitat and would be considered core habitat.

Indicative photograph



Description

***Eucalyptus todtiana*, *Banksia attenuata/menziesii* low open woodland – 219 ha**

Vegetation association: VT 05

This habitat type occurs in a portion of the survey area where soils are deep grey sands. The habitat comprises low open woodland that supports a overstorey of *Eucalyptus todtiana*, a midstorey of *Banksia attenuata* and *B. menziesii* and an understorey of *Macrozamia* sp., *Acacia* sp. and mixed shrubs. The majority of the low open woodland area appeared long unburnt (> 20 years) given the size and density of the habitat, however some areas were a mosaic of burn ages particularly in areas surrounding the homestead.

The dense understorey provides good foraging and breeding opportunities for small native ground mammals, birds and reptiles. Numerous bush birds were recorded in this habitat type and include Grey Shrike Thrush (*Colluricincla harmonica*), White-winged Triller (*Lalage tricolor*), Horsfield's Bronze-Cuckoo (*Chrysococcyx basalis*) and Spiny-cheeked Honeyeater (*Acanthagenys rufogularis*). Animal tracks (including species run ways), digs and occasional small burrows were recorded in this habitat type, most of which were Echidna and Western Grey Kangaroo.

Fallen timber was limited to areas under *E. todtiana*, however dense skirts of *Zamia* were present and where unburnt provided good cover for ground dwelling species. Leaf-litter was scattered and densest in long unburnt areas.


Habitat value for fauna species of conservation significance

High value

This habitat that is part of a larger area of continuous remnant vegetation extending within and beyond the survey area (in both Mount Lesueur and Coomallo). This habitat provides potential hunting and foraging opportunities for the Peregrine Falcon and excellent foraging habitat for Carnaby's Black Cockatoo. Chuditch could utilise the habitat for foraging. The Woma python and Black-striped Snake could utilise the sandy soils for refuge and this habitat would be considered core habitat for these species. The dense heathland could also be utilised by Western Ground Parrot, Quenda and Western Brush Wallaby and would be considered core habitat.

Indicative photograph



Description	Indicative photograph
<p><i>Scattered trees of Wandoo and Marri in Paddock - 247 ha with 27.5 ha of Wandoo, Marri tree cover</i></p> <p>Vegetation association: Disturbed/pasture</p> <p>This habitat type occurs in the cleared area on the eastern portion of the survey area where scattered Wandoo and Marri are present over pasture plants. The soils are light clay loam or sand with small areas of drainage lines and dams. This habitat is mostly disturbed however the isolated scattered paddock tree may provide habitat and linkage for birds and mobile mammals traversing the environment. Due to the nature of the habitat present both native and introduced grazers were recorded.</p> <p>Limited fallen branches, logs or hollows were present in this habitat type and were present only under the scattered trees.</p> <p>Numerous species able to adapt to a modified environment were recorded in this area including White-fronted Chats (<i>Epthianura albifrons</i>), Straw-necked Ibis (<i>Threskiornis spinicollis</i>), Wood Duck (<i>Chenonetta jubata</i>), Black Duck (<i>Anas superciliosa</i>) and Australian Pipit (<i>Anthus australis</i>).</p> <p><u><i>Habitat value for fauna species of conservation significance</i></u></p> <p>Low to Moderate value</p> <p>Cleared habitat within a larger area of contiguous remnant vegetation extending beyond the survey area. This habitat provides few resources for conservation listed species. However, Carnaby's Black Cockatoo were observed resting in a large Marri and the dams maybe utilised by the species for drinking.</p>	

4.3.2 Fauna diversity

One hundred and one native fauna species were recorded within the survey area during the survey, these included:

- 72 birds
- 12 mammals
- 12 reptiles
- Five frogs.

NatureMap (DPaW 2016) indicate 187 vertebrate fauna taxa occur within the study area, many of which occur in the same and similar habitats present and adjoining the survey area. The species diversity recorded during the current survey is considered to be moderate due to the timing and low intensity of the survey.

Of the 101 native fauna species recorded during this survey, all have been previously recorded within the locality of the Jurien area (Atlas of Living Australia (ALA) 2016 and DPaW 2016).

A full list of fauna recorded during the field survey is presented in Appendix E.

Remote cameras

The remote cameras yielded an additional eight fauna species not identified during the field survey and included the Western Brush Wallaby, Australasian Shelduck and Black-headed Monitor. A number of small mammals (House Mouse, Ash Grey Mouse, Western Bush Rat and Dunnarts) were also recorded on camera and identified as likely within the fauna species list Appendix E. Some of these species could not be verified and would require additional survey to confirm to species level.

Bat detection

Five species of microchiropteran bat species were recorded via echolocation call collection within the survey area. These species are listed in the fauna species list Appendix E. No microchiropteran bats of conservation significance were recorded.

Introduced fauna

During the survey, evidence for six introduced fauna species was recorded in the survey area and adjoining areas, including:

- Cat (*Felis catus*) – cat tracks
- Dingo/dog (*Canis lupus* subsp. *dingo*) – tracks
- Pig (*Sus scrofa*) – Scats, tracks and digs
- Fox (*Vulpes vulpes*) - scats and tracks
- Rabbit (*Oryctolagus cuniculus*) – Scats tracks, digs, burrows and sightings
- House Mouse (*Mus musculus*) – recorded on remote camera.

4.3.3 Conservation significant fauna

Two fauna of conservation significance were recorded during the field surveys within the survey area (Table 12).

Western Brush Wallaby (Macropus irma)

The Western Brush Wallaby is listed Priority 4 by the DPaW. The species is a grazer found primarily in open forest or woodland, particularly favouring open, seasonally wet flats with low grasses and open scrubby thickets. It is also found in some areas of mallee and heathlands, and is uncommon in karri forest. This species was once very common in the south-west of Western Australia, but has undergone a reduction in range and a significant decline in abundance (Van Dyke and Strahan 2008). This species was confirmed via a remote camera image as seen in Plate 11. This species is known to be in the region and would utilise all habitats within the survey area. The location of this record is presented in Figure 6, Appendix A.



Plate 11 Western Brush Wallaby recorded in Low Heathland

Carnaby's Black Cockatoo (Calyptorhynchus latirostris)

The Carnaby's Black Cockatoo is listed as Endangered under the EPBC Act and Endangered (Schedule 2) under the WC Act.

Carnaby's Black Cockatoo is endemic to the south-west of Western Australia with a wide-spread distribution from Kalbarri to east of Esperance (Berry 2008, DSEWPaC 2012a).

Breeding takes place between late July and January/February and most breeding occurs in the inland parts of the species distribution (Burbidge 2009, DSEWPaC 2012a). Carnaby's Black Cockatoo nest in hollows of live or dead eucalypts, primarily smooth-barked Salmon Gum and Wandoo (Saunders 1979, 1982) though breeding has been reported in other wheatbelt tree species and some tree species on the Swan Coastal Plain and jarrah forest (Saunders 1979, 1982; Storr 1991, Johnstone and Storr 1998). Success in breeding is dependent on the quality and proximity of feeding habitat within 12 km of nesting sites (Saunders 1977, 1986; Saunders and Ingram 1987). Along with the trees that provide nest hollows, the protection, management and increase of this feeding habitat that supports the breeding of Carnaby's Black Cockatoo is a critical requirement for the conservation of the species.

During the non-breeding season (January to July) the majority of the birds move to the higher rainfall coastal regions of their range including the mid-west coast, Swan Coastal Plain and south coast (DSEWPaC 2012a). This seasonal shift brings 4,600 to 15,000 Carnaby's Black Cockatoos out onto the northern Swan Coastal Plain (Stock et al. 2013). These areas have better natural water sources over the summer period and historically had extensive areas of

proteaceous woodlands and shrublands to provide feed for young birds, and good resources for adult birds to stock up for the following breeding season (DSEWPaC 2012a; Kendrick 2011).

During February, March, April and occasionally lingering into May-June, large transit flocks forage at major food sources including Banksia or Kwongan heaths and Pinus plantations on the Swan Coastal Plain between Lancelin and Perth (Johnstone *et al.* 2011). North of the Swan River, Carnaby's Black Cockatoo are known to feed on a range of food sources, including Pine trees (*Pinus* spp.), *Banksia* (e.g. *B. sessilis*, *B. attenuata*, *B. prionotes*, *B. menziesii*), *Hakea* spp., Marri (*Corymbia calophylla*), insect larvae, market vegetation and fallen seed, orchard fruit or nut (species undetermined), and several unknown food sources on the ground (Finn *et al.* 2009; Valentine and Stock 2008). Pine trees and the pine plantations are an important food source for Carnaby's Black Cockatoo (Kendrick 2011), and flocks of up to several hundred birds have been commonly sighted within pine plantations (Stock *et al.* 2013).

Observations

Ten observations of Carnaby's Black Cockatoo were made over the survey area comprising of 89 birds (excluding birds associated with breeding events). Birds were observed flying throughout the site from heathlands within the survey area and to areas offsite. Birds were also recorded in the middle of the day resting in large Wandoo and Marri (see Plate 12 and Plate 13).



Plate 12 A pair of Carnaby's Black Cockatoo resting in Wandoo (G. Gaikhorst)



Plate 13 A male Carnaby's Black Cockatoo (G. Gaikhorst)

Breeding

The field survey was conducted at the beginning of the known breeding season for Carnaby's Black Cockatoo. Ten actual breeding events were recorded during the survey that included visual observations of female birds exiting large hollows. All hollows were then inspected from the ground with chews recorded on the hollow rim or close to the entrance. Additionally, some active hollows had clipped dropped fresh leaves (on short stems) at the base inferring nest preparation. From the observations made it was concluded that the birds were commencing the breeding season and likely more nesting activity could be recorded. Some images of breeding activity is provided below in Plate 14, Plate 15 and Plate 16. Additional to the 10 confirmed active hollows a further eight were consider highly likely to be currently used based on the size of the hollow, chew marks present and clipped leaves at the base suggesting nest preparation. All trees identified as actual or highly likely are mapped and presented in Figure 6, Appendix A.



Plate 14 Female Carnaby's Black Cockatoo exiting a hollow (G. Gaikhorst)



Plate 15 Female Carnaby's Black Cockatoo at a Wandoo hollow entrance (G. Gaikhorst)



Plate 16 Large hollow a female Carnaby's Black Cockatoo was utilising with large amounts of recent and old chew scaring (G. Gaikhorst)

Feeding

Feeding habitat is present throughout the survey area and feeding evidence was recorded on *Banksia attenuata* twice, Marri, *Lambertia multiflora* and *Hakea neurophylla* (as shown in Plate 17). Feeding observations were made from visible nuts and cones discarded on the tracks or visual observation of feeding events. Due to the amount of feeding habitat available it is likely that this habitat is regularly utilised by the species for feeding. Feeding records were mapped and presented in Figure 6, Appendix A.



Plate 17 Female Carnaby's Black Cockatoo recorded feeding on *Hakea neurophylla*

Roosting

Roosting was recorded once during nocturnal surveys. It consisted of at least two individuals perched in a large wandoo above a running minor drainage line on the southern boundary of the survey area along Jurien Road (as shown on Figure 6, Appendix A). Due to the numbers observed in the survey area it is likely multiple roosting sites are present.

A summary of the habitat values to Carnaby's Black Cockatoo is presented below in Table 10.

Table 10 Type and extent of Carnaby's Black Cockatoo habitat within the survey area (1993 ha)

Habitat type	Wandoo Woodland	Marri Woodland	<i>Eucalyptus tottiana</i> , <i>Banksia attenuata</i> / <i>menziesii</i> low Open Woodland	Low Heathlands (Sandy and Lateritic soils)	Minor Drainage lines and Seasonally Inundated Areas and Dams	Scattered trees of Wandoo and Marri in Paddock	Total	% of total Site
Foraging habitat	Wandoo Woodland present throughout the survey area (580 ha). High habitat value. Approximately 580 ha.	Marri Woodlands throughout the survey area (618 ha). High habitat value. Approximately 618 ha.	Patchy <i>Eucalyptus tottiana</i> , <i>Banksia attenuata</i> <i>menziesii</i> low Open Woodland in the survey area. (219 ha). High habitat value. Approximately 219 ha.	Both Low heathlands (sandy, 128 ha and Lateritic 164 ha) have mixed proteaceous species including <i>Banksia</i> , <i>Grevillea</i> , <i>Lambertia</i> , <i>Hakea</i> , <i>Xanthorrhoea</i> . (292 ha). High habitat value. Approximately 292 ha.	Minor drainage line with <i>E. rudis</i> , <i>Melaleuca</i> and sedges. Some dams present. (35 ha). High habitat value, the dams and water bodies would provide a water resource. Approximately 35 ha.	Scattered Wandoo and Marri in paddock. (248 ha) of which 27.5 ha is foraging habitat. Moderate habitat value. Due to scattered nature. Approximately 27.5 ha.	1771.5 ha of foraging habitat (not including highly modified habitat) of which 1744 ha is high and 27.5 ha is moderate habitat value.	88.87 % (moderate – high value)
Actual breeding habitat	10 pairs were recorded in hollows either nesting or preparing for nesting. A further eight were considered highly likely due to the evidence presented at the time of the survey. All breeding activity was recorded in Wandoo only. High Value Habitat.						580 ha of High value Wandoo Woodland.	29.10%
Potential breeding habitat	All Wandoo and Marri woodland would be considered potential breeding habitat for Carnaby's Black Cockatoo. Ten 50 x 50 m tree plots were undertaken in Wandoo Woodlands and four in Marri Woodlands to ascertain tree densities (Wandoo > 300 mm at DBH and Marri >500 mm at DBH). Tree densities included 13 trees per 50 x 50 m or 26 trees per ha for wandoo and 6 trees per 50 x 50 m or 12 trees per ha for Marri. From this data large hollows were also recorded and it was found that 3 large hollows per present in Wandoo and 1 large hollow was present per ha of Marri. Isolated large hollows were also recorded within the survey area with an additional 29 trees identified to have large hollows suitable for Carnaby's Black Cockatoo, some with evidence of historical use. High value habitat.						1198 ha of potential breeding habitat comprising 580 ha of Wandoo and 618 ha of Marri.	60.11%
Roosting	One roosting site was recorded as being used by Carnaby's Black Cockatoos. There is potential roosting habitat in the Wandoo woodland habitats of the site, particularly those patches of woodland with nearby water sources.						35 ha High value habitat.	1.76%
				Total area of offset site			1993 ha of which 1771.5 ha is Black Cockatoo habitat.	88.87 % (moderate – high value)

Tree density assessments

Fourteen tree density plot assessments were undertaken in the survey area in both Wandoo and Marri Woodlands. A summary of the findings is provided below. A complete breakdown of the tree plot assessment data can be seen below in **Error! Not a valid bookmark self-reference.:**

Wandoo

- An average of 13 trees per 50 x 50 m plot were recorded or 26 trees per ha for Wandoo.
- Three large hollows per ha was present in Wandoo habitat.
- Feral bees were recorded in five hollows during the plot assessments in both medium and large hollows.

Marri

- An average of 6 trees per 50 x 50 m plot were recorded or 12 trees per ha for Marri.
- One large hollow per ha was present in Marri Woodland.

Tree plots are also mapped and presented in Figure 6, Appendix A.

Table 11 Tree Plot Data from the Survey Area

Plot	Habitat	Tree Species		Hollows Present and Size			Hollow Use Per Plot		
		Wandoo Trees	Marri Trees	Large	Medium	Small	Carnaby's BC Breeding evidence	Pest species	Comments
1	Wandoo	16	0	2	2	20	One large hollow has chews present	Bees in a medium hollow	Western Long-billed Corella breeding in medium hollow
2	Wandoo	18	0	4	14	14	One large hollow has chews present		Galah breeding in a medium hollow
3	Wandoo	8	0	1	9	15			
4	Wandoo	13	0	1	3	15			Galah breeding in a medium hollow
5	Wandoo	16	0	0	2	21			
6	Wandoo	5	0	1	1	3	One large hollow has old chews		
7	Wandoo	12	0	1	3	25		Bees in a medium hollow	
8	Wandoo	15	0	1	5	12	One large hollow has chews present	Bees in a medium hollow	
9	Wandoo	12	0	1	2	11	One large hollow has old chews		
10	Wandoo	14	0	1	3	17		Bees in large and medium hollow	
11	Marri	0	8	0	2	4			
12	Marri	0	6	0	2	3			
13	Marri	0	4	0	0	4			
14	Marri	1	7	2	3	8	One large hollow has old chews		

Likelihood of Occurrence

Searches of the EPBC Act PMST and *NatureMap* database identified the presence/potential presence of 21 conservation significant fauna species. An assessment on the Likelihood of Occurrence for conservation significant fauna species in the survey area was conducted (Appendix E). This assessment was based on species biology, habitat requirements, the quality and availability of suitable habitat and records of the species in the survey area and the surrounding area (e.g. DPaW 2016).

The assessment identified the likely presence of an additional six other species of conservation significance (see Table 12). The Likelihood of Occurrence assessment revealed that other fauna species of conservation significance could occasionally occur within the habitats of the survey area (those species deemed 'unlikely' to occur). However, it is considered unlikely that the survey area provides important habitat (e.g. breeding habitat or key foraging habitat) for any of these species deemed 'unlikely' to occur and that these other species may occasionally use the habitats of the survey area for temporary refuge and dispersal between other areas of habitat.

The Western Ground Parrot and Chuditch are not currently known to persist in the area with anecdotal records present in the region only. Due to the lack of surveys in the region and amount and type of habitat present in are surrounding the survey area these species could not be excluded from the assessment. A summary of the assessment is below in Table 12.

Table 12 Summary of fauna species of conservation significance recorded during survey and determined likely to occur within the survey area

Species and status (EPBC, WC Act)	Justification for Likelihood of Occurrence
Western Ground Parrot (<i>Pezoporus flaviventris</i>) Cr, S1, Cr	Likely – possible regular visitor or possible resident, The survey area provides suitable foraging and residential habitat for the species. The dense heath lands would be regarded as core habitat for the species. The remainder of the habitat in the survey area is supportive only. There are no historical records within survey area, but numerous unconfirmed records are present in the region just outside of the study area. Due to the habitat present and lack of surveys in the region the species cannot be excluded.
Chuditch, Western Quoll (<i>Dasyurus geoffroi</i>) Vu, S3, Vu	Likely – regular visitor or resident The survey area provides suitable denning, hunting and foraging habitat for the species. The woodlands would be regarded as core habitat for the species with denning opportunities available in Wandoo and Marri hollows both on the ground and aerial. The remainder of the habitat in the survey area is foraging and supportive only. There are no historical records within survey area, but numerous unconfirmed records are present in the region just outside of the study area. Due to the habitat present and lack of surveys in the region the species cannot be excluded.
Peregrine Falcon (<i>Falco peregrinus</i>) OS, S7	Likely – regular visitor or resident to survey area The survey area provides suitable breeding, hunting and roosting habitat. The survey area is probably part of the species broader home range; limited breeding habitat occurs within the survey area (breeding potential could occur in the large Wandoo or Marri).

Species and status (EPBC, WC Act)	Justification for Likelihood of Occurrence
	There are no historical records within survey area and several records within the study area the closest being 10 km east.
Woma Python (<i>Aspidites ramsayi</i> SW pop.) P1	<p>Likely – resident to survey area</p> <p>The survey area provides suitable habitat for the species. All sandy soil areas would be considered core habitat for the species including the woodlands with hollows and ground cover.</p> <p>There are no historical records within survey area, but numerous unconfirmed records are present in the region just outside of the study area. Due to the habitat present and lack of surveys in the region the species cannot be excluded.</p>
Southern Brown Bandicoot (<i>Isoodon obesulus</i> subsp. <i>fusciventer</i>) P5	<p>Likely –resident to survey area</p> <p>The survey area provides suitable habitat for the species. All dense areas of either heathlands, shrublands or woodlands would be considered core habitat for the species.</p> <p>There are no historical records within survey area, but numerous unconfirmed records are present in the region in Mount Lesueur. Due to the habitat present and lack of surveys in the region the species cannot be excluded.</p>
Black-striped Snake (<i>Neelaps calonotos</i>) P3	<p>Likely –resident to survey area</p> <p>The survey area provides suitable habitat for the species. All sandy soil areas would be considered core habitat for the species.</p> <p>There are no historical records within survey area, but there is one record 20 km north of the survey area and another 23 km east. The species is highly cryptic and rarely observed and the survey area is within the known range of the species. Due to the habitat present and lack of surveys in the region the species cannot be excluded.</p>

Table note:

Status (see Appendix B for full explanation)

EPBC Act – Species listed as one or more of the following: MiT = migratory terrestrial species, Vu = Vulnerable, En = Endangered, Cr = Critically Endangered

WC Act - Species listed as CR = critically endangered (S1, Schedule 1), En = Endangered (S2, Schedule 2), Vu = Vulnerable (S3, Schedule 3), IA = international migratory agreement migratory birds (S5, Schedule 5), OS = other specially protected fauna S7, Schedule 7)

DPaW – Species listed as Priority (P) 1, 2, 3, 4 or 5

5. Offset Assessment Guide Inputs

The *EPBC Act Offsets Assessment Guide* (the guide) (DSEWPaC 2012b) is designed to accompany the *EPBC Act Environmental Offsets Policy* (the policy) (DSEWPaC 2012c) which is used to support application of the policy for a proposed environmental offset. The guide is a tool to assist in determining the suitability of offset proposals. The guide includes four parts, including:

- Matter of National Environmental Significance assessment box
- Impact Calculator
- Offset Calculator
- Summary box.

For Stage 1 of the Mitchell Freeway Extension, Burns Beach to Hester Avenue, the guide has been used to determine the required offsets for impacts to Carnaby's Black Cockatoo. The document *How to use the Offset Assessment Guide* (DSEWPaC 2012b) has been used to inform the inputs into the guide.

The inputs into the *Impact Calculator* section include:

- Area of habitat – 88.7 ha (including 86.41 ha for Stage 1 and 2.29 ha for geotechnical trace lines)
- Quality of habitat – 8.

This section provides an outline and a justification of the inputs into the *Offsets Calculator* for the proposed offset site (the survey area).

5.1 The offset

A 564 ha portion of Lot 1, 1395 Banovich Road, Hill River (survey area) is being assessed as an environmental offset. The portion of the survey area to be used as the offset is yet to be determined. In providing the input values for the offset calculator the following assumptions have been made:

- At least 50 % (approximately 282 ha) of the offset area is Wandoo woodland containing one or more of the known breeding location
- The balance of the offset is foraging habitat (excluding Wandoo woodland)
- The land will be a conservation estate as vested in the Conservation and Parks Commission of Western Australia and will be managed by DPaW.

5.2 Time horizon

5.2.1 Time over which loss is averted

The *time over which loss is averted* is the foreseeable timeframe (in years) over which changes in the level of risk to a proposed offset site can be considered and quantified. That is, it is the time that any measures for securing a site for conservation purposes, such as conservation covenants on title, are intended to last. Longer time frames are valued more highly than shorter time frames.

Input – 20 years

The value of 20 was assigned as using a conservation covenant has an “in-perpetuity” lifespan. The transfer of land into conservation estate will provide legal protection of the offsets. Once land has been reserved for the purpose of a conservation park the purpose of the land can only be changed by an Act of State Parliament. Conservation estates are vested in the Conservation and Parks Commission of Western Australia and are then managed by DPAW.

5.2.2 Time until ecological benefit

The *time until ecological benefit* is the estimated time (in years) that it will take for the habitat quality to naturally decline if the site is not managed as a proposed offset.

Input – 10 years

The value of 10 was assigned as the survey area is expected to be impacted by weeds and feral species (e.g. bees, cats, foxes and pigs) reducing the quality from the initial habitat quality value for Carnaby’s Black Cockatoo of 8 to 7 over 10 years.

The value of 10 years is the standard decline expected for the nearby Gin gin area used by DotE during the previous assessment of other offset sites, in the absence of any specific threats to a parcel of land (Nikki Ward DotE, pers comm. April 2014). Therefore, the value of 10 years has been applied based on previous correspondence with DoTEE.

5.3 Start area

Input – 564 ha

A 564 ha portion of the 1993 ha survey area, is habitat for Carnaby’s Black Cockatoo. Main Roads intends to purchase the remainder of the survey area (approximately 1429 ha) to fulfil the offset requirements for other projects.

5.4 Start quality

The DotEE’s “How to use the Offset Assessment Guide” provides information on assessing the quality of habitat for EPBC Act listed threatened fauna species (DSEWPaC 2012b). Within this guide, the DotEE outlines the approach for assessing the quality score for area of habitat which is known to support supports EPBC listed threatened fauna (in this case Carnaby’s Black Cockatoo). This quality score is a measure of how well a particular site supports a particular threatened species and contributes to its ongoing viability (DSEWPaC 2012b). There are three components that contribute to the calculation of habitat quality: site condition, site context, and species stocking rates. These three components are defined as follows:

- **Site condition:** This is the condition of a site in relation to the ecological requirements of a threatened species. This includes considerations such as vegetation condition and structure, the diversity of habitat species present, and the number of relevant habitat features
- **Site context:** This is the relative importance of a site in terms of its position in the landscape, taking into account the connectivity needs of a threatened species. This includes considerations such as movement patterns of the species, the proximity of the site in relation to other areas of suitable habitat, and the role of the site in relation to the overall population or extent of a species
- **Species stocking rate:** This is the usage and/or density of a species at a particular site. The principle acknowledges that a particular site may have a high value for a particular threatened species, despite appearing to have poor condition and/or context. It includes

considerations such as survey data for a site in regards to a particular species population. It also includes consideration of the role of the site population in regards to the overall species population viability.

These three components contribute to the final habitat quality score, however the weighting given to each component is dependent on the ecological requirements of the impacted species (DotEE 2014c). When determining the suitability of a proposed offset using the guide, the minimum requirement is that the quality score of the offset site must at least reach the same value as the quality score of the impact site (i.e. for Stage 1 of the project).

5.4.1 Start quality input value

Input – 9

Based on the assessment below of the three components that contribute to the final habitat quality score, a strong weighting was given to all three components. Therefore, the survey area has been assigned a habitat quality score of 9.

An assessment of the quality of the habitat types available to Carnaby's Black Cockatoo within the survey area is provided below.

5.4.2 Site condition

The survey area provides remnant vegetation and habitat in excellent condition for Carnaby's Black Cockatoo. This habitat of the survey area comprises valuable breeding and foraging resources for the species.

A detractor to the survey area value is the presence of feral species which also use large hollows suitable for Carnaby's Black Cockatoo. This includes the Feral Bee and Laughing Kookaburra. During the tree plot assessment feral bees were recorded in at least one hollow per hectare.

Breeding

Ten actual breeding events were recorded during the survey, which included visual observations of female birds exiting large hollows. In addition to the 10 confirmed active hollows, a further eight were considered highly likely to be currently used based on the size of the hollow, chew marks present and clipped leaves at the base suggesting nest preparation.

Feeding

Feeding habitat is presented throughout the survey area and feeding evidence was recorded on *Banksia attenuata* twice, Marri, *Lambertia multiflora* and *Hakea neurophylla*. The feeding habitat present in the survey area was dense. The observations made were from visible nuts and cones discarded on the tracks or visual observation of feeding events. Due to the amount of feeding habitat available it is likely that area is heavily utilised by the species.

Roosting

Roosting was recorded once during nocturnal surveys and consisted of at least two individuals perched in a large Wandoo above a running minor drainage line on the southern boundary on the survey area along Jurien Road. Due to the numbers observed in the survey area it is likely multiple roosting sites are present.

5.4.3 Site context

Proximity to known breeding sites and larger areas of foraging vegetation.

The survey area is located within the known breeding range of Carnaby's Black Cockatoo, and within a region where the vegetation typically contains suitable foraging habitat. The survey area lies alongside Coomallo Nature Reserve a known Carnaby's Cockatoo breeding site and is recognised under the IBAs as a site for bird conservation (Dutson *et al.* 2009). The Coomallo site is known to support 40 breeding pairs of Carnaby's Black Cockatoo with the main breeding location only approximately 6 km from the survey area. Carnaby's Black Cockatoos are largely dependent on an abundance of suitable feeding habitat adjacent to breeding sites to provide the necessary food for the survival of the chick. While breeding, Carnaby's Black Cockatoos will generally forage within a 10–15 km radius of their nesting site.

Therefore, the survey area provides a significant area of suitable high quality foraging habitat within close proximity to known breeding sites in the region. Additionally, from this preliminary survey at least 10 known breeding sites were recorded within the survey area.

Proximity to Important Bird Areas

Thirteen Bird IBA's have been identified as significant to Carnaby Black Cockatoo (Dutson *et al.* 2009). The criteria used for the designation of IBAs for Carnaby's black Cockatoo are sites supporting at least 20 breeding pairs, or 1% of the population regularly utilising an area in the non-breeding part of the range. There are four IBAs within close proximity to the survey area, including:

- Coomallo IBA - known to support at least 40 pairs in nesting and associated feeding habitat. This IBA is located next to on the eastern boundary of the survey area
- The Cataby IBA - known to support at least 24 pairs in nesting and associated feeding habitat. This IBA is located approximately 55 km south of the survey area
- The Moora IBA - known to support up to 60 breeding pairs which nest in woodland remnants and isolated paddock trees and feed in native shrublands in the town of Moora. This IBA is located approximately 80 km south-east of the survey area
- The Koobabie IBA – known to support up to 32 breeding pairs which nest in woodland remnants and feed in native shrublands. This IBA is located approximately 110 km east of the survey.

5.4.4 Species stocking rate

Numerous observations of Carnaby's Black Cockatoos were observed using the habitat within the survey area for foraging, roosting and breeding during the field survey, in total 89 birds were recorded.

It is difficult to determine the specific density and usage of the survey area by Carnaby's Black Cockatoo. Coomallo Nature Reserve to the east of the survey area is 2,078 ha in size and supports approximately 40 breeding pairs of Carnaby's Black Cockatoo. This survey area is only 85 ha smaller and in the same area therefore is likely to hold similar numbers. The reporting of 89 birds within the survey area supports this assessment.

There is currently little information known on the home range of Carnaby's Black Cockatoo, however the species will generally forage within a 10–15 km radius of its nesting site. Given that breeding has been recording within Coomallo Nature Reserve, located within 10 km of the survey area and within the survey area, the habitats present provide foraging habitat within close proximity these breeding birds. Therefore, it is highly likely that Carnaby's Black Cockatoos would utilise the survey area for foraging during the breeding season.

5.5 Future area and quality with and without offset

The *risk of loss* is a percentage figure that describes the chance that the habitat on the proposed offset site will be completely lost (i.e. no longer hold any value for the protected matter) over the foreseeable future (either the life of the offset or 20 years, whichever is shorter). An estimated risk of loss is entered in the guide for both the business as usual (i.e. without offset) and with offset scenarios. The difference between these figures is the level of averted loss provided by the proposed offset.

There are a number of factors that could influence the risk of loss of a site, including:

- Presence and strength of formal protection mechanisms currently in place on the proposed site (e.g. zoning, restrictive covenants or state vegetation clearing laws)
- Presence of pending development applications, mining leases or other activities on the proposed offset site that indicate development intent and likelihood
- Average risk of loss for similar sites.

5.5.1 Risk of loss (%) without offset

Input – 15%

The value of 15% was assigned as the property prior to Main Roads purchase was privately owned for agriculture. The exponential population growth of Western Australia in the past decade has put increasing pressure on Western Australia to increase horticultural production and with this increase the need for extra land has also increased.

The value of 15% is the standard risk of loss for the Gin Gin region area used by DotEE during the previous assessment of other offset sites, in the absence of any specific threats to a parcel of land (Nikki Ward DotE, pers comm. April 2014). Therefore, the value of 15% has been applied based on previous correspondence with DoTEE.

5.5.2 Future quality without offset (scale 1-10)

Input – 8

The value of 8 was assigned as without the proposed offset the quality of the habitat for Carnaby's Black Cockatoo is likely to slightly decrease given the proximity to cleared and degraded land and the increased likelihood of disturbance, such as weed encroachment and feral species increases. During the field survey a number of hollows were observed with bees present, at a rate of approximately one hollow per hectare. There is the potential the rate of infestation could increase further reducing the number of large hollows available. In addition, there is the potential for fire to pass from the remnant vegetation surrounding the survey area, into the survey area which could result in the complete loss of the habitat for Carnaby's Black Cockatoo. Without management by DPaW the quality of the habitat is likely to be reduced in the absence of active management of these issues, i.e. weed, feral bee and fire management.

5.5.3 Risk of loss (%) with offset

Input – 2%

The value of 2% was assigned as the transfer of 564 ha of the total 1993 ha survey area (including 1771.5 ha of Carnaby's Black Cockatoo foraging habitat and 560 ha of known breeding habitat) into conservation estate is unlikely to completely remove all risks to the proposed offset site, as there will still be a small amount of residual risk the vegetation could be lost. This risk incorporates rare events, such as a catastrophic wildfire destroying all of the vegetation within the survey area.

5.5.4 Future quality with offset (scale 1-10)

Input – 9

The value of 9 was assigned as with the proposed offset, the quality of the habitat for Carnaby's Black Cockatoo is likely to remain the same. The quality of the habitat within the survey area for Carnaby's Black Cockatoo is already high, given the excellent site condition, context for the species and stocking rate. Therefore, the habitat does not currently require rehabilitation or revegetation to improve the site condition, and the context and stocking rate are likely to remain relatively static. The management of the survey area by DPaW will also allow the area to be actively managed to maintain the viability of Carnaby's Black Cockatoo habitat.

5.6 Confidence in result (%)

The *confidence in result* is a percentage figure that describes the level of certainty about the success of the proposed offset. Proposed offset actions that are designed to have a lower risk of failure should have a higher confidence in result score.

Averted loss component input – 80%

Change in habitat quality component input – 80%

The value of 80% was assigned to the averted loss component as there is a very high level of confidence in the strength and effectiveness of the proposed conservation covenant.

For the change in habitat quality component, a value of 80% is assigned as there is a high level of certainty that management of the survey area by DPaW (including management measures such as weed control, feral bee control, maintenance of firebreaks and fencing) will maintain and improve the quality of the Carnaby's Black Cockatoo habitat.

It should be noted that Main Roads have not currently allocated funds to the future management or improvement of the proposed offset site (i.e. for land management measures such as feral bee control, fencing and weed control).

5.7 Net present value (adjusted hectares)

The calculation of the net present value is a form of discounting that incorporates the annual probability of extinction and the relevant time horizons (time over which loss is averted and time until ecological benefit). It is used to reflect the fact that a given benefit (i.e. improving habitat quality or averting loss) today holds more value for a protected matter than the same benefit realised in the future.

Output – 75.63 ha

The outcome meets accounts for greater than 100% (106.57%) direct offset for the impact of clearing 88.7 ha of Carnaby's Black Cockatoo habitat for Stage 1 of the project.

5.8 Summary of inputs

A summary of the inputs into the *Offsets Calculator* for the proposed offset site (the survey area) is provided in Table 13. The *Offsets Calculator* is presented in Appendix F.

Table 13 Summary of inputs into Offset Calculator

Offset calculator attribute	Input value
Proposed offset	Portion of Lot 1, 1395 Banovich Road, Hill River. Area: 1993 ha including 1771.5 ha native vegetation and 27.5 ha of highly modified vegetation.
Time horizon (years)	
Time over which loss is averted	20 years
Time until ecological benefit	10 years
Start area (ha)	564 ha
Start quality (scale of 1-10)	9
Future area and quality with and without offset (%)	
Risk of loss (%) without offset	15%
Future quality without offset (scale 1-10)	8
Risk of loss (%) with offset	2%
Future quality with offset (scale 1-10)	9
Confidence in result (%)	
Averted loss component input	80%
Change in habitat quality component input	80%
Output	
Net present value (adjusted hectares)	75.63

6. Conclusion

6.1 Vegetation and Flora

Fourteen vegetation types were identified and described from the survey area. The three woodland vegetation types (VT05, VT09 and VT10) accounted for the majority of the vegetation within the survey area (69.62%). VT03 and VT07 are associated with *Melaleuca* species along drainage lines. The remaining eight native vegetation types are all heathlands with the vegetation rarely exceeding 150 cm in height and comprised of a range of species at varying densities in a range of soil types and landforms. As this was not an intensive survey, not all of the vegetation types may have been accurately assessed or mapped.

Four vegetation types are considered to be conservation significant ecological communities, including:

- VT01 is associated with the Lesueur-Coomallo Floristic Community D1 TEC, listed as Critically Endangered under the WC Act
- VT03 is associated with the Lesueur-Coomallo Floristic Community M2 (*Melaleuca preissiana* woodland) Priority 1 PEC
- VT04 is associated with the Lesueur-Coomallo Floristic Community DFGH Priority 1 PEC, in particular 'D' heath and woodlands on gravelly hills and slopes
- VT02 is associated with the *Petrophile chrysantha* low heath on Lesueur dissected uplands (Gp200-170) Priority 2 PEC.

All of the native vegetation within the survey area is considered significant vegetation as defined by the EPA and DPaW (2015). The majority of the survey area is in a Pristine condition that contains different combinations of taxa associated with a variety of heathlands and provides a linkage between Lesueur National Park and Coomallo Nature Reserve. In addition, the vegetation is a refuge for a number of conservation significant flora that occur throughout the survey area in a variety of vegetation types.

Nine conservation significant flora were recorded from the survey area during the field survey including:

- *Hakea megalosperma* (listed as Vulnerable under both the EPBC Act and WC Act)
- *Acacia retrorsa* (Priority 2)
- *Grevillea delta* (Priority 2)
- *Thelymitra variegata* (Priority 2)
- *Hensmania stoniella* (Priority 3)
- *Lepidobolus quadratus* (Priority 3)
- *Stylidium ?hymenocraspedum* (Priority 3)
- *Stylidium ?torticarpum* (Priority 3)
- *Hakea neurophylla* (Priority 4).

The locations and counts of conservation significant flora within the survey area are likely to increase if the survey effort was to increase to a Level 2 survey during the correct season (mid-September to October).

The majority of the survey area is in a Pristine condition with the presence of introduced species generally restricted to the cleared paddock area, along creeklines and the borders of vegetation

to previously cleared areas (see Section 4.1.3). Thirteen introduced taxa were recorded within the survey area during the field survey. The most commonly recorded weed species in the survey area include **Arctotheca calendula*, **Hypochaeris glabra* and **Romulea rosea*. No introduced species listed as a Declared Pest plant under Section 22 of the BAM Act or a WoNS (DotE 2016d), was recorded within the survey area.

6.2 Fauna

Seven main fauna habitat types were recorded during the field survey, which broadly aligned with the vegetation associations and include, Wandoo Woodlands (560 ha), Marri Woodland (640 ha), *Eucalyptus tottiana*, *Banksia attenuata/ menziesii* low Open Woodland (219 ha), minor drainage lines and seasonally inundated areas and dams (35 ha), Low Heathlands on sandy soils (128 ha), Low Heathlands on lateritic soils (164 ha) and scattered trees of Wandoo and Marri in paddock (248 ha of which 27.5 ha is scattered Wandoo and Marri).

One hundred and seven fauna species were recorded within the survey area during the survey, these included, 72 birds, 18 mammals (6 introduced), 12 reptiles and five frogs. Of these species two were identified as conservation significant and consisted of Carnaby's Black Cockatoo listed as endangered under both EPBC and WC Acts and Brush Wallaby listed as priority 4 under DPAW.

Carnaby's Black Cockatoo were recorded via observations of birds (89 individuals), actual breeding events (10 birds recorded in hollows) with an additional 8 records of hollows highly likely used or being used (but not confirmed), five records of feeding behaviour and one location of roosting.

6.3 Offset Calculator

The EPBC Act Offsets Assessment Guide has been used to determine the required offsets for impacts to Carnaby's Black Cockatoo for Stage 1 of the Mitchell Freeway Extension.

The outcome based on an offset area of 564 ha accounts for greater than 100% (106.57%) direct offset for the impact of clearing 88.7 ha of Carnaby's Black Cockatoo habitat for Stage 1 of the project.

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Appendices

Appendix A – Figures

Figure 1 Project location

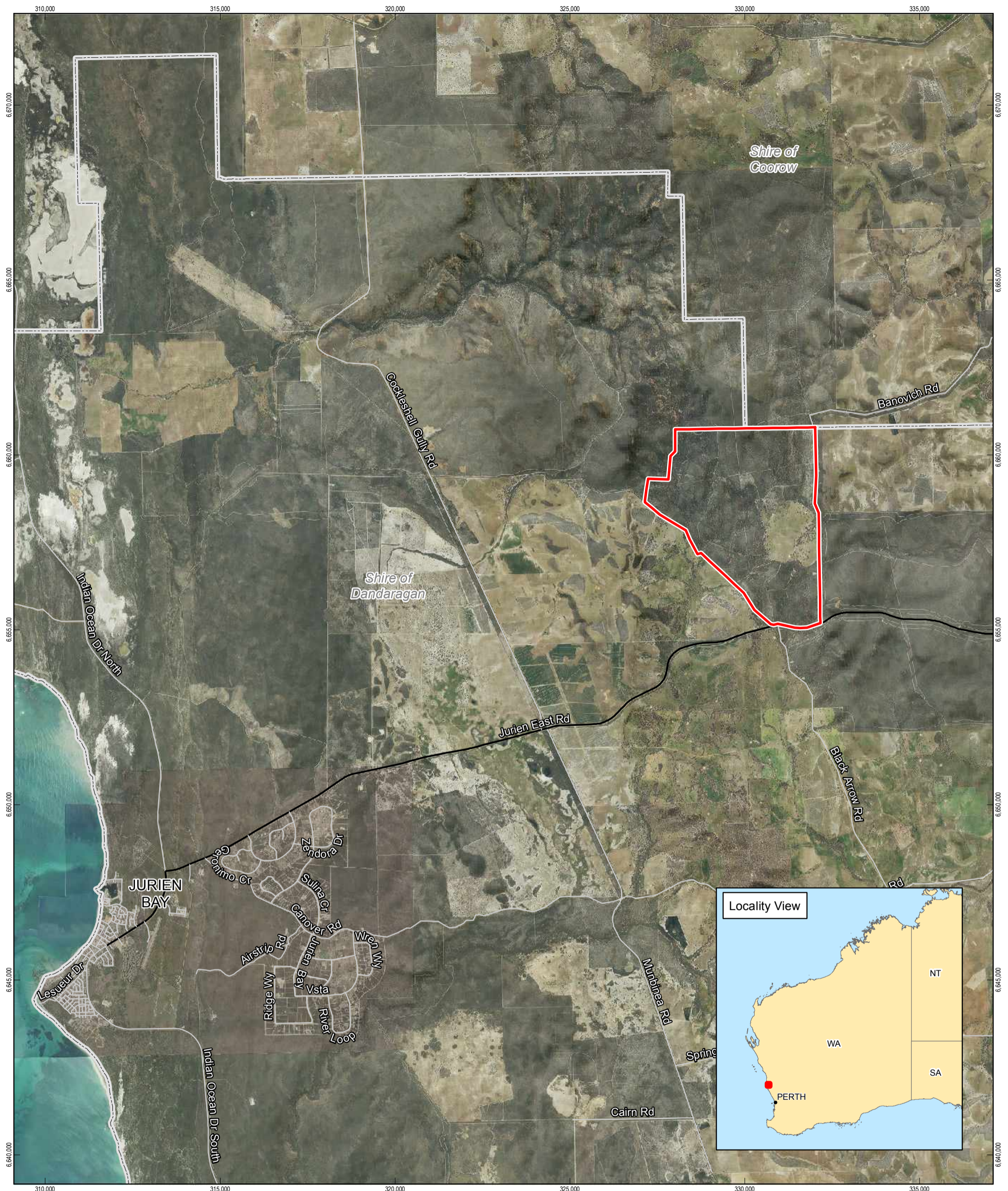
Figure 2 Biological constraints

Figure 3 Vegetation associations, quadrat locations and Conservation Significant Flora

Figure 4 Vegetation condition

Figure 5 Fauna methods and results

Figure 6 Black Cockatoo Habitat



LEGEND

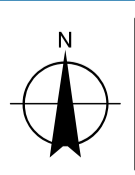
— Major road Survey area

— Minor road Shire boundary

Page Size A3

0 0.5 1 2 3 4
Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

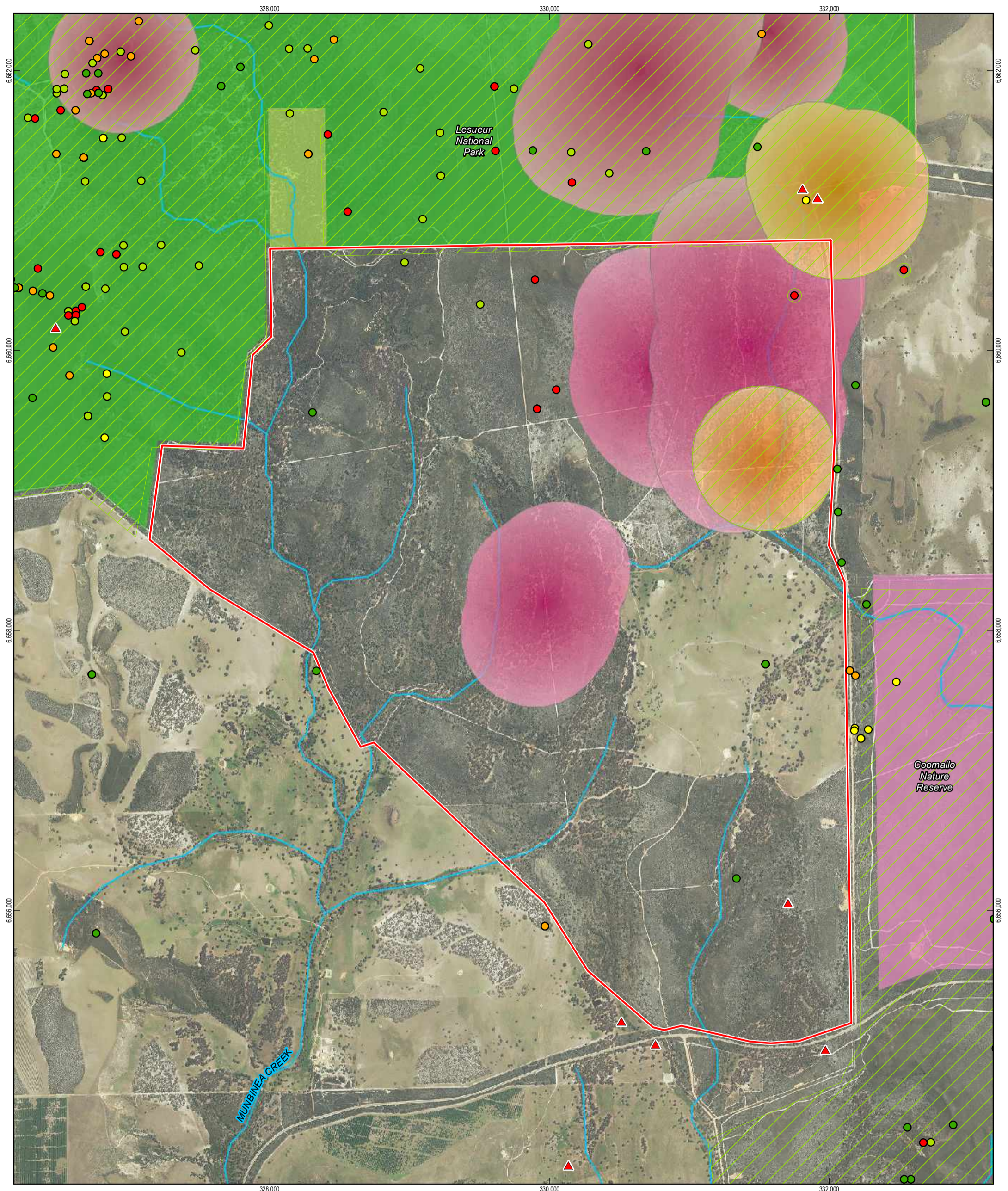


Main Roads WA
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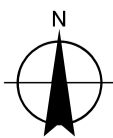
Locality Map

Figure 1



LEGEND

- | | | | | |
|---------------------------------------|----------------------------------|----------------------------------|-------------------------------------|---------------------------|
| Conservation Significant Fauna | ● Priority 1 - Poorly Known Taxa | — Watercourse | ■ Threatened Ecological Communities | DPaW Managed Lands |
| ▲ Endangered | ● Priority 2 - Poorly Known Taxa | ▭ Survey area | ■ Priority Ecological Communities | ■ Conservation Park |
| Conservation Significant Flora | ● Priority 3 - Poorly Known Taxa | ▨ Environmentally Sensitive Area | | ■ National Park |
| ● Threatened | ● Priority 4 - Rare Taxa | | | ■ Nature Reserve |

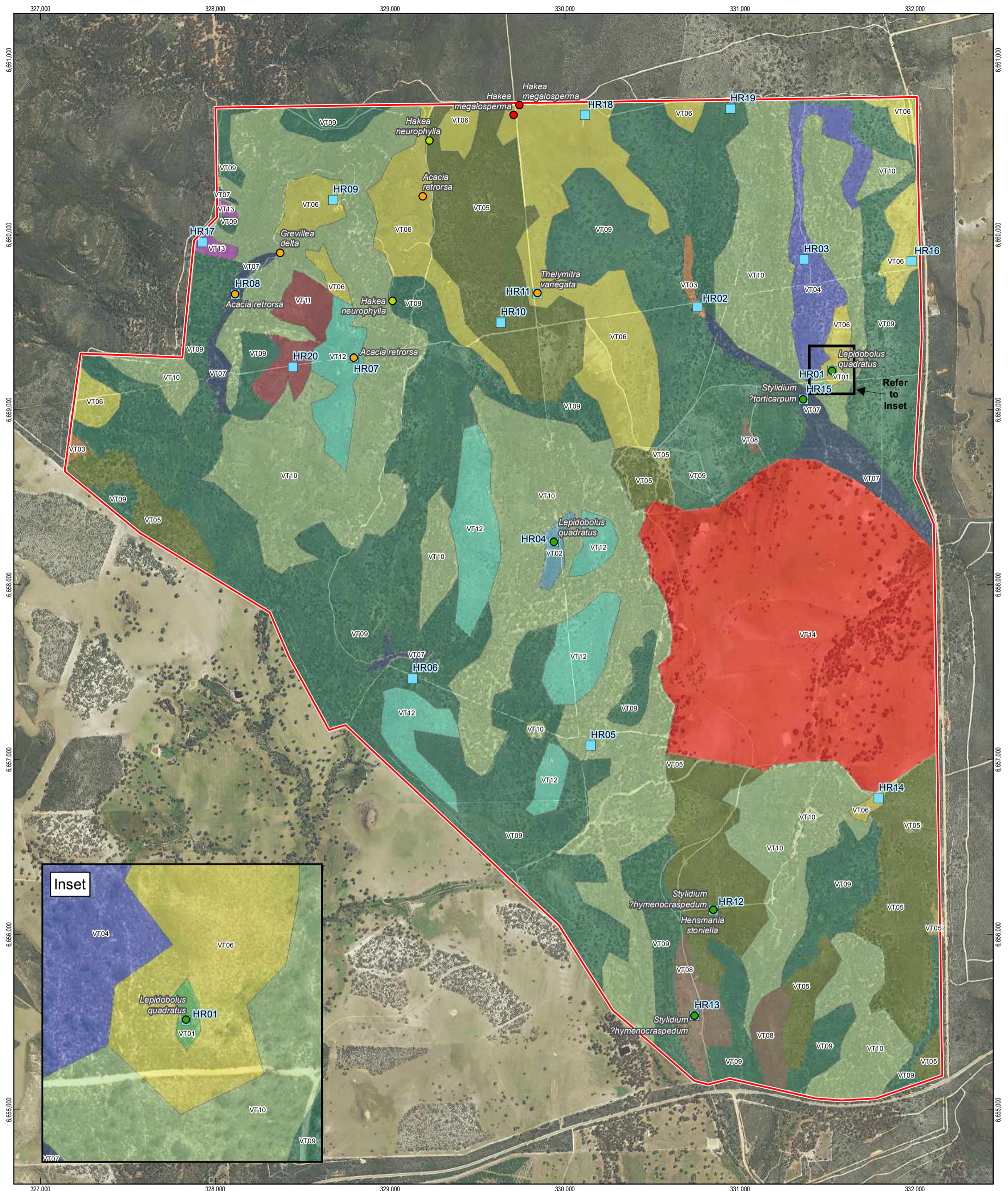


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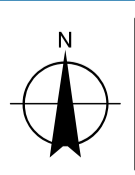
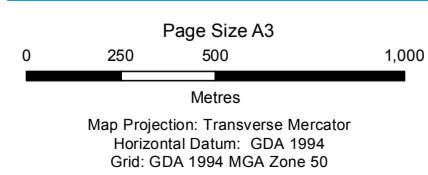
Biological Constraints

Figure 2



LEGEND

● Threatened	 Survey area	 Vegetation type	 VT05 <i>Eucalyptus todiana</i> , <i>Banksia attenuata</i> and <i>B. menziesii</i> woodland	 VT10 <i>Eucalyptus wandoo</i> woodland
● Priority 2 - Poorly Known Taxa		 VT01 <i>Allocasuarina microstachya</i> heathland	 VT06 <i>Xanthorrhoea</i> and <i>Kingia</i> heathland	 VT11 <i>Banksia attenuata</i> open heathland
● Priority 3 - Poorly Known Taxa		 VT02 <i>Petrophile chrysantha</i> heathland	 VT07 <i>Melaleuca raphiophylla</i> woodland	 VT12 Mixed heath with isolated clumps of mallee
● Priority 4 - Rare Taxa		 VT03 <i>Melaleuca preissiana</i> open woodland	 VT08 <i>Ecdeiocolea monostachya</i> herbland	 VT13 <i>Melaleuca ?concreta</i> heathland
		 VT04 <i>Melaleuca platycalyx</i> heathland and <i>Eucalyptus wandoo</i> woodland	 VT09 <i>Corymbia calophylla</i> woodland	 VT14 Pasture with emergent trees

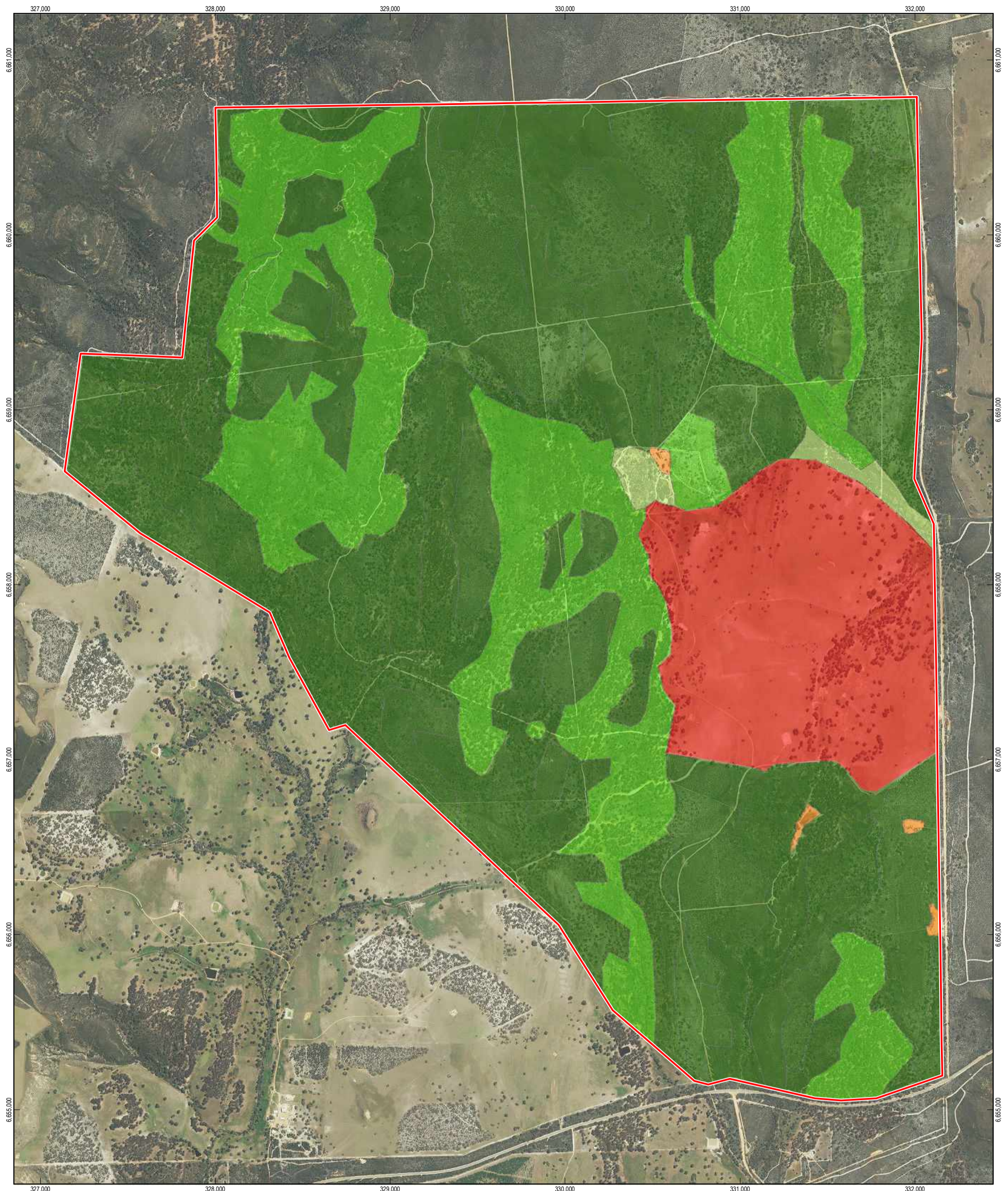


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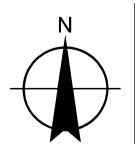
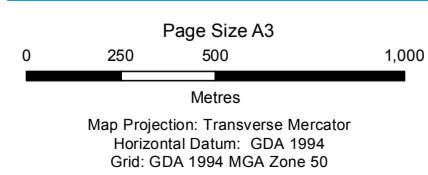
Vegetation Type

Figure 3



LEGEND

 Survey area	 Excellent
Vegetation Condition (EPA and DPaw 2015)	 Very Good
 Pristine	 Degraded
	 Completely Degraded

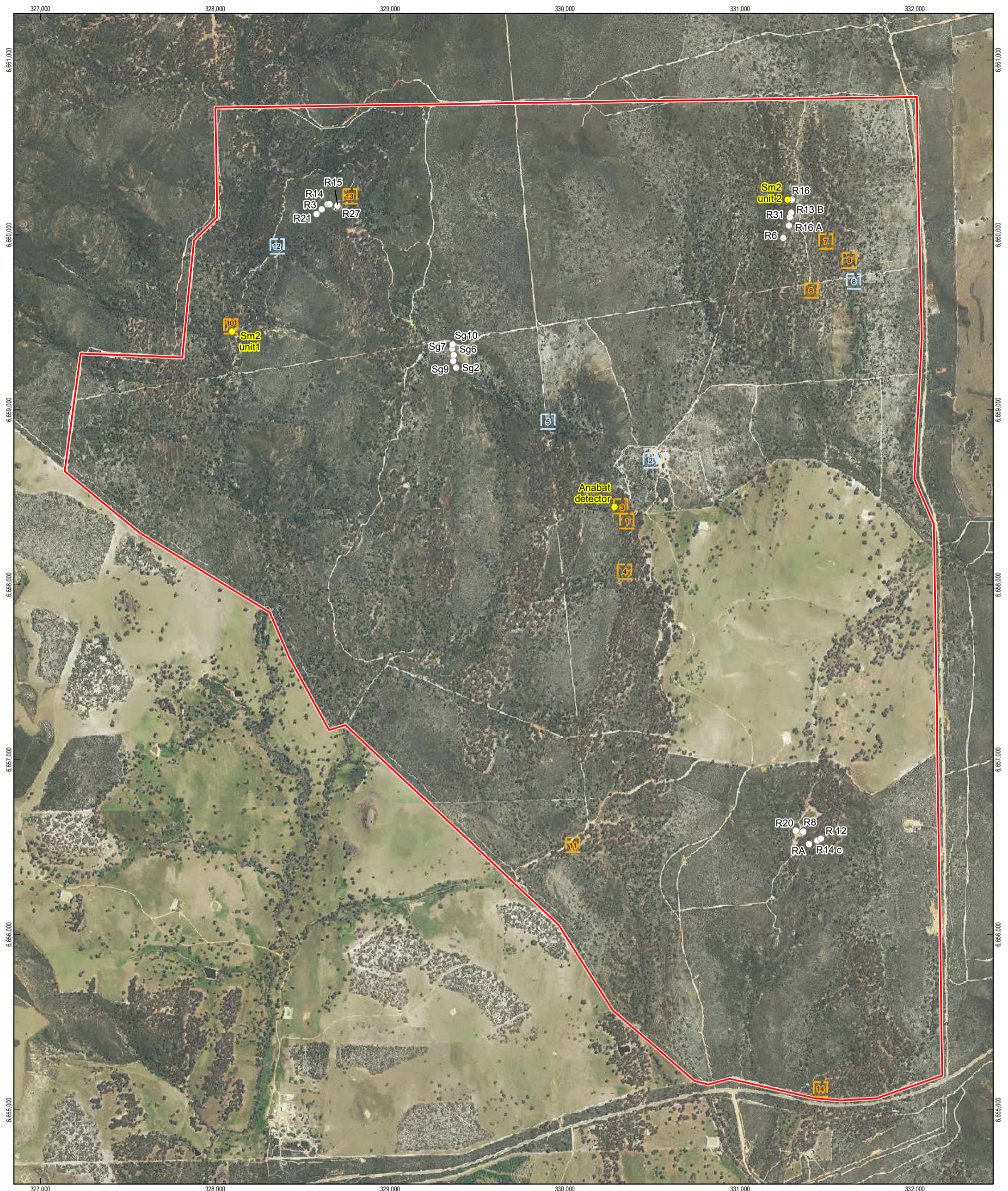


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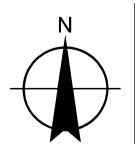
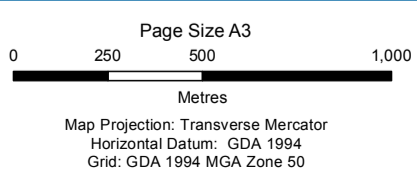
Job Number	61-34834
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Date	12 Sep 2016

Vegetation Condition

Figure 4



- LEGEND**
- Bat detector location
 - Remote camera location
 - Marri tree plot
 - Wandoo tree plot
 - ▭ Survey area

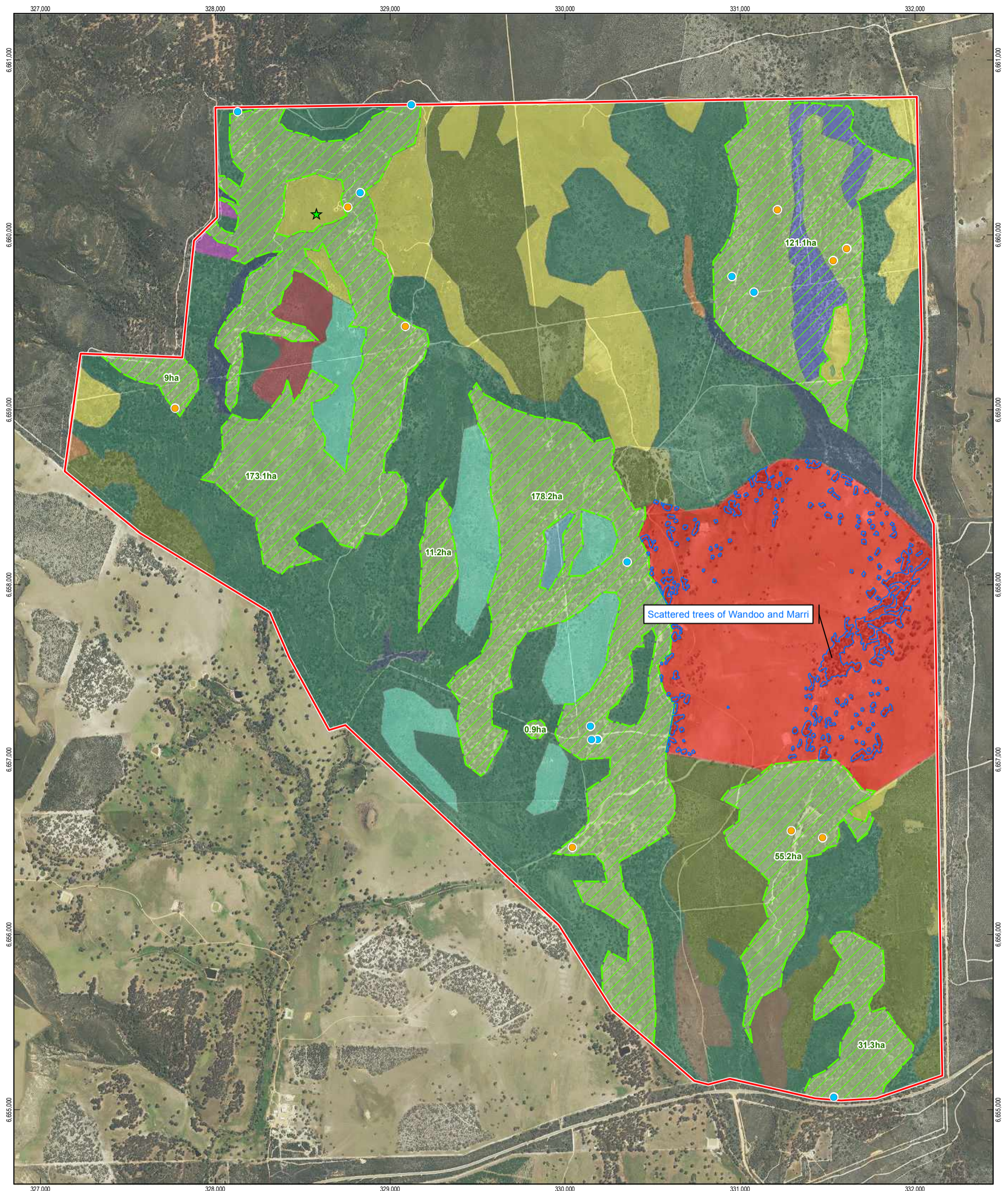


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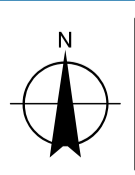
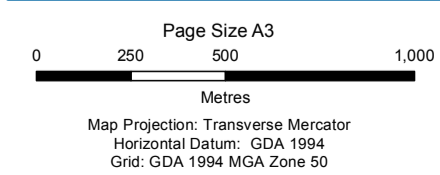
Job Number 61-34834
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Fauna Methods

Figure 5



<ul style="list-style-type: none"> ★ Conservation significant fauna - Brush Wallaby ● Suspected Black Cockatoo breeding tree ● Actual Black Cockatoo breeding tree ▭ Survey area ▨ Black Cockatoo breeding habitat 	<p>Vegetation type</p> <ul style="list-style-type: none"> ▭ VT01 <i>Allocasuarina microstachya</i> heathland ▭ VT02 <i>Petrophile chrysantha</i> heathland ▭ VT03 <i>Melaleuca preissiana</i> open woodland ▭ VT04 <i>Melaleuca platycalyx</i> heathland and <i>Eucalyptus wandoo</i> woodland ▭ VT05 <i>Eucalyptus tottiana</i>, <i>Banksia attenuata</i> and <i>B. menziesii</i> woodland ▭ VT06 <i>Xanthorrhoea</i> and <i>Kingia</i> heathland ▭ VT07 <i>Melaleuca raphiophylla</i> woodland ▭ VT08 <i>Ecdiocollea monostachya</i> herbland ▭ VT09 <i>Corymbia calophylla</i> woodland ▭ VT10 <i>Eucalyptus wandoo</i> woodland ▭ VT11 <i>Banksia attenuata</i> open heathland ▭ VT12 Mixed heath with isolated clumps of mallee ▭ VT13 <i>Melaleuca ?concreta</i> heathland ▭ VT14 Pasture with emergent trees
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Main Roads WA
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Black Cockatoo Habitat

Figure 6

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 999 Hay Street, Perth WA 6000 Australia T 61 8 6222 8555 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au
 © 2016. Whilst every care has been taken to prepare this map, GHD, Landgate and Main Roads WA make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.
 Data source: GHD: Vegetation Types, Cockatoo Breeding Trees, Cockatoo Breeding Habitat - 20160728, Site Boundary - 20160722, Conservation Significant Fauna - 20160824, Landgate, Aerial Imagery - Virtual Mosaic, Created by:afeeney

Appendix B – Relevant legislation, conservation codes and background information

Legislation

Federal *Environment Protection and Biodiversity Conservation Act 1999*

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Federal Government's central piece of environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places, which are defined in the EPBC Act as Matters of National Environmental Significance (MNES).

The biological aspects listed as MNES include:

- Nationally threatened flora and fauna species and ecological communities
- Migratory species

A person must not take an action that has, will have, or is likely to have a significant impact MNES, without approval from the Federal Minister for the Environment.

A person must not undertake an action that has, will have, or is likely to have a significant impact (direct or indirect) on MNES, without approval from the Australian Government Minister for the Environment.

State *Environmental Protection Act 1986*

The *Environmental Protection Act 1986* (EP Act) is the primary legislative Act dealing with the protection of the environment in Western Australia. It provides for an Environmental Protection Authority (EPA), for the prevention, control and abatement of pollution and environmental harm, for the conservation, preservation, protection, enhancement and management of the environment and for matters incidental to or connected with the above.

Clearing of native vegetation in Western Australia requires a permit from the Department of Environment Regulation (DER) (formerly the Department of Environment and Conservation – DEC), unless exemptions apply. Native vegetation includes aquatic and terrestrial vegetation indigenous to Western Australia, and intentionally planted vegetation declared by regulation to be native, but not vegetation planted in a plantation or planted with commercial intent.

In the EP Act Section 51A, clearing is defined as the killing or destruction of; the removal of; the severing or ringbarking of trunks or stems of; or the doing of substantial damage of some or all of the native vegetation in an area, including the flooding of land, the burning of vegetation, the grazing of stock or an act or activity that results in the above.

When making a decision to grant or refuse a permit to clear native vegetation the assessment considers clearing against the ten clearing principles as specified in Schedule 5 of the EP Act:

- a) Native vegetation should not be cleared if it comprises a high level of biodiversity.
- b) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a significance habitat for fauna indigenous to Western Australia.
- c) Native vegetation should not be cleared if it includes, or is necessary, for the continued existence of rare flora.
- d) Native vegetation should not be cleared if it comprises the whole or part of native vegetation in an area that has been extensively cleared.
- 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.
- f) Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.

- g) 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.
- h) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.
- 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.
- j) Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence of flooding.

There are a number of Environmentally Sensitive Areas (ESAs) within Western Australia where exemptions in regulations do not apply. ESAs include locations of threatened communities and species.

State *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*

ESAs are declared by a notice under Section 51B of the EP Act. The Table below outlines the aspects of areas declared as ESA (under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004 – Reg 6*).

Aspects of Environmentally Sensitive Areas

Aspects of Environmentally Sensitive Areas
A declared World Heritage property as defined in Section 13 of the <i>Environment Protection and Biodiversity Conservation Act 1999</i> (EPBC Act).
An area that is registered on the Register of the National Estate (RNE), because of its natural values, under the <i>Australian Heritage Commission Act 1975</i> of the Commonwealth (the RNE was closed in 2007 and is no longer a statutory list – all references to the RNE were removed from the EPBC Act on 19 February 2012).
A defined wetland and the area within 50 m of the wetland.
The area covered by vegetation within 50 m of rare flora, to the extent to which the vegetation is continuous with the vegetation in which the rare flora is located.
The area covered by a TEC.
A Bush Forever Site.
The areas covered by the following policies:
a) The <i>Environmental Protection (Gnangara Mound Crown Land) Policy 1992</i> .
b) The <i>Environmental Protection (Western Swamp Tortoise Habitat) Policy 2002</i> .
The areas covered by the lakes to which the <i>Environmental Protection (Swan Coastal Plain Lakes) Policy 1992</i> (SCPL) (EPP Lakes) applies.
Protected wetlands as defined in the <i>Environmental Protection (South West Agricultural Zone Wetlands) Policy 1998</i> .
Areas of fringing native vegetation in the policy area as defined in the <i>Environmental Protection (Swan and Canning Rivers) Policy 1997</i> .

State Wildlife Conservation Act 1950

The *Wildlife Conservation Act 1950* (WC Act) provides for the conservation and protection of wildlife. It is administered by the Department of Parks and Wildlife (DPaW) (formerly the DEC) and applies to both flora and fauna. Any person wanting to capture, collect, disturb or study fauna requires a permit to do so. A permit is required under the WC Act if removal of threatened species is required.

State Biosecurity and Agriculture Management Act 2007

Under the *Biosecurity and Agriculture Management Act 2007* (BAM Act), a Declared Pest is a prohibited organism or an organism for which a declaration under Section 22(2) is in force. The Department of Agriculture and Food Western Australia (DAFWA) maintains a list of Declared Pests for Western Australia. If a Pest is declared for the whole of the State or for particular Local Government Areas, all landholders are obliged to comply with the specific category of control. Declared plants are gazetted under categories, which define the action required. The category may apply to the whole of the State, districts, individual properties or even paddocks. Categories of control are defined below. Among the factors considered in categorising Declared Pests are:

- The impact of the plant on individuals, agricultural production and the community in general
- Whether it is already established in the area
- The feasibility and cost of possible control measures

The BAM Act replaces the repealed *Agriculture and Related Resources Protection Act 1976* (ARRP Act).

Department of Agriculture and Food (Western Australia) Categories for Declared Pests under the *Biosecurity and Agriculture Management Act 2007*

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

Background information and conservation codes

Reserves and conservation areas

Department of Parks and Wildlife managed lands and waters

DPaW manages lands and waters throughout Western Australia to conserve ecosystems and species, and to provide for recreation and appreciation of the natural environment. DPaW managed lands and waters include national parks, conservation parks and reserves, marine parks and reserves, regional parks, nature reserves, State forest and timber reserves. DPaW managed conservation estate, is vested with the Conservation Commission of Western Australia. Access to, or through, some areas of DPaW managed lands may require a permit or could be restricted due to management activities. Proposed land use changes and development proposals that about DPaW managed lands will generally be referred to DPaW throughout the assessment process.

Ramsar Listed Wetlands

The Convention of Wetlands of International Importance was signed in 1971 at the Iranian town of Ramsar. The Convention has since been referred to as the Ramsar Convention. Ramsar Listed wetlands are “sites containing representative, rare or unique wetlands, or wetlands that are important for conserving biological diversity ... because of their ecological, botanical, zoological, limnological or hydrological importance” (DotEE 2016a). Once a Ramsar Listed Wetland is designated, the country agrees to manage its conservation and ensure its wise use. Under the Convention, wise use is broadly defined as “maintaining the ecological character of a wetland” (DotEE 2016a).

Nationally important wetlands

Wetlands of national significance are listed under the Directory of Important Wetlands in Australia. Nationally important wetlands are wetlands which meet at least one of the following criteria (DotEE 2016b):

- It is a good example of a wetland type occurring within a biogeographic region in Australia
- It is a wetland which plays an important ecological or hydrological role in the natural functioning of a major wetland system/complex
- It is a wetland which is important as the habitat for animal taxa at a vulnerable stage in their life cycles, or provides a refuge when adverse conditions such as drought prevail
- The wetland supports one percent or more of the national populations of any native plant or animal taxa
- The wetland supports native plant or animal taxa or communities which are considered endangered or vulnerable at the national level
- The wetland is of outstanding historical or cultural significance

Vegetation extent and status

The National Objectives and Targets for Biodiversity Conservation 2001–2005 (Commonwealth of Australia 2001) recognise that the retention of 30 percent or more of the pre-clearing extent of each ecological community is necessary if Australia’s biological diversity is to be protected. This is the threshold level below which species loss appears to accelerate exponentially and loss below this level should not be permitted. This level of recognition is in keeping with the targets recommended in the review of the National Strategy for the Conservation of Australia’s Biological Diversity (ANZECC 2000) and in Environmental Protection Authority (EPA) Position Statement No. 2 on environmental protection of native vegetation in Western Australia (EPA 2000).

From a purely biodiversity perspective and taking no account of any other land degradation issues, there are a number of key criteria now being applied to the clearing of native vegetation in Western Australia (EPA 2000).

- The “threshold level” below which species loss appears to accelerate exponentially at an ecosystem level is regarded as being at a level of 30 percent of the pre-European extent of the vegetation type.
- A level of 10 percent of the original extent is regarded as being a level representing Endangered.
- Clearing which would put the threat level into the class below should be avoided.
- From a biodiversity perspective, stream reserves should generally be in the order of at least 200 metres (m) wide.

Vegetation condition

The vegetation condition in the Geraldton Sandplains IBRA Bioregion can be assessed in accordance with the vegetation condition rating scale for the South West and Interzone Botanical Provinces (EPA and DPaW 2015). The scale recognises the intactness of vegetation and consists of six rating levels as outlined below.

Vegetation condition rating scale

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

Conservation codes

Species of significant flora, fauna and communities are protected under both Federal and State Acts. The Federal EPBC Act provides a legal framework to protect and manage nationally important flora and communities. The State WC Act is the primary wildlife conservation legislation in Western Australia. Information on the conservation codes is summarised in the following sections.

Conservation significant communities

Ecological communities are defined as naturally occurring biological assemblages that occur in a particular type of habitat (English and Blyth 1997). Federally listed Threatened Ecological Communities (TECs) are protected under the EPBC Act administered by the Department of the Environment (DotEE) (formerly Department of Sustainability, Environment, Water, Population and Communities – DSEWPaC). The DPaW also maintains a list of TECs for Western Australia; some of which are also protected under the EPBC Act. TECs are ecological communities that have been assessed and assigned to one of four categories related to the status of the threat to the community, i.e. Presumed Totally Destroyed, Critically Endangered, Endangered and Vulnerable.

Possible TEC that do not meet survey criteria are added to the DPaW Priority Ecological Community (PEC) List under Priorities 1, 2 and 3. These are ecological communities that are adequately known; are rare but not threatened, or meet criteria for Near Threatened. PECs that have been recently removed from the threatened list are placed in Priority 4. These ecological communities require regular

monitoring. Conservation dependent ecological communities are placed in Priority 5. PECs are not listed under any formal Federal or State legislation.

Conservation codes and definitions for Threatened Ecological Communities endorsed by the Western Australian Minister for the Environment and listed under the *Environment Protection and Biodiversity Conservation Act 1999*

Western Australia conservation categories		Federal Government Conservation Categories (EPBC Act)	
Presumed Totally Destroyed (PD)	The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future.	Critically Endangered (CR)	If, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future
Critically Endangered (CR)	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated	Endangered (EN)	If, at that time, it is not critically endangered and is facing a very high risk of extinction in the wild in the near future
Endangered (EN)	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future.	Vulnerable (VU)	If, at that time, it is not critically endangered or endangered, and is facing a high risk of extinction in the wild in the medium-term future
Vulnerable (VU)	An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range.		

Conservation categories and definitions for Priority Ecological Communities as listed by the Department of Parks and Wildlife

Category	Description
Priority 1	<p>Poorly known ecological communities.</p> <p>Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤ 5 occurrences or a total area of ≤ 100 ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.</p>
Priority 2	<p>Poorly known ecological communities.</p> <p>Communities that are known from few occurrences with a restricted distribution (generally ≤ 10 occurrences or a total area of ≤ 200 ha). At least some occurrences are not believed to be under immediate threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.</p>
Priority 3	<p>Poorly known ecological communities.</p> <p>(i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or:</p> <p>(ii) communities known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or;</p> <p>(iii) communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes.</p> <p>Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.</p>
Priority 4	<p>Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring.</p> <p>(i) Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands.</p> <p>(ii) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.</p> <p>(iii) Ecological communities that have been removed from the list of threatened communities during the past five years.</p>

Category	Description
Priority 5	<p>Conservation Dependent ecological communities.</p> <p>Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.</p>

Other significant vegetation

Vegetation may be significant for a range of reasons, other than a statutory listing as TEC or because the extent is below a threshold level. The EPA (2004) states that significant vegetation may include vegetation that includes the following:

- Scarcity
- Unusual species
- Novel combinations of species
- A role as a refuge
- A role as a key habitat for Threatened species or large population representing a significant proportion of the local to regional total population of a species
- Being representative of the range of a unit (particularly, a good local and/or regional example of a unit in 'prime' habitat, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range)
- A restricted distribution

This may apply at a number of levels, so the unit may be significant when considered at the fine-scale (intra-locality), intermediate-scale (locality or inter-locality) or broad-scale (local to region).

Conservation significant flora and fauna

Species of significant flora are protected under both Federal and State legislation. Any activities that are deemed to have a significant impact on species that are recognised by the EPBC Act, and/or the WC Act can warrant referral to the DotEE and/or the EPA.

The Federal conservation level of flora and fauna species and their significance status is assessed under the EPBC Act. The significance levels for fauna used in the EPBC Act are those recommended by the International Union for the Conservation of Nature and Natural Resources (IUCN).

Threatened species have been published as Specially Protected under the WC Act 1950, and listed under Schedules 1 to 7 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora. The schedules align with the categories of the EPBC Act. Threatened species are those species which have been adequately searched for and are deemed to be, in the wild, either rare, at risk of extinction, or otherwise in need of special protection, and have been gazetted as such.

Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora or fauna.

Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring.

For the purposes of this assessment, all species listed under the EPBC Act, WC Act and DPaW Priority species are considered conservation significant.

Conservation categories and definitions for *Environment Protection and Biodiversity Conservation Act 1999* listed flora & fauna species

Conservation category	Definition
Extinct	Taxa not definitely located in the wild during the past 50 years
Extinct in the Wild	Taxa known to survive only in captivity
Critically Endangered	Taxa facing an extremely high risk of extinction in the wild in the immediate future
Endangered	Taxa facing a very high risk of extinction in the wild in the near future
Vulnerable	Taxa facing a high risk of extinction in the wild in the medium-term
Near Threatened	Taxa that risk becoming Vulnerable in the wild
Conservation Dependent	Taxa whose survival depends upon ongoing conservation measures. Without these measures, a conservation dependent taxon would be classified as Vulnerable or more severely threatened.
Data Deficient (Insufficiently Known)	Taxa suspected of being Rare, Vulnerable or Endangered, but whose true status cannot be determined without more information.
Least Concern	Taxa that are not considered Threatened

Conservation codes and descriptions for Western Australian flora and fauna

Code	Conservation category	Description
<i>Wildlife Conservation Act 1950</i>		
T	Threatened species	<p>Published as Specially Protected under the <i>Wildlife Conservation Act 1950</i>, and listed under Schedules 1 to 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora (which may also be referred to as Declared Rare Flora).</p> <p>Threatened fauna is that subset of ‘Specially Protected Fauna’ declared to be ‘likely to become extinct’ pursuant to section 14(4) of the Wildlife Conservation Act.</p> <p>Threatened flora is flora that has been declared to be ‘likely to become extinct or is rare, or otherwise in need of special protection’, pursuant to section 23F(2) of the Wildlife Conservation Act.</p> <p>The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below.</p>
CR	Critically endangered species	Threatened species considered to be facing an extremely high risk of extinction in the wild. Published as Specially Protected under the <i>Wildlife Conservation Act 1950</i> , in Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.
EN	Endangered species	Threatened species considered to be facing a very high risk of extinction in the wild. Published as Specially Protected under the <i>Wildlife Conservation Act 1950</i> , in Schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.
VU	Vulnerable species	Threatened species considered to be facing a high risk of extinction in the wild. Published as Specially Protected under the <i>Wildlife Conservation Act 1950</i> , in Schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.
EX	Presumed extinct species	Species which have been adequately searched for and there is no reasonable doubt that the last individual has died. Published as Specially Protected under the <i>Wildlife Conservation Act 1950</i> , in Schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Presumed Extinct Fauna and Wildlife Conservation (Rare Flora) Notice for Presumed Extinct Flora.
IA	Migratory birds protected under an international agreement	Birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and the Bonn Convention, relating to the protection of migratory birds. Published as Specially Protected under the <i>Wildlife Conservation Act 1950</i> , in Schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice.
CD	Conservation dependent fauna	Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened. Published as Specially Protected under the <i>Wildlife Conservation Act 1950</i> , in Schedule 6 of the Wildlife Conservation (Specially Protected Fauna) Notice.
OS	Other specially protected fauna	Fauna otherwise in need of special protection to ensure their conservation. Published as Specially Protected under the <i>Wildlife Conservation Act 1950</i> , in Schedule 7 of the Wildlife Conservation (Specially Protected Fauna) Notice.

Code	Conservation category	Description
DPaW Priority Listed		
1	Priority One: Poorly-known taxa	Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
2	Priority Two: Poorly-known taxa	Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
3	Priority Three: Poorly-known taxa	Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
4	Priority Four: Rare, Near Threatened and other taxa in need of monitoring	<p>(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands.</p> <p>(b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for Vulnerable, but are not listed as Conservation Dependent.</p> <p>(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.</p>

Migratory species listed under the EPBC Act

The EPBC Act also protects land and migratory species that are listed under International Agreements. The list of migratory species established under section 209 of the EPBC Act comprises:

- Migratory species which are native to Australia and are included in the appendices to the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals Appendices I and II)
- Migratory species included in annexes established under the Japan-Australia Migratory Bird Agreement (JAMBA) and the China–Australia Migratory Bird Agreement (CAMBA)

- Native, migratory species identified in a list established under, or an instrument made under, an international agreement approved by the Minister, such as the Republic of Korea–Australia Migratory Bird Agreement (ROKAMBA)

Other significant flora and fauna

Flora species, subspecies, varieties, hybrids and ecotypes may be significant for a range of reasons, other than as Threatened (Declared Rare) Flora or Priority Flora. The EPA (2004) states that significant flora may include taxa that have:

- A keystone role in a particular habitat for threatened species or supporting large populations representing a significant proportion of the local regional population of a species
- Relic status
- Anomalous features that indicate a potential new discovery
- Being representative of the range of a species (particularly, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range)
- The presence of restricted subspecies, varieties, or naturally occurring hybrids
- Local endemism/a restricted distribution
- Being poorly reserved

The application of the degree of significance may apply at a range of scales.

Introduced plants (weeds)

Declared Pests

Information on species considered to be Declared Pests is provided under *State Biosecurity and Agriculture Management Act 2007*.

Weeds of National Significance

The spread of weeds across a range of land uses or ecosystems is important in the context of socio-economic and environmental values. The assessment of Weeds of National Significance (WoNS) is based on four major criteria:

- Invasiveness
- Impacts
- Potential for spread
- Socio-economic and environmental values

Australian state and territory governments have identified thirty two Weeds of National Significance (WoNS); a list of 20 WoNS was endorsed in 1999 and a further 12 were added in 2012 (Australian Government 2014).

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- Western Australian Herbarium 1998–, *FloraBase—the Western Australian Flora*. Department of Parks and Wildlife, retrieved 2015, from <http://florabase.dpaw.wa.gov.au/>.

Appendix C – Desktop searches

EPBC Act PMST Report (20 km buffer)

NatureMap Flora Report (20 km buffer)

NatureMap Fauna Report (20 km buffer)



EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

Report created: 20/07/16 17:07:14

[Summary](#)

[Details](#)

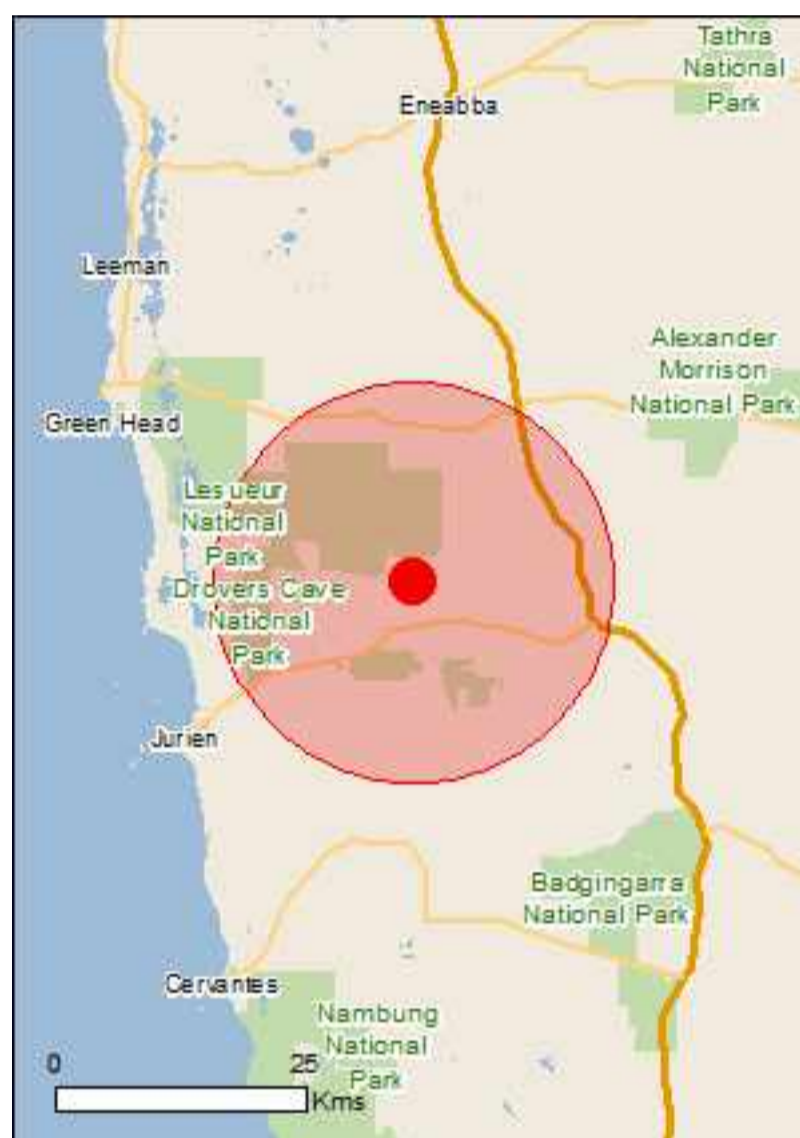
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

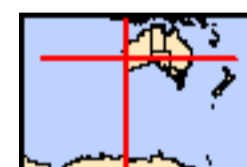
[Acknowledgements](#)



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

[Coordinates](#)

Buffer: 20.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the [Administrative Guidelines on Significance](#).

World Heritage Properties:	None
National Heritage Places:	1
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	30
Listed Migratory Species:	5

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at <http://www.environment.gov.au/heritage>

A [permit](#) may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	10
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	18
Regional Forest Agreements:	None
Invasive Species:	17
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

National Heritage Properties		[Resource Information]
Name	State	Status
Natural		
Lesueur National Park	WA	Listed place

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Calyptorhynchus latirostris Carnaby's Black-Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Breeding likely to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area

Mammals		
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat likely to occur within area

Plants		
Acacia forrestiana Forest's Wattle [17235]	Vulnerable	Species or species habitat known to occur within area
Andersonia gracilis Slender Andersonia [14470]	Endangered	Species or species habitat likely to occur within area
Anigozanthos viridis subsp. terraspectans Dwarf Green Kangaroo Paw [3435]	Vulnerable	Species or species habitat likely to occur within area
Banksia serratuloides subsp. perissa Northern Serrate Dryandra [82767]	Critically Endangered	Species or species habitat may occur within area
Caladenia hoffmanii Hoffman's Spider-orchid [56719]	Endangered	Species or species habitat may occur within area
Caladenia huegelii King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat may occur within area
Drakaea elastica Glossy-leafed Hammer-orchid, Praying Virgin [16753]	Endangered	Species or species habitat may occur within area
Eleocharis keigheryi Keighery's Eleocharis [64893]	Vulnerable	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Eucalyptus absita Badgingarra Box [24260]	Endangered	Species or species habitat likely to occur within area
Eucalyptus balanites Cadda Road Mallee, Cadda Mallee [24264]	Endangered	Species or species habitat likely to occur within area
Eucalyptus crispata Yandanooka Mallee [24268]	Vulnerable	Species or species habitat known to occur within area
Eucalyptus impensa Eneabba Mallee [56711]	Endangered	Species or species habitat known to occur within area
Eucalyptus johnsoniana Johnson's Mallee [14516]	Vulnerable	Species or species habitat likely to occur within area
Eucalyptus lateritica Laterite Mallee [6271]	Vulnerable	Species or species habitat likely to occur within area
Eucalyptus leprophloia Scaly Butt Mallee, Scaly-butt Mallee [56712]	Endangered	Species or species habitat known to occur within area
Eucalyptus pruiniramis Midlands Gum, Jingymia Gum [56403]	Endangered	Species or species habitat likely to occur within area
Eucalyptus rhodantha Rose Mallee [9362]	Vulnerable	Species or species habitat may occur within area
Eucalyptus suberea Cork Mallee, Mount Lesueur Mallee [5529]	Vulnerable	Species or species habitat likely to occur within area
Grevillea batrachioides Mt Lesueur Grevillea [21735]	Endangered	Species or species habitat known to occur within area
Grevillea humifusa Spreading Grevillea [61182]	Endangered	Species or species habitat known to occur within area
Hakea megalosperma Lesueur Hakea [10505]	Vulnerable	Species or species habitat likely to occur within area
Hemiandra gardneri Red Snakebush [7945]	Endangered	Species or species habitat known to occur within area
Leucopogon obtectus Hidden Beard-heath [19614]	Endangered	Species or species habitat known to occur within area
Paracaleana dixonii Sandplain Duck Orchid [86882]	Endangered	Species or species habitat known to occur within area
Tetratheca nephelioides [83217]	Critically Endangered	Species or species habitat known to occur within area
Thelymitra stellata Star Sun-orchid [7060]	Endangered	Species or species habitat known to occur within area

Reptiles

Name	Status	Type of Presence
Egernia stokesii badia Western Spiny-tailed Skink, Baudin Island Spiny-tailed Skink [64483]	Endangered	Species or species habitat likely to occur within area

Listed Migratory Species [\[Resource Information \]](#)

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
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Migratory Marine Birds

Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
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Sterna dougallii Roseate Tern [817]		Foraging, feeding or related behaviour likely to occur within area
--	--	--

Migratory Terrestrial Species

Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
---	--	--

Migratory Wetlands Species

Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area
---	--	--

Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area
---	--	--

Other Matters Protected by the EPBC Act

Commonwealth Land [\[Resource Information \]](#)

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -

Listed Marine Species [\[Resource Information \]](#)

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
------	------------	------------------

Birds

Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
---	--	--

Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
--	--	---

Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
--	--	--

Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
---	--	--

Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
---	--	--

Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within
---	--	---

Name	Threatened	Type of Presence area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area
Sterna dougallii Roseate Tern [817]		Foraging, feeding or related behaviour likely to occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Beekeepers	WA
Coomallo	WA
Drovers Cave	WA
Hill River	WA
Lesueur	WA
South Eneabba	WA
Southern Beekeepers	WA
Unnamed WA26125	WA
Unnamed WA29901	WA
Unnamed WA33287	WA
Unnamed WA35593	WA
Unnamed WA35594	WA
Unnamed WA42481	WA
Unnamed WA43786	WA
Unnamed WA46713	WA
Unnamed WA48717	WA
Unnamed WA51272	WA
Victoria Location 3860	WA

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resources Audit, 2001.

Name	Status	Type of Presence
Birds		
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area

Mammals

Name	Status	Type of Presence
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Brachiaria mutica Para Grass [5879]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-30.19194 115.23639

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [-Office of Environment and Heritage, New South Wales](#)
- [-Department of Environment and Primary Industries, Victoria](#)
- [-Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [-Department of Environment, Water and Natural Resources, South Australia](#)
- [-Parks and Wildlife Commission NT, Northern Territory Government](#)
- [-Department of Environmental and Heritage Protection, Queensland](#)
- [-Department of Parks and Wildlife, Western Australia](#)
- [-Environment and Planning Directorate, ACT](#)
- [-Birdlife Australia](#)
- [-Australian Bird and Bat Banding Scheme](#)
- [-Australian National Wildlife Collection](#)
- Natural history museums of Australia
- [-Museum Victoria](#)
- [-Australian Museum](#)
- [-South Australian Museum](#)
- [-Queensland Museum](#)
- [-Online Zoological Collections of Australian Museums](#)
- [-Queensland Herbarium](#)
- [-National Herbarium of NSW](#)
- [-Royal Botanic Gardens and National Herbarium of Victoria](#)
- [-Tasmanian Herbarium](#)
- [-State Herbarium of South Australia](#)
- [-Northern Territory Herbarium](#)
- [-Western Australian Herbarium](#)
- [-Australian National Herbarium, Atherton and Canberra](#)
- [-University of New England](#)
- [-Ocean Biogeographic Information System](#)
- [-Australian Government, Department of Defence Forestry Corporation, NSW](#)
- [-Geoscience Australia](#)
- [-CSIRO](#)
- Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the [Contact Us](#) page.

Hill River Flora NatureMap Species Report

Created By Guest user on 20/07/2016

Kingdom Plantae
Current Names Only Yes
Core Datasets Only Yes
Species Group Vascular Plants
Method 'By Circle'
Centre 115° 14' 11" E, 30° 11' 31" S
Buffer 20km
Group By Family

Family	Species	Records
Amaranthaceae	7	27
Anacardiaceae	1	1
Anarthriaceae	8	51
Apiaceae	15	127
Apodanthaceae	1	1
Araliaceae	4	23
Asparagaceae	39	185
Asphodelaceae	2	3
Asteraceae	77	252
Boraginaceae	1	1
Boryaceae	3	8
Brassicaceae	2	3
Byblidaceae	2	8
Campanulaceae	12	43
Caryophyllaceae	6	10
Casuarinaceae	8	51
Celastraceae	5	43
Centrolepidaceae	9	20
Chenopodiaceae	7	8
Colchicaceae	6	26
Convolvulaceae	2	7
Crassulaceae	6	10
Cucurbitaceae	1	2
Cupressaceae	3	56
Cyperaceae	69	241
Dasygongonaceae	7	53
Dennstaedtiaceae	1	1
Dilleniaceae	23	229
Dioscoreaceae	1	6
Droseraceae	31	151
Ecdiocoleaceae	2	46
Elaeocarpaceae	8	45
Emblingiaceae	1	1
Ericaceae	70	600
Euphorbiaceae	11	55
Fabaceae	167	1297
Gentianaceae	2	5
Geraniaceae	6	9
Goodeniaceae	48	351
Gyrostemonaceae	7	28
Haemodoraceae	51	421
Haloragaceae	6	13
Hemerocallidaceae	14	85
Hypoxidaceae	3	10
Iridaceae	9	26
Juncaceae	6	16
Juncaginaceae	6	8
Lamiaceae	25	162
Lauraceae	10	43
Lentibulariaceae	2	4
Loganiaceae	4	47
Loranthaceae	3	6
Malvaceae	26	163
Menyanthaceae	1	1
Molluginaceae	2	8
Myrtaceae	228	2202
Olacaceae	2	31
Onagraceae	3	3
Orchidaceae	52	122
Orobanchaceae	3	6
Oxalidaceae	3	5
Papaveraceae	1	1
Philydraceae	2	4
Phyllanthaceae	2	11
Pittosporaceae	6	27
Poaceae	51	108
Polygalaceae	10	58
Polygonaceae	3	12
Portulacaceae	7	18
Primulaceae	3	11
Proteaceae	185	1862
Pteridaceae	3	8
Ranunculaceae	2	2
Restionaceae	31	236

Rhamnaceae	22	147
Rubiaceae	2	9
Rutaceae	22	194
Santalaceae	4	19
Sapindaceae	7	28
Scrophulariaceae	5	10
Selaginellaceae	1	3
Solanaceae	8	29
Stylidiaceae	53	352
Surianaceae	1	9
Thymelaeaceae	11	79
Typhaceae	1	1
Urticaceae	1	2
Violaceae	4	30
Vitaceae	1	3
Xanthorrhoeaceae	4	23
Zamiaceae	2	10
TOTAL	1595	10772

Name ID	Species Name	Naturalised	Conservation Code	Endemic To Query Area
Amaranthaceae				
1.	44602 <i>Ptilotus clivicola</i>		P2	
2.	2718 <i>Ptilotus drummondii</i> (Narrowleaf Mulla Mulla)			
3.	2733 <i>Ptilotus humilis</i>			
4.	2742 <i>Ptilotus manglesii</i> (Pom Poms, Mulamula)			
5.	2751 <i>Ptilotus polystachyus</i> (Prince of Wales Feather)			
6.	<i>Ptilotus</i> sp.			
7.	40841 <i>Ptilotus stirlingii</i> subsp. <i>stirlingii</i>			
Anacardiaceae				
8.	17056 <i>Schinus molle</i> var. <i>areira</i>	Y		
Anarthriaceae				
9.	1058 <i>Anarthria gracilis</i>			
10.	1059 <i>Anarthria humilis</i>			
11.	1060 <i>Anarthria laevis</i>			
12.	<i>Anarthria</i> sp.			
13.	1097 <i>Lyginia barbata</i>			
14.	19245 <i>Lyginia excelsa</i>		P1	
15.	18049 <i>Lyginia imberbis</i>			
16.	<i>Lyginia</i> sp.			
Apiaceae				
17.	6205 <i>Actinotus leucocephalus</i> (Flannel Flower)			
18.	6214 <i>Centella asiatica</i>			
19.	6218 <i>Daucus glochidiatus</i> (Australian Carrot)			
20.	6219 <i>Eryngium pinnatifidum</i> (Blue Devils)			
21.	15446 <i>Eryngium pinnatifidum</i> subsp. <i>pinnatifidum</i>			
22.	<i>Eryngium</i> sp.			
23.	6222 <i>Homalosciadium homalocarpum</i>			
24.	6255 <i>Platysace juncea</i>			
25.	11132 <i>Platysace ramosissima</i>		P3	
26.	6262 <i>Platysace xerophila</i>			
27.	6285 <i>Xanthosia ciliata</i>			
28.	6287 <i>Xanthosia fruticulosa</i>			
29.	6289 <i>Xanthosia huegelii</i>			
30.	<i>Xanthosia</i> sp.			
31.	6294 <i>Xanthosia tomentosa</i> (Lesueur Southern Cross)		P4	
Apodanthaceae				
32.	2408 <i>Pilostyles hamiltonii</i>			
Araliaceae				
33.	6223 <i>Hydrocotyle alata</i>			
34.	6226 <i>Hydrocotyle callicarpa</i> (Small Pennywort)			
35.	6268 <i>Trachymene cyanopetala</i>			
36.	6280 <i>Trachymene pilosa</i> (Native Parsnip)			
Asparagaceae				
37.	1205 <i>Acanthocarpus canaliculatus</i>			
38.	1208 <i>Acanthocarpus preissii</i>			
39.	1209 <i>Acanthocarpus robustus</i>			
40.	20797 <i>Acanthocarpus</i> sp. <i>Ajana</i> (C.A. Gardner 8596)			
41.	<i>Arthropodium</i> sp.			
42.	8779 <i>Asparagus asparagoides</i> (Bridal Creeper)	Y		
43.	1280 <i>Chamaescilla corymbosa</i> (Blue Squill)			
44.	11299 <i>Chamaescilla corymbosa</i> var. <i>corymbosa</i>			
45.	8788 <i>Chamaescilla versicolor</i>			
46.	1287 <i>Dichopogon capillipes</i>			
47.	1289 <i>Dichopogon preissii</i>			
48.	1305 <i>Laxmannia omnifertilis</i>			
49.	11911 <i>Laxmannia ramosa</i> subsp. <i>ramosa</i>			
50.	11464 <i>Laxmannia sessiliflora</i> subsp. <i>australis</i>			
51.	11679 <i>Laxmannia sessiliflora</i> subsp. <i>drummondii</i>			
52.	11732 <i>Laxmannia sessiliflora</i> subsp. <i>sessiliflora</i>			
53.	<i>Laxmannia</i> sp.			
54.	1223 <i>Lomandra caespitosa</i> (Tufted Mat Rush)			
55.	1227 <i>Lomandra hastilis</i>			
56.	14542 <i>Lomandra micrantha</i> subsp. <i>micrantha</i>			
57.	1239 <i>Lomandra preissii</i>			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
58.	1243 <i>Lomandra sericea</i> (Silky Mat Rush)			
59.	1246 <i>Lomandra suaveolens</i>			
60.	1312 <i>Sowerbaea laxiflora</i> (Purple Tassels)			
61.	1317 <i>Thysanotus anceps</i>		P3	
62.	1318 <i>Thysanotus arbuscula</i>			
63.	1319 <i>Thysanotus arenarius</i>			
64.	1320 <i>Thysanotus asper</i> (Hairy Fringe Lily)			
65.	1334 <i>Thysanotus glaucus</i>		P4	
66.	1338 <i>Thysanotus manglesianus</i> (Fringed Lily)			
67.	1343 <i>Thysanotus patersonii</i>			
68.	<i>Thysanotus</i> sp.			
69.	13783 <i>Thysanotus</i> sp. Badgingarra (E.A. Griffin 2511)		P2	
70.	29456 <i>Thysanotus</i> sp. Twining Wheatbelt (N.H. Brittan 81/29)			
71.	1351 <i>Thysanotus sparteus</i>			
72.	1356 <i>Thysanotus teretifolius</i>			
73.	1357 <i>Thysanotus thyrsoides</i>			
74.	1358 <i>Thysanotus triandrus</i>			
75.	1359 <i>Thysanotus vernalis</i>		P3	

Asphodelaceae

76.	1366 <i>Bulbine semibarbata</i> (Leek Lily)			
77.	1368 <i>Trachyandra divaricata</i>	Y		

Asteraceae

78.	7832 <i>Angianthus milnei</i> (Cone-spike Angianthus)			
79.	7833 <i>Angianthus preissianus</i>			
80.	7838 <i>Arctotheca calendula</i> (Cape Weed)	Y		
81.	7840 <i>Arctotis stoechadifolia</i> (White Arctotis)	Y		
82.	7851 <i>Asteridea pulverulenta</i> (Common Bristle Daisy)			
83.	7856 <i>Blennospora drummondii</i>			
84.	7867 <i>Brachyscome bellidioides</i>			
85.	7875 <i>Brachyscome glandulosa</i>			
86.	7878 <i>Brachyscome iberidifolia</i>			
87.	7883 <i>Brachyscome pusilla</i>			
88.	<i>Brachyscome</i> sp.			
89.	7916 <i>Centaurea melitensis</i> (Maltese Cockspur)	Y		
90.	12612 <i>Chrysocephalum apiculatum</i>			
91.	7941 <i>Conyza parva</i>	Y		
92.	20074 <i>Conyza sumatrensis</i>	Y		
93.	7943 <i>Cotula australis</i> (Common Cotula)			
94.	7944 <i>Cotula bipinnata</i> (Ferny Cotula)	Y		
95.	7945 <i>Cotula coronopifolia</i> (Waterbuttons)	Y		
96.	7946 <i>Cotula cotuloides</i> (Smooth Cotula)			
97.	13354 <i>Craspedia variabilis</i>			
98.	12740 <i>Erymophyllum tenellum</i>			
99.	15137 <i>Euchiton sphaericus</i>			
100.	16311 <i>Gazania linearis</i>	Y		
101.	7991 <i>Gnephosis drummondii</i>			
102.	8002 <i>Gnephosis tenuissima</i>			
103.	12741 <i>Hyalosperma cotula</i>			
104.	8086 <i>Hypochoeris glabra</i> (Smooth Catsear)	Y		
105.	8087 <i>Isoetopsis graminifolia</i> (Cushion Grass)			
106.	18585 <i>Lagenophora huegelii</i>			
107.	17852 <i>Leptorhynchus scaber</i> (Lanky Buttons)			
108.	8105 <i>Millotia myosotidifolia</i>			
109.	14344 <i>Millotia tenuifolia</i> var. <i>tenuifolia</i> (Soft Millotia)			
110.	29418 <i>Monoculus monstrosus</i>	Y		
111.	8114 <i>Myriocephalus appendiculatus</i> (White-tip Myriocephalus)			
112.	14187 <i>Myriocephalus occidentalis</i>			
113.	8136 <i>Olearia homolepis</i>			
114.	32716 <i>Olearia lehmanniana</i>			
115.	8143 <i>Olearia paucidentata</i> (Autumn Scrub Daisy)			
116.	8149 <i>Olearia rudis</i> (Rough Daisybush)			
117.	42024 <i>Olearia</i> sp. Kennedy Range (G. Byrne 66)			
118.	18353 <i>Pithocarpa pulchella</i> var. <i>pulchella</i>			
119.	<i>Pithocarpa</i> sp.			
120.	45237 <i>Podolepis aristata</i> subsp. <i>aristata</i>			
121.	8173 <i>Podolepis capillaris</i> (Wiry Podolepis)			
122.	8175 <i>Podolepis gracilis</i> (Slender Podolepis)			
123.	8177 <i>Podolepis lessonii</i>			
124.	8182 <i>Podotrochea angustifolia</i> (Sticky Longheads)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
125.	8183 <i>Podotheca chrysantha</i> (Yellow Podotheca)			
126.	8184 <i>Podotheca gnaphalioides</i> (Golden Long-heads)			
127.	8188 <i>Pogonolepis stricta</i>			
128.	13255 <i>Pterochaeta paniculata</i>			
129.	8195 <i>Quinetia urvillei</i>			
130.	15035 <i>Rhodanthe corymbosa</i>			
131.	13234 <i>Rhodanthe manglesii</i>			
132.	20663 <i>Senecio multicaulis</i> subsp. <i>multicaulis</i>			
133.	20161 <i>Senecio pinnatifolius</i>			
134.	25884 <i>Senecio pinnatifolius</i> var. <i>latilobus</i>			
135.	<i>Senecio</i> sp.			
136.	8224 <i>Siloxerus filifolius</i>			
137.	8225 <i>Siloxerus humifusus</i> (<i>Procumbent Siloxerus</i>)			
138.	14583 <i>Siloxerus multiflorus</i>			
139.	8230 <i>Sonchus asper</i> (<i>Rough Sowthistle</i>)	Y		
140.	9367 <i>Sonchus hydrophilus</i> (<i>Native Sowthistle</i>)			
141.	8231 <i>Sonchus oleraceus</i> (<i>Common Sowthistle</i>)	Y		
142.	8251 <i>Trichocline spathulata</i> (<i>Native Gerbera</i>)			
143.	8254 <i>Urospermum picroides</i> (<i>False Hawkbit</i>)	Y		
144.	8255 <i>Ursinia anthemoides</i> (<i>Ursinia</i>)	Y		
145.	38388 <i>Ursinia anthemoides</i> subsp. <i>anthemoides</i>	Y		
146.	8257 <i>Vellereophyton dealbatum</i> (<i>White Cudweed</i>)	Y		
147.	8275 <i>Waitzia acuminata</i> (<i>Orange Immortelle</i>)			
148.	13330 <i>Waitzia acuminata</i> var. <i>albicans</i>			
149.	13328 <i>Waitzia nitida</i>			
150.	8281 <i>Waitzia podolepis</i>			
151.	13333 <i>Waitzia suaveolens</i> var. <i>suaveolens</i>			
152.	19938 <i>Xerochrysum bracteatum</i>			
153.	44861 <i>Xerochrysum macranthum</i>			
154.	<i>Xerochrysum</i> sp.			
Boraginaceae				
155.	6707 <i>Heliotropium curassavicum</i> (<i>Smooth Heliotrope</i>)			
Boryaceae				
156.	1269 <i>Borya laciniata</i>			
157.	1272 <i>Borya scirpoidea</i>			
158.	1273 <i>Borya sphaerocephala</i> (<i>Pincushions</i>)			
Brassicaceae				
159.	3000 <i>Brassica tournefortii</i> (<i>Mediterranean Turnip</i>)	Y		
160.	3042 <i>Lepidium pseudotasmanicum</i>		P4	
Byblidaceae				
161.	3178 <i>Byblis gigantea</i> (<i>Rainbow Plant</i>)		P3	
162.	20230 <i>Byblis lamellata</i>			
Campanulaceae				
163.	7396 <i>Isotoma hypocraeteriformis</i> (<i>Woodbridge Poison</i>)			
164.	7398 <i>Isotoma pusilla</i> (<i>Small Isotome</i>)			
165.	7399 <i>Isotoma scapigera</i> (<i>Long-scaped Isotome</i>)			
166.	9289 <i>Lobelia anceps</i> (<i>Angled Lobelia</i>)			
167.	7403 <i>Lobelia heterophylla</i> (<i>Wing-seeded Lobelia</i>)			
168.	36863 <i>Lobelia heterophylla</i> subsp. <i>heterophylla</i>			
169.	7405 <i>Lobelia rarifolia</i>			
170.	7407 <i>Lobelia rhytidosperra</i> (<i>Wrinkled-seeded Lobelia</i>)			
171.	7410 <i>Monopsis debilis</i>	Y		
172.	37440 <i>Monopsis debilis</i> var. <i>depressa</i>	Y		
173.	7384 <i>Wahlenbergia capensis</i> (<i>Cape Bluebell</i>)	Y		
174.	7389 <i>Wahlenbergia preissii</i>			
Caryophyllaceae				
175.	13489 <i>Cerastium pumilum</i>	Y		
176.	19825 <i>Petrorhagia dubia</i>	Y		
177.	2905 <i>Polycarpon tetraphyllum</i> (<i>Fourleaf Allseed</i>)	Y		
178.	2909 <i>Silene gallica</i> (<i>French Catchfly</i>)	Y		
179.	2914 <i>Spergularia diandra</i> (<i>Lesser Sand Spurry</i>)	Y		
180.	2918 <i>Stellaria media</i> (<i>Chickweed</i>)	Y		
Casuarinaceae				
181.	1721 <i>Allocasuarina campestris</i>			
182.	1729 <i>Allocasuarina grevilleoides</i>		P3	
183.	1732 <i>Allocasuarina humilis</i> (<i>Dwarf Sheoak</i>)			
184.	13908 <i>Allocasuarina lehmanniana</i> subsp. <i>lehmanniana</i>			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
185.	1734 <i>Allocasuarina microstachya</i>			
186.	1736 <i>Allocasuarina ramosissima</i>		P3	
187.	1739 <i>Allocasuarina thuyoides</i> (Horned Sheoak)			
188.	1742 <i>Casuarina obesa</i> (Swamp Sheoak, Kuli)			
Celastraceae				
189.	4733 <i>Stackhousia monogyna</i>			
190.	9070 <i>Stackhousia pubescens</i> (Downy Stackhousia)			
191.	<i>Stackhousia</i> sp.			
192.	43540 <i>Stackhousia</i> sp. Red-blotched corolla (A. Markey 911)		P3	
193.	4737 <i>Tripterococcus brunonis</i> (Winged Stackhousia)			
Centrolepidaceae				
194.	1116 <i>Aphelia brizula</i>			
195.	<i>Aphelia</i> sp.			
196.	43548 <i>Aphelia</i> sp. Albany (B.G. Briggs 596)			
197.	1120 <i>Centrolepis alepyroides</i>			
198.	1121 <i>Centrolepis aristata</i> (Pointed Centrolepis)			
199.	1125 <i>Centrolepis drummondiana</i>			
200.	45093 <i>Centrolepis milleri</i>		P3	
201.	1133 <i>Centrolepis pilosa</i>			
202.	1134 <i>Centrolepis polygyna</i> (Wiry Centrolepis)			
Chenopodiaceae				
203.	2452 <i>Atriplex cinerea</i> (Grey Saltbush)			
204.	2490 <i>Chenopodium glaucum</i> (Glaucous Goosefoot)	Y		
205.	11254 <i>Rhagodia preissii</i> subsp. <i>preissii</i>			
206.	2591 <i>Sarcocornia blackiana</i>			
207.	2593 <i>Sarcocornia quinqueflora</i> (Beaded Samphire)			
208.	2639 <i>Suaeda australis</i> (Seablite)			
209.	33319 <i>Tecticornia indica</i> subsp. <i>bidens</i>			
Colchicaceae				
210.	1383 <i>Burchardia bairdiae</i>			
211.	12770 <i>Burchardia congesta</i>			
212.	1385 <i>Burchardia multiflora</i> (Dwarf Burchardia)			
213.	12072 <i>Wurmbea dioica</i> subsp. <i>alba</i>			
214.	1398 <i>Wurmbea monantha</i>			
215.	1401 <i>Wurmbea pygmaea</i>			
Convolvulaceae				
216.	6614 <i>Convolvulus remotus</i>			
217.	6630 <i>Ipomoea indica</i> (Morning Glory)	Y		
Crassulaceae				
218.	3136 <i>Crassula alata</i>	Y		
219.	17701 <i>Crassula closiana</i>			
220.	11709 <i>Crassula colorata</i> var. <i>acuminata</i>			
221.	11563 <i>Crassula colorata</i> var. <i>colorata</i>			
222.	11349 <i>Crassula decumbens</i> var. <i>decumbens</i>			
223.	15706 <i>Crassula natans</i> var. <i>minus</i>	Y		
Cucurbitaceae				
224.	7370 <i>Citrullus lanatus</i> (Pie Melon)	Y		
Cupressaceae				
225.	36520 <i>Callitris acuminata</i> (Dwarf Cypress)			
226.	36560 <i>Callitris arenaria</i> (Sandplain Cypress)			
227.	36600 <i>Callitris pyramidalis</i> (Swamp Cypress)			
Cyperaceae				
228.	741 <i>Baumea articulata</i> (Jointed Rush)			
229.	743 <i>Baumea juncea</i> (Bare Twigrush)			
230.	749 <i>Bolboschoenus caldwelii</i> (Marsh Club-rush)			
231.	760 <i>Caustis dioica</i>			
232.	13765 <i>Caustis gigas</i> (Giant Twigrush)		P2	
233.	763 <i>Chorizandra enodis</i> (Black Bristlerush)			
234.	768 <i>Cyathochaeta avenacea</i>			
235.	<i>Cyathochaeta</i> sp.			
236.	794 <i>Cyperus gymnocaulos</i> (Spiny Flat-sedge)			
237.	806 <i>Cyperus polystachyos</i> (Bunchy Sedge)	Y		
238.	816 <i>Cyperus tenuiflorus</i> (Scaly Sedge)	Y		
239.	822 <i>Eleocharis acuta</i> (Common Spikerush)			
240.	17605 <i>Eleocharis keigheryi</i>		T	
241.	20216 <i>Ficinia nodosa</i> (Knotted Club Rush)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
242.	901 <i>Gahnia australis</i>			
243.	907 <i>Gahnia trifida</i> (Coast Saw-sedge)			
244.	910 <i>Isolepis cernua</i> (Nodding Club-rush)			
245.	20200 <i>Isolepis cernua</i> var. <i>setiformis</i>			
246.	911 <i>Isolepis congrua</i>			
247.	912 <i>Isolepis cyperoides</i>			
248.	<i>Isolepis levynsiana</i>			
249.	917 <i>Isolepis marginata</i> (Coarse Club-rush)			
250.	<i>Isolepis multicaulis</i>			
251.	<i>Isolepis</i> sp.			
252.	925 <i>Lepidosperma angustatum</i>			
253.	42741 <i>Lepidosperma apricola</i>			
254.	41620 <i>Lepidosperma asperatum</i>			
255.	929 <i>Lepidosperma carphoides</i> (Black Rapier Sedge)			
256.	937 <i>Lepidosperma longitudinale</i> (Pithy Sword-sedge)			
257.	940 <i>Lepidosperma pubisquamium</i>			
258.	41647 <i>Lepidosperma sanguinolentum</i>			
259.	944 <i>Lepidosperma scabrum</i>			
260.	<i>Lepidosperma</i> sp.			
261.	945 <i>Lepidosperma squamatum</i>			
262.	946 <i>Lepidosperma striatum</i>			
263.	947 <i>Lepidosperma tenue</i>			
264.	949 <i>Lepidosperma tuberculatum</i>			
265.	951 <i>Lepidosperma viscidum</i> (Sticky Sword Sedge)			
266.	953 <i>Mesomelaena graciliceps</i>			
267.	954 <i>Mesomelaena preissii</i>			
268.	955 <i>Mesomelaena pseudostygia</i>			
269.	957 <i>Mesomelaena tetragona</i> (Semaphore Sedge)			
270.	<i>Schoenoplectus tabernaemontani</i>			
271.	972 <i>Schoenus armeria</i>			
272.	978 <i>Schoenus brevisetis</i>			
273.	979 <i>Schoenus caespititius</i>			
274.	982 <i>Schoenus clandestinus</i>			
275.	984 <i>Schoenus curvifolius</i>			
276.	992 <i>Schoenus grandiflorus</i> (Large Flowered Bogrush)			
277.	17617 <i>Schoenus insolitus</i>			
278.	1000 <i>Schoenus minutulus</i>			
279.	1002 <i>Schoenus nanus</i> (Tiny Bog Rush)			
280.	1005 <i>Schoenus obtusifolius</i>			
281.	1006 <i>Schoenus odontocarpus</i>			
282.	1007 <i>Schoenus pedicellatus</i>			
283.	1009 <i>Schoenus pleiostemoneus</i>			
284.	17614 <i>Schoenus plumosus</i>			
285.	1011 <i>Schoenus rigens</i>			
286.	1013 <i>Schoenus sculptus</i> (Gimlet Bog-rush)			
287.	<i>Schoenus</i> sp.			
288.	16274 <i>Schoenus</i> sp. A3 Ciliate Sheaths (K.R. Newbey 9402)			
289.	18164 <i>Schoenus</i> sp. smooth culms (K.R. Newbey 7823)			
290.	1018 <i>Schoenus subfascicularis</i>			
291.	1019 <i>Schoenus subflavus</i> (Yellow Bog-rush)			
292.	1023 <i>Schoenus tenellus</i>			
293.	1026 <i>Schoenus unispiculatus</i>			
294.	1036 <i>Tetraria octandra</i>			
295.	35579 <i>Tetraria</i> sp. Jarrah Forest (R. Davis 7391)			
296.	43400 <i>Tricostularia</i> sp. Ongerup (L. Strahan 409)			
Dasypogonaceae				
297.	19304 <i>Calectasia browneana</i>		P2	
298.	1213 <i>Calectasia cyanea</i> (Blue Tinsel Lily)		T	
299.	19312 <i>Calectasia hispida</i>			
300.	19309 <i>Calectasia narragara</i>			
301.	1218 <i>Dasypogon bromeliifolius</i> (Pineapple Bush)			
302.	1220 <i>Dasypogon obliquifolius</i>			
303.	1221 <i>Kingia australis</i> (Kingia, Pulonok)			
Dennstaedtiaceae				
304.	41651 <i>Pteridium esculentum</i> subsp. <i>esculentum</i>			
Dilleniaceae				
305.	5108 <i>Hibbertia acerosa</i> (Needle Leaved Guinea Flower)			
306.	5112 <i>Hibbertia aurea</i>			
307.	5116 <i>Hibbertia crassifolia</i>			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
308.	5120 <i>Hibbertia desmophylla</i>			
309.	5130 <i>Hibbertia glomerosa</i> (Guinea-flower)			
310.	5133 <i>Hibbertia helianthemoides</i>		P4	
311.	20046 <i>Hibbertia hibbertioides</i> var. <i>hibbertioides</i>			
312.	5134 <i>Hibbertia huegelii</i>			
313.	5135 <i>Hibbertia hypericoides</i> (Yellow Buttercups)			
314.	45534 <i>Hibbertia hypericoides</i> subsp. <i>hypericoides</i>			
315.	45533 <i>Hibbertia hypericoides</i> subsp. <i>septentrionalis</i>			
316.	35520 <i>Hibbertia leucocrossa</i>			
317.	5148 <i>Hibbertia mylnei</i>			
318.	5153 <i>Hibbertia pachyrrhiza</i>			
319.	5157 <i>Hibbertia polystachya</i>			
320.	35518 <i>Hibbertia propinqua</i>		P4	
321.	5162 <i>Hibbertia racemosa</i> (Stalked Guinea Flower)			
322.	44609 <i>Hibbertia robur</i>			
323.	<i>Hibbertia</i> sp.			
324.	<i>Hibbertia</i> sp. Bankstown (R.T.Miller & C.P.Gibson s.n. 18/10/06)			
325.	5171 <i>Hibbertia spicata</i>			
326.	11481 <i>Hibbertia spicata</i> subsp. <i>spicata</i>			
327.	5173 <i>Hibbertia subvaginata</i>			

Dioscoreaceae

328. 1509 *Dioscorea hastifolia* (Warrine, Warram)

Droseraceae

329.	31231 <i>Drosera allantostigma</i>		P1	
330.	3090 <i>Drosera barbiger</i>			
331.	13219 <i>Drosera bulbosa</i> subsp. <i>bulbosa</i>			
332.	13202 <i>Drosera echinoblastus</i>			
333.	13201 <i>Drosera eneabba</i>			
334.	3095 <i>Drosera erythrorhiza</i> (Red Ink Sundew)			
335.	13217 <i>Drosera erythrorhiza</i> subsp. <i>erythrorhiza</i>			
336.	13212 <i>Drosera erythrorhiza</i> subsp. <i>magna</i>			
337.	3097 <i>Drosera gigantea</i> (Giant Sundew)			
338.	15453 <i>Drosera gigantea</i> subsp. <i>gigantea</i>			
339.	3098 <i>Drosera glanduligera</i> (Pimpernel Sundew)			
340.	3101 <i>Drosera heterophylla</i> (Swamp Rainbow)			
341.	8910 <i>Drosera humilis</i>			
342.	3105 <i>Drosera leucoblata</i> (Wheel Sundew)			
343.	14298 <i>Drosera macrantha</i> subsp. <i>macrantha</i>			
344.	13209 <i>Drosera marchantii</i> subsp. <i>marchantii</i>			
345.	13208 <i>Drosera marchantii</i> subsp. <i>prophylla</i>		P3	
346.	3109 <i>Drosera menziesii</i> (Pink Rainbow)			
347.	11853 <i>Drosera menziesii</i> subsp. <i>menziesii</i>			
348.	13216 <i>Drosera menziesii</i> subsp. <i>penicillaris</i>			
349.	11196 <i>Drosera menziesii</i> subsp. <i>thysanosepala</i>			
350.	3110 <i>Drosera microphylla</i> (Golden Rainbow)			
351.	15710 <i>Drosera miniata</i> (Orange Sundew)			
352.	3115 <i>Drosera occidentalis</i> (Western Sundew)			
353.	3118 <i>Drosera pallida</i> (Pale Rainbow)			
354.	3119 <i>Drosera parvula</i> (Small Sundew)			
355.	29178 <i>Drosera porrecta</i>			
356.	3128 <i>Drosera ramellosa</i> (Branched Sundew)			
357.	<i>Drosera</i> sp.			
358.	13185 <i>Drosera spilos</i>			
359.	3133 <i>Drosera subhirtella</i> (Sunny Rainbow)			

Ecdeiocoleaceae

360. 1066 *Ecdeiocolea monostachya*

361. 18404 *Georgeantha hexandra*

Elaeocarpaceae

362.	4524 <i>Platytheca galioides</i>			
363.	23982 <i>Tetratheca angulata</i>		P3	
364.	4528 <i>Tetratheca confertifolia</i>			
365.	23989 <i>Tetratheca nephelioides</i>		T	
366.	4539 <i>Tetratheca paucifolia</i>			
367.	4542 <i>Tetratheca remota</i>		P1	
368.	4544 <i>Tetratheca setigera</i>			
369.	<i>Tetratheca</i> sp.			

Emblingiaceae

370. 2989 *Emblingia calceoliflora*

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
Ericaceae				
371.	6311 <i>Andersonia heterophylla</i>			
372.	6312 <i>Andersonia involucrata</i>			
373.	6314 <i>Andersonia lehmanniana</i>			
374.	11471 <i>Andersonia lehmanniana</i> subsp. <i>lehmanniana</i>			
375.	11606 <i>Andersonia lehmanniana</i> subsp. <i>pubescens</i>			
376.	<i>Andersonia</i> sp.			
377.	17647 <i>Andersonia</i> sp. Mt Lesueur (E.A. Griffin 5536)		P2	Y
378.	41738 <i>Andersonia</i> sp. Mysosma (E.A. Griffin 2213)			
379.	6323 <i>Astroloma ciliatum</i> (Candle Cranberry)			
380.	6326 <i>Astroloma epacridis</i>			
381.	6328 <i>Astroloma glaucescens</i>			
382.	6331 <i>Astroloma microcalyx</i> (Native Cranberry)			
383.	6332 <i>Astroloma microdonta</i> (Sandplain Cranberry)			
384.	42144 <i>Astroloma oblongifolium</i>			
385.	6334 <i>Astroloma pallidum</i> (Kick Bush)			
386.	6336 <i>Astroloma serratifolium</i> (Kondrung)			
387.	<i>Astroloma</i> sp.			
388.	14501 <i>Astroloma</i> sp. Eneabba (N. Marchant s.n. PERTH 01291777)			
389.	6337 <i>Astroloma stomarrhena</i> (Red Swamp Cranberry)			
390.	6339 <i>Astroloma xerophyllum</i>			
391.	30133 <i>Brachyloma jillup</i>			
392.	6341 <i>Brachyloma preissii</i> (Globe Heath)			
393.	30136 <i>Brachyloma preissii</i> subsp. <i>preissii</i>			
394.	19026 <i>Conostephium magnum</i>		P4	
395.	6347 <i>Conostephium minus</i> (Pink-tipped Pearl flower)			
396.	6348 <i>Conostephium pendulum</i> (Pearl Flower)			
397.	6349 <i>Conostephium preissii</i>			
398.	6350 <i>Conostephium roei</i>			
399.	13527 <i>Croninia kingiana</i>			
400.	6368 <i>Leucopogon carinatus</i>			
401.	6370 <i>Leucopogon cochlearifolius</i>			
402.	6374 <i>Leucopogon conostephioides</i>			
403.	6379 <i>Leucopogon crassiflorus</i>			
404.	6380 <i>Leucopogon crassifolius</i>			
405.	6397 <i>Leucopogon glaucifolius</i>			
406.	6405 <i>Leucopogon insularis</i>			
407.	6410 <i>Leucopogon leptanthus</i>			
408.	6417 <i>Leucopogon obovatus</i>			
409.	6418 <i>Leucopogon obtectus</i> (Hidden Beard-heath)		T	
410.	6419 <i>Leucopogon obtusatus</i>			
411.	6420 <i>Leucopogon oldfieldii</i>			
412.	6421 <i>Leucopogon oliganthus</i>			
413.	6425 <i>Leucopogon oxycedrus</i>			
414.	6426 <i>Leucopogon ozothamnoides</i>		P1	
415.	6429 <i>Leucopogon phyllostachys</i>			
416.	6430 <i>Leucopogon planifolius</i>			
417.	6432 <i>Leucopogon plumuliflorus</i>		P2	
418.	6434 <i>Leucopogon polymorphus</i>			
419.	6436 <i>Leucopogon propinquus</i>			
420.	6438 <i>Leucopogon pubescens</i>			
421.	<i>Leucopogon</i> sp.			
422.	19578 <i>Leucopogon</i> sp. Bifid Eneabba (M. Hislop 1927)			
423.	20868 <i>Leucopogon</i> sp. Cataby (F. Hort 1638)			
424.	34162 <i>Leucopogon</i> sp. Cocksleshell Gully (J.M. Powell 1749)			
425.	39501 <i>Leucopogon</i> sp. Coomallo (R.J. Cranfield 1457)			
426.	17723 <i>Leucopogon</i> sp. Lesueur (B. Evans 530)			
427.	19579 <i>Leucopogon</i> sp. Murdoch (M. Hislop 1037)			
428.	34163 <i>Leucopogon</i> sp. Newdegate (M. Hislop 3585)			
429.	29053 <i>Leucopogon</i> sp. South Eneabba (E.A. Griffin 8027)			
430.	19368 <i>Leucopogon</i> sp. Warradarge (M. Hislop 1908)			
431.	37040 <i>Leucopogon</i> sp. Watheroo (R.D. Royce 9616)			
432.	34156 <i>Leucopogon</i> sp. short style (S. Barrett 1578)			
433.	6446 <i>Leucopogon striatus</i>			
434.	6447 <i>Leucopogon strictus</i>			
435.	6448 <i>Leucopogon stronglylophyllus</i>			
436.	20648 <i>Lissanthe powelliae</i>			
437.	20647 <i>Lissanthe rubicunda</i>			
438.	6456 <i>Lysinema ciliatum</i> (Curry Flower)			
439.	34736 <i>Lysinema pentapetalum</i>			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
440.	<i>Styphelia tenuifolia</i>			
Euphorbiaceae				
441.	4582 <i>Adriana quadripartita</i> (Bitter Bush)			
442.	4594 <i>Beyeria cinerea</i>			
443.	34237 <i>Beyeria cinerea</i> subsp. <i>borealis</i>			
444.	34236 <i>Beyeria cinerea</i> subsp. <i>cinerea</i>		P3	
445.	4600 <i>Beyeria similis</i>		P2	
446.	34297 <i>Beyeria sulcata</i> var. <i>gracilis</i>			
447.	4662 <i>Monotaxis grandiflora</i> (Diamond of the Desert)			
448.	19585 <i>Monotaxis grandiflora</i> var. <i>grandiflora</i>			
449.	4699 <i>Ricinocarpos psilocladus</i>			
450.	19942 <i>Ricinocarpos undulatus</i>			
451.	4713 <i>Stachystemon axillaris</i> (Leafy Stachystemon)			
Fabaceae				
452.	3207 <i>Acacia alata</i> (Winged Wattle)			
453.	15430 <i>Acacia alata</i> var. <i>tetrantha</i>			
454.	15466 <i>Acacia applanata</i>			
455.	3231 <i>Acacia auronitens</i>			
456.	3242 <i>Acacia blakelyi</i>			
457.	15471 <i>Acacia brumalis</i>			
458.	14055 <i>Acacia carens</i>		P2	
459.	14061 <i>Acacia clydonophora</i>			
460.	3262 <i>Acacia cochlearis</i> (Rigid Wattle)			
461.	14066 <i>Acacia cummingiana</i>		P3	
462.	3282 <i>Acacia cyclops</i> (Coastal Wattle)			
463.	20435 <i>Acacia daphnifolia</i>			
464.	3303 <i>Acacia dilatata</i>			
465.	11661 <i>Acacia drummondii</i> subsp. <i>drummondii</i>			
466.	3319 <i>Acacia epacantha</i>		P3	
467.	3323 <i>Acacia ericifolia</i>			
468.	3324 <i>Acacia erinacea</i>			
469.	3332 <i>Acacia fagonioides</i>			
470.	3341 <i>Acacia forrestiana</i> (Forrest's Wattle)		T	
471.	3342 <i>Acacia fragilis</i>			
472.	3382 <i>Acacia incrassata</i>			
473.	3409 <i>Acacia lasiocarpa</i> (Panjang)			
474.	11519 <i>Acacia lasiocarpa</i> var. <i>bracteolata</i>			
475.	11611 <i>Acacia lasiocarpa</i> var. <i>lasiocarpa</i>			
476.	14931 <i>Acacia lasiocarpa</i> var. <i>lasiocarpa</i> Cockleshell Gully variant (E.A. Griffin 2039)		P2	
477.	3412 <i>Acacia latipes</i>			
478.	15476 <i>Acacia latipes</i> subsp. <i>latipes</i>			
479.	11448 <i>Acacia leptospermoides</i> subsp. <i>leptospermoides</i>			
480.	3419 <i>Acacia ligulata</i> (Umbrella Bush, Watarka)			
481.	3442 <i>Acacia microbotrya</i> (Manna Wattle, Kalyang)			
482.	11678 <i>Acacia moirii</i> subsp. <i>recurvistipula</i>			
483.	3451 <i>Acacia multispicata</i>			
484.	3464 <i>Acacia obovata</i>			
485.	3493 <i>Acacia plicata</i>		P3	
486.	3502 <i>Acacia pulchella</i> (Prickly Moses)			
487.	15481 <i>Acacia pulchella</i> var. <i>glaberrima</i>			
488.	15480 <i>Acacia pulchella</i> var. <i>reflexa</i>			
489.	3518 <i>Acacia retrorsa</i>		P2	
490.	3525 <i>Acacia rostellifera</i> (Summer-scented Wattle)			
491.	3527 <i>Acacia saligna</i> (Orange Wattle, Kudjong)			
492.	30033 <i>Acacia saligna</i> subsp. <i>lindleyi</i>			
493.	30032 <i>Acacia saligna</i> subsp. <i>saligna</i>			
494.	3532 <i>Acacia scirpifolia</i>			
495.	3534 <i>Acacia sclerosperma</i> (Limestone Wattle)			
496.	3541 <i>Acacia sessilis</i>			
497.	3543 <i>Acacia shuttleworthii</i>			
498.	<i>Acacia</i> sp.			
499.	18615 <i>Acacia</i> sp. Mullewa (B.R. Maslin 4269)			
500.	3549 <i>Acacia spathulifolia</i>			
501.	3550 <i>Acacia sphacelata</i>			
502.	15484 <i>Acacia sphacelata</i> subsp. <i>sphacelata</i>			
503.	15486 <i>Acacia sphacelata</i> subsp. <i>verticillata</i>			
504.	3554 <i>Acacia squamata</i>			
505.	3557 <i>Acacia stenoptera</i> (Narrow Winged Wattle)			
506.	3571 <i>Acacia tayloriana</i>		P4	

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507.	3574 <i>Acacia teretifolia</i>			
508.	3581 <i>Acacia trigonophylla</i>			
509.	3584 <i>Acacia truncata</i>			
510.	3592 <i>Acacia validinervia</i>			
511.	3602 <i>Acacia willdenowiana</i> (Grass Wattle)			
512.	14154 <i>Acacia wilsonii</i>		T	
513.	3604 <i>Acacia xanthina</i> (White-stemmed Wattle)			
514.	3692 <i>Aotus procumbens</i>			
515.	3710 <i>Bossiaea eriocarpa</i> (Common Brown Pea)			
516.	3719 <i>Bossiaea spinescens</i>			
517.	13111 <i>Chorizema aciculare</i> subsp. <i>laxum</i>			
518.	8971 <i>Chorizema cordatum</i>			
519.	<i>Chorizema</i> sp.			
520.	35837 <i>Cristonia biloba</i> subsp. <i>pubescens</i>			
521.	3793 <i>Daviesia angulata</i>			
522.	14199 <i>Daviesia chapmanii</i>			
523.	3803 <i>Daviesia daphnoides</i>			
524.	11562 <i>Daviesia debilior</i> subsp. <i>debilior</i>		P2	
525.	3805 <i>Daviesia decurrens</i> (Prickly Bitter-pea)			
526.	3807 <i>Daviesia divaricata</i> (Marno)			
527.	18560 <i>Daviesia divaricata</i> subsp. <i>divaricata</i>			
528.	3809 <i>Daviesia epiphyllum</i>			
529.	11879 <i>Daviesia hakeoides</i> subsp. <i>hakeoides</i>			
530.	15505 <i>Daviesia incrassata</i> subsp. <i>incrassata</i>			
531.	15506 <i>Daviesia incrassata</i> subsp. <i>teres</i>			
532.	3818 <i>Daviesia lancifolia</i>			
533.	3819 <i>Daviesia longifolia</i>			
534.	16585 <i>Daviesia nudiflora</i> subsp. <i>nudiflora</i>			
535.	3831 <i>Daviesia pedunculata</i>			
536.	3833 <i>Daviesia podophylla</i>			
537.	3834 <i>Daviesia polyphylla</i>			
538.	3835 <i>Daviesia preissii</i>			
539.	14201 <i>Daviesia pteroclada</i>		P3	
540.	3837 <i>Daviesia quadrilatera</i>			
541.	<i>Daviesia</i> sp.			
542.	3845 <i>Daviesia triflora</i>			
543.	<i>Dillwynia</i> sp.			
544.	29078 <i>Dillwynia</i> sp. Northern Sandplains (M. Hislop 3278)			
545.	20515 <i>Gastrolobium axillare</i>			
546.	3894 <i>Gastrolobium callistachys</i> (Rock Poison)			
547.	20475 <i>Gastrolobium capitatum</i>			
548.	20473 <i>Gastrolobium ebracteolatum</i>			
549.	3904 <i>Gastrolobium hamulosum</i> (Hookpoint Poison)		T	
550.	3906 <i>Gastrolobium ilicifolium</i>			
551.	3907 <i>Gastrolobium laytonii</i> (Breelya, Prilya)			
552.	20483 <i>Gastrolobium linearifolium</i>			
553.	20482 <i>Gastrolobium nervosum</i>			
554.	3910 <i>Gastrolobium obovatum</i> (Boat-leaved Poison)			
555.	3912 <i>Gastrolobium oxylobioides</i> (Champion Bay Poison)			
556.	3915 <i>Gastrolobium plicatum</i>			
557.	3916 <i>Gastrolobium polystachyum</i> (Horned Poison)			
558.	3924 <i>Gastrolobium spinosum</i> (Prickly Poison)			
559.	3945 <i>Gompholobium aristatum</i>			
560.	10909 <i>Gompholobium confertum</i>			
561.	23489 <i>Gompholobium gairdnerianum</i>		P3	
562.	<i>Gompholobium gairdnerium</i>			Y
563.	3950 <i>Gompholobium knightianum</i>			
564.	3951 <i>Gompholobium marginatum</i>			
565.	3955 <i>Gompholobium preissii</i>			
566.	19295 <i>Gompholobium pungens</i>			
567.	3956 <i>Gompholobium shuttleworthii</i>			
568.	<i>Gompholobium</i> sp.			
569.	3957 <i>Gompholobium tomentosum</i> (Hairy Yellow Pea)			
570.	3958 <i>Gompholobium venustum</i> (Handsome Wedge-pea)			
571.	3961 <i>Hardenbergia comptoniana</i> (Native Wisteria)			
572.	3966 <i>Hovea pungens</i> (Devil's Pins, Puyenak)			
573.	<i>Hovea</i> sp.			
574.	3967 <i>Hovea stricta</i>			
575.	3968 <i>Hovea trisperma</i> (Common Hovea)			
576.	3992 <i>Isotropis cuneifolia</i> (Granny Bonnets)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
577.	19700 <i>Isotropis cuneifolia</i> subsp. <i>cuneifolia</i>			
578.	3998 <i>Jacksonia angulata</i>			
579.	14747 <i>Jacksonia anthoclada</i>		P3	
580.	14783 <i>Jacksonia calcicola</i>			
581.	4005 <i>Jacksonia condensata</i>			
582.	4010 <i>Jacksonia floribunda</i> (Holly Pea)			
583.	4015 <i>Jacksonia hakeoides</i>			
584.	4018 <i>Jacksonia lehmannii</i>			
585.	14778 <i>Jacksonia nutans</i>			
586.	20709 <i>Jacksonia ramulosa</i>			
587.	4025 <i>Jacksonia restioides</i>			
588.	4029 <i>Jacksonia sternbergiana</i> (Stinkwood, Kapur)			
589.	37960 <i>Kennedia coccinea</i> subsp. <i>calcaria</i>			
590.	4044 <i>Kennedia prostrata</i> (Scarlet Runner)			
591.	<i>Kennedia</i> sp.			
592.	3664 <i>Labichea cassioides</i>			
593.	3667 <i>Labichea lanceolata</i> (Tall Labichea)			
594.	11289 <i>Labichea lanceolata</i> subsp. <i>lanceolata</i>			
595.	3669 <i>Labichea punctata</i> (Lance-leaved Cassia)			
596.	4091 <i>Mirbelia floribunda</i> (Purple Mirbelia)			
597.	4094 <i>Mirbelia microphylla</i>			
598.	4097 <i>Mirbelia ramulosa</i>			
599.	4100 <i>Mirbelia spinosa</i>			
600.	4104 <i>Mirbelia trichocalyx</i>			
601.	4113 <i>Ornithopus compressus</i> (Yellow Serradella)	Y		
602.	4172 <i>Pultenaea ericifolia</i>			
603.	<i>Pultenaea</i> sp.			
604.	<i>Pultenaea</i> sp. Mt Lesueur (Beard 7827)			Y
605.	23460 <i>Pultenaea</i> sp. Mt Lesueur (L.A. Orthia 86)			Y
606.	17551 <i>Sphaerolobium drummondii</i>			
607.	4206 <i>Sphaerolobium macranthum</i>			
608.	4207 <i>Sphaerolobium medium</i>			
609.	10800 <i>Sphaerolobium pulchellum</i>			
610.	4256 <i>Templetonia retusa</i> (Cockies Tongues)			
611.	17542 <i>Trifolium arvense</i> var. <i>arvense</i>	Y		
612.	4292 <i>Trifolium campestre</i> (Hop Clover)	Y		
613.	17763 <i>Trifolium campestre</i> var. <i>campestre</i> (Hop Clover)	Y		
614.	4295 <i>Trifolium dubium</i> (Suckling Clover)	Y		
615.	4297 <i>Trifolium glomeratum</i> (Cluster Clover)	Y		
616.	4298 <i>Trifolium hirtum</i> (Rose Clover)	Y		
617.	4313 <i>Trifolium subterraneum</i> (Subterranean Clover)	Y		
618.	4325 <i>Viminaria juncea</i> (Swishbush, Koweda)			
Gentianaceae				
619.	6542 <i>Centaurium tenuiflorum</i>	Y		
620.	41660 <i>Schenkia australis</i>			
Geraniaceae				
621.	4332 <i>Erodium botrys</i> (Long Storksbill)	Y		
622.	4333 <i>Erodium cicutarium</i> (Common Storksbill)	Y		
623.	4335 <i>Erodium cygnorum</i> (Blue Heronsbill)			
624.	4343 <i>Pelargonium capitatum</i> (Rose Pelargonium)	Y		
625.	4346 <i>Pelargonium littorale</i>			
626.	<i>Pelargonium</i> sp.			
Goodeniaceae				
627.	7425 <i>Dampiera carinata</i> (Summer Dampiera)			
628.	7428 <i>Dampiera coronata</i> (Wedge-leaved Dampiera)			
629.	7449 <i>Dampiera juncea</i> (Rush-like Dampiera)			
630.	7451 <i>Dampiera lavandulacea</i>			
631.	7453 <i>Dampiera lindleyi</i>			
632.	7454 <i>Dampiera linearis</i> (Common Dampiera)			
633.	7459 <i>Dampiera oligophylla</i> (Sparse-leaved Dampiera)			
634.	<i>Dampiera</i> sp.			
635.	18441 <i>Dampiera</i> sp. Jurien (G. Lullfitz s.n. 10/7/1986)		P2	
636.	7475 <i>Dampiera spicigera</i> (Spiked Dampiera)			
637.	7481 <i>Dampiera tephrea</i>		P2	
638.	7482 <i>Dampiera teres</i> (Terete-leaved Dampiera)			
639.	7488 <i>Goodenia affinis</i> (Silver Goodenia)			
640.	7495 <i>Goodenia berardiana</i>			
641.	29362 <i>Goodenia coerulea</i>			
642.	7508 <i>Goodenia filiformis</i> (Thread-leaved Goodenia)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
643.	7513 <i>Goodenia hassallii</i>			
644.	12551 <i>Goodenia micrantha</i>			
645.	19286 <i>Goodenia pulchella</i> subsp. Coastal Plain A (M. Hislop 634)			
646.	19284 <i>Goodenia pulchella</i> subsp. Coastal Plain B (L.W. Sage 2336)			
647.	<i>Goodenia</i> sp.			
648.	7566 <i>Goodenia xanthotricha</i> (Yellow-haired Goodenia)		P2	
649.	7568 <i>Lechenaultia biloba</i> (Blue Leschenaultia)			
650.	7572 <i>Lechenaultia expansa</i>			
651.	7574 <i>Lechenaultia floribunda</i> (Free-flowering Leschenaultia)			
652.	7577 <i>Lechenaultia hirsuta</i> (Hairy Leschenaultia)			
653.	7580 <i>Lechenaultia linarioides</i> (Yellow Leschenaultia)			
654.	<i>Lechenaultia</i> sp.			
655.	7586 <i>Lechenaultia stenosepala</i> (Narrow-sepaled Leschenaultia)			
656.	7595 <i>Scaevola anchusifolia</i>			
657.	7603 <i>Scaevola canescens</i> (Grey Scaevola)			
658.	7613 <i>Scaevola glandulifera</i> (Viscid Hand-flower)			
659.	7614 <i>Scaevola globulifera</i>			
660.	7619 <i>Scaevola lanceolata</i> (Long-leaved Scaevola)			
661.	7626 <i>Scaevola nitida</i> (Shining Fanflower)			
662.	7634 <i>Scaevola phlebopetala</i> (Velvet Fanflower)			
663.	7635 <i>Scaevola pilosa</i> (Hairy Fan-flower)			
664.	12585 <i>Scaevola repens</i>			
665.	29356 <i>Scaevola repens</i> subsp. Northern Sandplains (R.J. Cranfield & P.J. Spencer 8445)			
666.	<i>Scaevola repens</i> subsp. Northern Sandplains (R.J.Cranfield & P.J.Spencer 8445)			
667.	13181 <i>Scaevola repens</i> var. <i>angustifolia</i>			
668.	13182 <i>Scaevola repens</i> var. <i>repens</i>			
669.	7643 <i>Scaevola sericophylla</i>			
670.	<i>Scaevola</i> sp.			
671.	13152 <i>Scaevola thesioides</i> subsp. <i>thesioides</i>			
672.	12588 <i>Scaevola virgata</i>			
673.	7665 <i>Velleia trinervis</i>			
674.	7666 <i>Verreauxia reinwardtii</i> (Common Verreauxia)			

Gyrostemonaceae

675.	2778 <i>Codonocarpus cotinifolius</i> (Native Poplar, Kundurangu)			
676.	2783 <i>Gyrostemon racemiger</i>			
677.	2784 <i>Gyrostemon ramulosus</i> (Corkybark)			
678.	<i>Gyrostemon</i> sp.			
679.	2788 <i>Gyrostemon subnudus</i>			
680.	2791 <i>Tersonia cyathiflora</i> (Button Creeper)			
681.	2792 <i>Walteranthus erectus</i>		P2	

Haemodoraceae

682.	1407 <i>Anigozanthos flavidus</i> (Tall Kangaroo Paw)			
683.	1409 <i>Anigozanthos humilis</i> (Catspaw)			
684.	11434 <i>Anigozanthos humilis</i> subsp. <i>humilis</i>			
685.	1411 <i>Anigozanthos manglesii</i> (Mangles Kangaroo Paw, Kurulbrang)			
686.	11261 <i>Anigozanthos manglesii</i> subsp. <i>manglesii</i>			
687.	11565 <i>Anigozanthos manglesii</i> subsp. <i>quadrans</i>			
688.	1414 <i>Anigozanthos pulcherrimus</i> (Yellow Kangaroo Paw)			
689.	<i>Anigozanthos</i> sp.			
690.	1417 <i>Blancoa canescens</i> (Winter Bell)			
691.	11414 <i>Conostylis aculeata</i> subsp. <i>breviflora</i>			
692.	12109 <i>Conostylis aculeata</i> subsp. <i>preissii</i>			
693.	11641 <i>Conostylis aculeata</i> subsp. <i>rhypidion</i>			
694.	1420 <i>Conostylis androstemma</i> (Trumpets)			
695.	1421 <i>Conostylis angustifolia</i>			
696.	1423 <i>Conostylis aurea</i> (Golden Conostylis)			
697.	1427 <i>Conostylis candicans</i> (Grey Cottonhead)			
698.	12027 <i>Conostylis candicans</i> subsp. <i>calcicola</i>			
699.	11438 <i>Conostylis candicans</i> subsp. <i>candicans</i>			
700.	11515 <i>Conostylis candicans</i> subsp. <i>procumbens</i>			
701.	1428 <i>Conostylis canteriata</i>			
702.	<i>Conostylis crassinerva</i> subsp. <i>absens</i>			
703.	<i>Conostylis crassinerva</i> subsp. <i>crassinerva</i>			
704.	11773 <i>Conostylis crassinerva</i> subsp. <i>absens</i>			
705.	11938 <i>Conostylis crassinerva</i> subsp. <i>crassinerva</i>			
706.	1435 <i>Conostylis hiemalis</i>			
707.	1436 <i>Conostylis juncea</i>			
708.	1437 <i>Conostylis latens</i>			
709.	1446 <i>Conostylis prolifera</i> (Mat Cottonheads)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
710.	1451 <i>Conostylis seminuda</i>			
711.	1454 <i>Conostylis setigera</i> (Bristly Cottonhead)			
712.	<i>Conostylis</i> sp.			
713.	1456 <i>Conostylis stylidioides</i>			
714.	1457 <i>Conostylis teretifolia</i>			
715.	11870 <i>Conostylis teretifolia</i> subsp. <i>teretifolia</i>			
716.	1458 <i>Conostylis teretiuscula</i>			
717.	1464 <i>Haemodorum brevisepalum</i>			
718.	1465 <i>Haemodorum discolor</i>			
719.	1469 <i>Haemodorum loratum</i>		P3	
720.	1470 <i>Haemodorum paniculatum</i> (Mardja)			
721.	1472 <i>Haemodorum simplex</i>			
722.	1473 <i>Haemodorum simulans</i>			
723.	<i>Haemodorum</i> sp.			
724.	1475 <i>Haemodorum spicatum</i> (Mardja)			
725.	1476 <i>Haemodorum venosum</i>			
726.	1477 <i>Macropidia fuliginosa</i> (Black Kangaroo Paw)			
727.	1478 <i>Phlebocarya ciliata</i>			
728.	1479 <i>Phlebocarya filifolia</i>			
729.	11557 <i>Phlebocarya pilosissima</i> subsp. <i>pilosissima</i>		P3	
730.	11906 <i>Phlebocarya pilosissima</i> subsp. <i>teretifolia</i>		P2	
731.	1481 <i>Tribonanthes australis</i>			
732.	1483 <i>Tribonanthes longipetala</i>			

Haloragaceae

733.	33620 <i>Glischrocaryon angustifolium</i>			
734.	6143 <i>Glischrocaryon aureum</i> (Common Popflower)			
735.	6159 <i>Gonocarpus nodulosus</i>			
736.	6161 <i>Gonocarpus pithyoides</i>			
737.	<i>Gonocarpus</i> sp.			
738.	34676 <i>Meionectes brownii</i> (Swamp Rasperwort)			

Hemerocallidaceae

739.	1263 <i>Arnocrinum gracillimum</i>		P2	
740.	1264 <i>Arnocrinum preissii</i>			
741.	1276 <i>Caesia micrantha</i> (Pale Grass Lily)			
742.	29439 <i>Caesia</i> sp. Wongan (K.F. Kenneally 8820)			
743.	11883 <i>Corynotheca micrantha</i> var. <i>elongata</i>			
744.	11283 <i>Corynotheca micrantha</i> var. <i>micrantha</i>			
745.	1259 <i>Dianella revoluta</i> (Blueberry Lily)			
746.	11636 <i>Dianella revoluta</i> var. <i>divaricata</i>			
747.	1292 <i>Hensmania stoniella</i>		P3	
748.	1293 <i>Hensmania turbinata</i>			
749.	1298 <i>Johnsonia pubescens</i> (Pipe Lily)			
750.	19632 <i>Johnsonia pubescens</i> subsp. <i>pubescens</i>			
751.	1361 <i>Tricoryne elatior</i> (Yellow Autumn Lily)			
752.	29481 <i>Tricoryne</i> sp. <i>Eneabba</i> (E.A. Griffin 1200)			

Hypoxidaceae

753.	43764 <i>Pauridia glabella</i> var. <i>leptantha</i>			
754.	43760 <i>Pauridia occidentalis</i>			
755.	43761 <i>Pauridia occidentalis</i> var. <i>occidentalis</i>			

Iridaceae

756.	19179 <i>Moraea flaccida</i> (One-leaf Cape Tulip)	Y		
757.	11749 <i>Orthrosanthus laxus</i> var. <i>laxus</i> (Morning Iris)			
758.	1541 <i>Patersonia argyrea</i>		P3	
759.	1546 <i>Patersonia juncea</i> (Rush Leaved Patersonia)			
760.	1550 <i>Patersonia occidentalis</i> (Purple Flag, Koma)			
761.	30476 <i>Patersonia occidentalis</i> var. <i>latifolia</i>			
762.	30472 <i>Patersonia occidentalis</i> var. <i>occidentalis</i>			
763.	1556 <i>Romulea rosea</i> (Guildford Grass)	Y		
764.	11544 <i>Romulea rosea</i> var. <i>australis</i> (Guildford Grass)	Y		

Juncaceae

765.	1177 <i>Juncus articulatus</i> (Jointed Rush)	Y		
766.	1178 <i>Juncus bufonius</i> (Toad Rush)	Y		
767.	1179 <i>Juncus caespiticius</i> (Grassy Rush)			
768.	11922 <i>Juncus kraussii</i> subsp. <i>australiensis</i>			
769.	1188 <i>Juncus pallidus</i> (Pale Rush)			
770.	1189 <i>Juncus pauciflorus</i> (Loose Flower Rush)			

Juncaginaceae

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
771.	40661 <i>Cynogeton lineare</i>			
772.	33276 <i>Triglochin isingiana</i>			
773.	146 <i>Triglochin minutissima</i>			
774.	147 <i>Triglochin mucronata</i>			
775.	18587 <i>Triglochin nana</i>			
776.	<i>Triglochin procera</i>			
Lamiaceae				
777.	6835 <i>Hemiandra gardneri</i> (Red Snakebush)		T	
778.	16933 <i>Hemiandra glabra</i>			
779.	6837 <i>Hemiandra leiantha</i>			
780.	6838 <i>Hemiandra linearis</i> (Speckled Snakebush)			
781.	6839 <i>Hemiandra pungens</i> (Snakebush)			
782.	6840 <i>Hemiandra rubriflora</i>			
783.	<i>Hemiandra</i> sp.			
784.	38320 <i>Hemiandra</i> sp. <i>Jurien</i> (B.J. Conn & M.E. Tozer BJC 3885)			
785.	<i>Hemiandra</i> sp. <i>Jurien</i> (B.J.Conn 3885 & M.E.Tozer)			
786.	14595 <i>Hemiandra</i> sp. <i>Watheroo</i> (S. Hancocks 4)		P4	
787.	33756 <i>Hemigenia appressa</i>			
788.	6847 <i>Hemigenia curvifolia</i>		P2	
789.	6849 <i>Hemigenia diplanthera</i>			
790.	6856 <i>Hemigenia incana</i> (Silky Hemigenia)			
791.	6871 <i>Hemigenia sericea</i> (Silky Hemigenia)			
792.	<i>Hemigenia</i> sp.			
793.	41020 <i>Hemiphora bartlingii</i> (Woolly Dragon)			
794.	6780 <i>Lachnostachys eriobotrya</i> (Lambswool)			
795.	<i>Microcorys</i> sp.			
796.	15456 <i>Microcorys</i> sp. <i>Coomallo</i> (L. Haegi 2677)			
797.	6797 <i>Physopsis spicata</i> (Hill River Lambstail)			
798.	<i>Pityrodia</i> sp.			
799.	41063 <i>Quoya loxocarpa</i>			
800.	41080 <i>Quoya verbascina</i> (Golden Bush)			
801.	6930 <i>Stachys arvensis</i> (Staggerweed)	Y		
Lauraceae				
802.	2948 <i>Cassytha aurea</i>			
803.	12073 <i>Cassytha aurea</i> var. <i>aurea</i>			
804.	2951 <i>Cassytha flava</i> (Dodder Laurel)			
805.	2952 <i>Cassytha glabella</i> (Tangled Dodder Laurel)			
806.	11206 <i>Cassytha glabella</i> forma <i>bicallosa</i>			
807.	2956 <i>Cassytha pomiformis</i> (Dodder Laurel)			
808.	2957 <i>Cassytha racemosa</i> (Dodder Laurel)			
809.	11242 <i>Cassytha racemosa</i> forma <i>pilosa</i>			
810.	11799 <i>Cassytha racemosa</i> forma <i>racemosa</i>			
811.	<i>Cassytha</i> sp.			
Lentibulariaceae				
812.	7145 <i>Utricularia menziesii</i> (Redcoats)			
813.	7148 <i>Utricularia multifida</i>			
Loganiaceae				
814.	6506 <i>Logania campanulata</i> (Bell-flowered Logania)			
815.	6508 <i>Logania flaviflora</i> (Yellow Logania)			
816.	6512 <i>Logania spermacoea</i>			
817.	16825 <i>Phyllangium divergens</i>			
Loranthaceae				
818.	13267 <i>Amyema linophylla</i> subsp. <i>linophylla</i>			
819.	2380 <i>Amyema miquelii</i> (Stalked Mistletoe)			
820.	2401 <i>Nuytsia floribunda</i> (Christmas Tree, Mudja)			
Malvaceae				
821.	4906 <i>Alyogyne huegelii</i> (Lilac Hibiscus)			
822.	43023 <i>Alyogyne</i> sp. <i>Hutt River</i> (B.J. Lepschi & T.R. Lally 2310)			
823.	<i>Alyogyne</i> sp. <i>Hutt River</i> (B.J.Lepschi & T.R.Lally 2310)			
824.	40908 <i>Androcalva pulchella</i>			
825.	40872 <i>Commersonia borealis</i>			
826.	13233 <i>Guichenotia alba</i>		P3	
827.	5011 <i>Guichenotia ledifolia</i>			
828.	5012 <i>Guichenotia macrantha</i> (Large-flowered Guichenotia)			
829.	5014 <i>Guichenotia sarotes</i>			
830.	4927 <i>Hibiscus drummondii</i> (Drummond's Hibiscus)			
831.	<i>Hibiscus</i> sp.			

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832.	5022 <i>Keraudrenia hermanniifolia</i>			
833.	5023 <i>Keraudrenia integrifolia</i> (Common Firebush)			
834.	5031 <i>Lasiopetalum drummondii</i>			
835.	5033 <i>Lasiopetalum floribundum</i> (Free Flowering Lasiopetalum)			
836.	5035 <i>Lasiopetalum indutum</i>			
837.	5042 <i>Lasiopetalum ogilvieanum</i>		P1	
838.	36660 <i>Lasiopetalum</i> sp. Mount Lesueur (E.A. Griffin 1997)		P2	
839.	4958 <i>Lawrenzia spicata</i>			
840.	4959 <i>Lawrenzia squamata</i>			
841.	4980 <i>Sida hookeriana</i>			
842.	5080 <i>Thomasia foliosa</i>			
843.	5084 <i>Thomasia grandiflora</i> (Large Flowered Thomasia)			
844.	5086 <i>Thomasia macrocalyx</i>			
845.	<i>Thomasia</i> sp.			
846.	42040 <i>Thomasia</i> sp. Lesueur (M. Hislop 4217)			Y

Menyanthaceae

847.	36160 <i>Liparophyllum capitatum</i>			
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Molluginaceae

848.	2838 <i>Macarthuria apetala</i>			
849.	2839 <i>Macarthuria australis</i>			

Myrtaceae

850.	5330 <i>Astartea fascicularis</i>			
851.	36441 <i>Babingtonia camphorosmae</i> (Camphor Myrtle)			
852.	45397 <i>Babingtonia cherticola</i>		P3	
853.	45398 <i>Babingtonia erecta</i>			
854.	45416 <i>Babingtonia grandiflora</i> (Large-flowered Babingtonia)			
855.	<i>Baekkea crispiflora</i> subsp. Mt Lesueur (E.A. Griffin 2325)			Y
856.	<i>Baekkea</i> sp.			
857.	17761 <i>Beaufortia aestiva</i>			
858.	5377 <i>Beaufortia bicolor</i>		P3	
859.	5378 <i>Beaufortia bracteosa</i>			
860.	5382 <i>Beaufortia elegans</i>			
861.	5384 <i>Beaufortia eriocephala</i> (Woolly Bottlebrush)		P3	
862.	<i>Beaufortia</i> sp.			
863.	5393 <i>Beaufortia squarrosa</i> (Sand Bottlebrush, Puno)			
864.	5401 <i>Calothamnus blepharospermus</i>			
865.	35856 <i>Calothamnus glaber</i>			
866.	5411 <i>Calothamnus hirsutus</i>			
867.	5417 <i>Calothamnus longissimus</i>			
868.	5426 <i>Calothamnus quadrifidus</i> (One-sided Bottlebrush, Kwondjard)			
869.	35756 <i>Calothamnus quadrifidus</i> subsp. <i>angustifolius</i>			
870.	35816 <i>Calothamnus quadrifidus</i> subsp. <i>quadrifidus</i>			
871.	5429 <i>Calothamnus sanguineus</i> (Silky-leaved Blood flower, Pindak)			
872.	<i>Calothamnus</i> sp.			
873.	5431 <i>Calothamnus torulosus</i>			
874.	5441 <i>Calytrix aurea</i>			
875.	5447 <i>Calytrix chrysantha</i>		P4	
876.	5450 <i>Calytrix depressa</i>			
877.	5453 <i>Calytrix drummondii</i>			
878.	19980 <i>Calytrix ecalycata</i> subsp. <i>brevis</i>		P3	
879.	5458 <i>Calytrix flavescens</i> (Summer Starflower)			
880.	5460 <i>Calytrix fraseri</i> (Pink Summer Calytrix)			
881.	5465 <i>Calytrix leschenaultii</i>			
882.	5476 <i>Calytrix sapphirina</i>			
883.	<i>Calytrix</i> sp.			
884.	5479 <i>Calytrix strigosa</i>			
885.	5493 <i>Chamelaucium drummondii</i>			
886.	5498 <i>Chamelaucium uncinatum</i> (Geraldton Wax)			
887.	5502 <i>Conothamnus trinervis</i>			
888.	17104 <i>Corymbia calophylla</i> (Marri)			
889.	17105 <i>Corymbia haematoxylon</i> (Mountain Marri)			
890.	<i>Corymbia</i> sp.			
891.	5503 <i>Corynanthera flava</i>			
892.	5511 <i>Darwinia helichrysoides</i>			
893.	5518 <i>Darwinia neildiana</i> (Fringed Bell)			
894.	5522 <i>Darwinia pauciflora</i>			
895.	5523 <i>Darwinia pimelioides</i>		P4	
896.	5528 <i>Darwinia sanguinea</i>			
897.	<i>Darwinia</i> sp.			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
898.	5529 <i>Darwinia speciosa</i>			
899.	5534 <i>Darwinia virescens</i> (Murchison <i>Darwinia</i>)			
900.	13949 <i>Eremaea asterocarpa</i>			
901.	13950 <i>Eremaea asterocarpa</i> subsp. <i>asterocarpa</i>			
902.	14097 <i>Eremaea asterocarpa</i> subsp. <i>brachyclada</i>			
903.	13952 <i>Eremaea asterocarpa</i> subsp. <i>histoclada</i>			
904.	5537 <i>Eremaea beaufortioides</i>			
905.	14098 <i>Eremaea beaufortioides</i> var. <i>beaufortioides</i>			
906.	14099 <i>Eremaea beaufortioides</i> var. <i>lachnosanthe</i>			
907.	14100 <i>Eremaea beaufortioides</i> var. <i>microphylla</i>			
908.	5538 <i>Eremaea brevifolia</i>			
909.	14102 <i>Eremaea ebracteata</i> var. <i>ebracteata</i>			
910.	13955 <i>Eremaea ectadioclada</i>			
911.	5540 <i>Eremaea fimbriata</i>			
912.	13951 <i>Eremaea hadra</i>			
913.	5541 <i>Eremaea pauciflora</i>			
914.	14103 <i>Eremaea pauciflora</i> var. <i>calyptra</i>			
915.	13818 <i>Eremaea pauciflora</i> var. <i>lonchophylla</i>			
916.	14104 <i>Eremaea pauciflora</i> var. <i>pauciflora</i>			
917.	5542 <i>Eremaea purpurea</i>			
918.	<i>Eremaea</i> sp.			
919.	5543 <i>Eremaea violacea</i> (<i>Violet Eremaea</i>)			
920.	17459 <i>Eremaea violacea</i> subsp. <i>raphiophylla</i>			
921.	36239 <i>Eremaea violacea</i> subsp. <i>violacea</i>			
922.	13953 <i>Eremaea</i> x <i>codonocarpa</i>			
923.	13956 <i>Eremaea</i> x <i>phoenicea</i>			
924.	45253 <i>Ericomyrtus</i> sp. <i>Mt Lesueur</i> (E.A. Griffin 2325)			
925.	45215 <i>Ericomyrtus tenuior</i>			
926.	12898 <i>Eucalyptus abdita</i>		P2	
927.	5545 <i>Eucalyptus accedens</i> (<i>Powderbark Wandoo</i>)			
928.	5548 <i>Eucalyptus albida</i> (<i>White-leaved Mallee</i>)			
929.	13545 <i>Eucalyptus angularis</i>		P2	
930.	12895 <i>Eucalyptus arachnaea</i> subsp. <i>arachnaea</i>			
931.	13091 <i>Eucalyptus argutifolia</i> (<i>Wabling Hill Mallee</i>)		T	
932.	5560 <i>Eucalyptus beardiana</i> (<i>Beard's Mallee</i>)		T	
933.	5580 <i>Eucalyptus camaldulensis</i> (<i>River Gum, Yabalyinyba</i>)			
934.	35345 <i>Eucalyptus camaldulensis</i> subsp. <i>obtusa</i> (<i>Blunt-budded River Red Gum</i>)			
935.	15684 <i>Eucalyptus conveniens</i>			
936.	12885 <i>Eucalyptus crispata</i> (<i>Yandanooka Mallee</i>)		T	
937.	15494 <i>Eucalyptus diminuta</i>			
938.	5628 <i>Eucalyptus drummondii</i> (<i>Drummond's Gum</i>)			
939.	5638 <i>Eucalyptus erythrocorys</i> (<i>Illyarrie</i>)			
940.	5642 <i>Eucalyptus exilis</i> (<i>Boyagin Mallee</i>)		P4	
941.	5643 <i>Eucalyptus falcata</i> (<i>Silver Mallet, Dulyumuk</i>)			
942.	5649 <i>Eucalyptus foecunda</i> (<i>Narrow-leaved Red Mallee</i>)			
943.	5658 <i>Eucalyptus gittinsii</i> (<i>Northern Sandplain Mallee</i>)			
944.	19472 <i>Eucalyptus gittinsii</i> subsp. <i>gittinsii</i>			
945.	18292 <i>Eucalyptus gittinsii</i> subsp. <i>illucida</i>			
946.	13532 <i>Eucalyptus impensa</i>		T	
947.	5680 <i>Eucalyptus johnsoniana</i> (<i>Johnson's Mallee</i>)		T	
948.	5690 <i>Eucalyptus lane-poolei</i> (<i>Salmon White Gum</i>)			
949.	5691 <i>Eucalyptus lateritica</i> (<i>Laterite Mallee</i>)		T	
950.	13543 <i>Eucalyptus leprophloia</i> (<i>Scaly Butt Mallee</i>)		T	
951.	11295 <i>Eucalyptus loxophleba</i> subsp. <i>loxophleba</i> (<i>York Gum</i>)			
952.	5705 <i>Eucalyptus macrocarpa</i> (<i>Mottlecah, Mudelka</i>)			
953.	13531 <i>Eucalyptus macrocarpa</i> subsp. <i>elachantha</i> (<i>Small-leaved Mottlecah</i>)		P4	
954.	13530 <i>Eucalyptus macrocarpa</i> subsp. <i>macrocarpa</i> (<i>Mottlecah</i>)			
955.	5708 <i>Eucalyptus marginata</i> (<i>Jarra, Djara</i>)			
956.	13547 <i>Eucalyptus marginata</i> subsp. <i>marginata</i> (<i>Jarra</i>)			
957.	5722 <i>Eucalyptus obtusiflora</i> (<i>Dongara Mallee</i>)			
958.	19815 <i>Eucalyptus obtusiflora</i> subsp. <i>dongarraensis</i>			
959.	19559 <i>Eucalyptus obtusiflora</i> subsp. <i>obtusiflora</i>			
960.	42062 <i>Eucalyptus opimiflora</i>			
961.	18664 <i>Eucalyptus optima</i>			
962.	5730 <i>Eucalyptus oraria</i> (<i>Ooragmandee</i>)			
963.	5741 <i>Eucalyptus pendens</i> (<i>Badgingarra Mallee</i>)		P4	
964.	13541 <i>Eucalyptus petrensis</i>			
965.	16180 <i>Eucalyptus pleurocarpa</i>			
966.	12866 <i>Eucalyptus pluricaulis</i> subsp. <i>pluricaulis</i>			
967.	13040 <i>Eucalyptus pruiniramis</i>		T	

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968.	5756 <i>Eucalyptus pyriformis</i> (Pear-fruited Mallee)			
969.	5763 <i>Eucalyptus rudis</i> (Flooded Gum, Kulurda)			
970.	13511 <i>Eucalyptus rudis</i> subsp. <i>rudis</i>			
971.	<i>Eucalyptus</i> sp.			
972.	<i>Eucalyptus</i> sp. <i>Badgingarra</i> (D.Nicolle & M.French DN 3515)			Y
973.	5781 <i>Eucalyptus suberea</i> (Mount Lesueur Mallee)		T	
974.	5790 <i>Eucalyptus todtiana</i> (Coastal Blackbutt)			
975.	5797 <i>Eucalyptus wandoo</i> (Wandoo, Wandu)			
976.	12905 <i>Eucalyptus wandoo</i> subsp. <i>pulverea</i>			
977.	12906 <i>Eucalyptus wandoo</i> subsp. <i>wandoo</i>			
978.	5817 <i>Hypocalymma angustifolium</i> (White Myrtle, Kudjid)			
979.	35070 <i>Hypocalymma angustifolium</i> subsp. <i>Swan Coastal Plain</i> (G.J. Keighery 16777)			
980.	20851 <i>Hypocalymma gardneri</i>		P3	
981.	20044 <i>Hypocalymma hirsutum</i>			
982.	31412 <i>Hypocalymma</i> sp. <i>Gairdner Range</i> (C.A. Gardner 9091)		P2	Y
983.	16179 <i>Hypocalymma tenuatum</i>		P2	Y
984.	5829 <i>Hypocalymma xanthopetalum</i>			
985.	5835 <i>Kunzea micrantha</i>			
986.	17785 <i>Kunzea micrantha</i> subsp. <i>petiolata</i>			
987.	5850 <i>Leptospermum laevigatum</i> (Coast Teatree)	Y		
988.	5853 <i>Leptospermum oligandrum</i>			
989.	<i>Leptospermum</i> sp.			
990.	5857 <i>Leptospermum spinescens</i>			
991.	37580 <i>Melaleuca acutifolia</i>			
992.	5878 <i>Melaleuca blairiifolia</i>			
993.	5881 <i>Melaleuca brevifolia</i>			
994.	17982 <i>Melaleuca carrii</i>			
995.	5888 <i>Melaleuca ciliosa</i>			
996.	19387 <i>Melaleuca clavifolia</i>			
997.	5893 <i>Melaleuca concreta</i>			
998.	18125 <i>Melaleuca delta</i>			
999.	5904 <i>Melaleuca depressa</i>			
1000.	19952 <i>Melaleuca dichroma</i>			
1001.	19486 <i>Melaleuca hamata</i>			
1002.	5919 <i>Melaleuca holosericea</i>			
1003.	5920 <i>Melaleuca huegelii</i> (Chenille Honey Myrtle)			
1004.	13271 <i>Melaleuca huegelii</i> subsp. <i>huegelii</i>			
1005.	13273 <i>Melaleuca incana</i> subsp. <i>incana</i>			
1006.	5926 <i>Melaleuca lateritia</i> (Robin Redbreast Bush)			
1007.	5930 <i>Melaleuca leiopyxis</i>			
1008.	18112 <i>Melaleuca leuropoma</i>			
1009.	18435 <i>Melaleuca longistaminea</i>			
1010.	41120 <i>Melaleuca marginata</i>			
1011.	5936 <i>Melaleuca megacephala</i>			
1012.	5949 <i>Melaleuca platycalyx</i>			
1013.	5952 <i>Melaleuca preissiana</i> (Moonah)			
1014.	5958 <i>Melaleuca radula</i> (Graceful Honey Myrtle)			
1015.	5959 <i>Melaleuca raphiophylla</i> (Swamp Paperbark)			
1016.	19365 <i>Melaleuca ryeae</i>			
1017.	5961 <i>Melaleuca scabra</i> (Rough Honey Myrtle, Wurru Bush)			
1018.	5964 <i>Melaleuca seriata</i>			
1019.	<i>Melaleuca</i> sp.			
1020.	18598 <i>Melaleuca systema</i>			
1021.	18278 <i>Melaleuca tinkeri</i>			
1022.	5983 <i>Melaleuca trichophylla</i>			
1023.	5984 <i>Melaleuca uncinata</i> (Broom Bush, Kwidjard)			
1024.	5986 <i>Melaleuca urceolaris</i>			
1025.	5987 <i>Melaleuca viminea</i> (Mohan)			
1026.	19611 <i>Melaleuca zonalis</i>			
1027.	6008 <i>Phymatocarpus porphyrocephalus</i>			
1028.	<i>Phymatocarpus</i> sp.			
1029.	6009 <i>Pileanthus filifolius</i> (Summer Coppercups)			
1030.	6010 <i>Pileanthus limacis</i> (Coastal Coppercups)			
1031.	6011 <i>Pileanthus peduncularis</i> (Coppercups)			
1032.	6012 <i>Regelia ciliata</i>			
1033.	6033 <i>Scholtzia involucrata</i> (Spiked Scholtzia)			
1034.	6034 <i>Scholtzia laxiflora</i>			
1035.	6035 <i>Scholtzia leptantha</i>			
1036.	6037 <i>Scholtzia parviflora</i>			
1037.	<i>Scholtzia</i> sp.			

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1038.	20379 <i>Scholtzia</i> sp. <i>Jurien</i> (R. Cranfield & P. Spencer RJC 8443)			
1039.	20382 <i>Scholtzia</i> sp. <i>Wongonderrah</i> (M.E. & M.R. Trudgen MET 12000)			
1040.	6039 <i>Scholtzia teretifolia</i>			
1041.	6041 <i>Scholtzia umbellifera</i>			
1042.	6057 <i>Thryptomene hyporhytis</i>			
1043.	6060 <i>Thryptomene mucronulata</i>			
1044.	<i>Thryptomene</i> sp.			
1045.	12388 <i>Verticordia acerosa</i> var. <i>preissii</i>			
1046.	12390 <i>Verticordia amphigia</i>		P3	
1047.	12393 <i>Verticordia aurea</i>		P4	
1048.	12396 <i>Verticordia blepharophylla</i>			
1049.	6071 <i>Verticordia brachypoda</i>			
1050.	6072 <i>Verticordia brownii</i>			
1051.	12401 <i>Verticordia centipeda</i>			
1052.	6073 <i>Verticordia chrysantha</i>			
1053.	12402 <i>Verticordia chrysanthella</i>			
1054.	6076 <i>Verticordia densiflora</i> (<i>Compacted Featherflower</i>)			
1055.	12411 <i>Verticordia densiflora</i> var. <i>cespitosa</i>			
1056.	15432 <i>Verticordia densiflora</i> var. <i>densiflora</i>			
1057.	12414 <i>Verticordia densiflora</i> var. <i>stelluligera</i>			
1058.	15620 <i>Verticordia endlicheriana</i> var. <i>manicula</i>			
1059.	12422 <i>Verticordia eriocephala</i> (<i>Common Cauliflower</i>)			
1060.	12425 <i>Verticordia fragrans</i>		P3	
1061.	6082 <i>Verticordia grandiflora</i> (<i>Claw Featherflower</i>)			
1062.	6083 <i>Verticordia grandis</i> (<i>Scarlet Featherflower</i>)			
1063.	6088 <i>Verticordia huegelii</i> (<i>Variogated Featherflower</i>)			
1064.	15433 <i>Verticordia huegelii</i> var. <i>huegelii</i>			
1065.	12434 <i>Verticordia insignis</i> subsp. <i>eomagis</i>		P3	
1066.	12437 <i>Verticordia laciniata</i>			
1067.	14688 <i>Verticordia luteola</i> var. <i>rosea</i>		P1	
1068.	14716 <i>Verticordia muelleriana</i> subsp. <i>muelleriana</i>		P3	
1069.	10822 <i>Verticordia nobilis</i>			
1070.	6103 <i>Verticordia ovalifolia</i>			
1071.	6107 <i>Verticordia pennigera</i>			
1072.	6109 <i>Verticordia picta</i> (<i>Painted Featherflower</i>)			
1073.	6110 <i>Verticordia plumosa</i> (<i>Plumed Featherflower</i>)			
1074.	12449 <i>Verticordia plumosa</i> var. <i>brachyphylla</i>			
1075.	12456 <i>Verticordia rutilastra</i>		P3	
1076.	<i>Verticordia</i> sp.			
1077.	12468 <i>Verticordia venusta</i>		P3	

Olacaceae

1078.	2365 <i>Olax benthamiana</i>			
1079.	2367 <i>Olax scalariformis</i>			

Onagraceae

1080.	6138 <i>Oenothera drummondii</i> (<i>Beach Evening Primrose</i>)	Y		
1081.	16390 <i>Oenothera drummondii</i> subsp. <i>drummondii</i>	Y		
1082.	14292 <i>Oenothera stricta</i> subsp. <i>stricta</i>	Y		

Orchidaceae

1083.	1582 <i>Caladenia crebra</i> (<i>Arrowsmith Spider Orchid</i>)			
1084.	44893 <i>Caladenia denticulata</i> subsp. <i>denticulata</i>			
1085.	15348 <i>Caladenia flava</i> subsp. <i>flava</i>			
1086.	15502 <i>Caladenia footeana</i>			
1087.	15354 <i>Caladenia hirta</i> subsp. <i>hirta</i>			
1088.	15358 <i>Caladenia longicauda</i> subsp. <i>albella</i>			
1089.	15360 <i>Caladenia longicauda</i> subsp. <i>borealis</i>			
1090.	15369 <i>Caladenia lorea</i>			
1091.	17760 <i>Caladenia nobilis</i>			
1092.	17589 <i>Caladenia occidentalis</i>			
1093.	1611 <i>Caladenia radialis</i> (<i>Drooping Spider Orchid</i>)			
1094.	18019 <i>Caladenia vulgata</i>			
1095.	15114 <i>Cyanicula gemmata</i>			
1096.	11049 <i>Diuris corymbosa</i>			
1097.	1634 <i>Diuris laxiflora</i> (<i>Bee Orchid</i>)			
1098.	42182 <i>Diuris perialla</i>			
1099.	42229 <i>Diuris segregata</i>			
1100.	42228 <i>Diuris septentrionalis</i>			
1101.	1638 <i>Diuris setacea</i> (<i>Bristly Donkey Orchid</i>)			
1102.	<i>Diuris</i> sp.			
1103.	44162 <i>Diuris tinkeri</i>			

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1104.	1643 <i>Elythranthera brunonis</i> (Purple Enamel Orchid)			
1105.	1644 <i>Elythranthera emarginata</i> (Pink Enamel Orchid)			
1106.	<i>Eriochilus</i> sp.			
1107.	1653 <i>Leporella fimbriata</i> (Hare Orchid)			
1108.	15418 <i>Leptoceras menziesii</i>			
1109.	1657 <i>Microtis alba</i> (White Mignonette Orchid)			
1110.	10954 <i>Microtis media</i> (Tall Mignonette Orchid)			
1111.	15419 <i>Microtis media</i> subsp. <i>media</i>			
1112.	13867 <i>Paracaleana dixonii</i>		T	
1113.	1667 <i>Paracaleana nigrita</i> (Flying Duck Orchid)			
1114.	20460 <i>Pheladenia deformis</i>			
1115.	1671 <i>Prasophyllum elatum</i> (Tall Leek Orchid)			
1116.	1672 <i>Prasophyllum fimbria</i> (Fringed Leek Orchid)			
1117.	16688 <i>Prasophyllum gracile</i>			
1118.	1677 <i>Prasophyllum macrostachyum</i> (Laughing Leek Orchid)			
1119.	1680 <i>Prasophyllum parvifolium</i> (Autumn Leek Orchid)			
1120.	10853 <i>Prasophyllum plumiforme</i>			
1121.	1682 <i>Prasophyllum sargentii</i>			
1122.	1687 <i>Pterostylis dilatata</i>			
1123.	45343 <i>Pterostylis platypetala</i>			
1124.	12217 <i>Pterostylis sanguinea</i>			
1125.	<i>Pterostylis scabrida</i>			
1126.	1698 <i>Pterostylis vittata</i> (Banded Greenhood)			
1127.	16367 <i>Pyrorchis nigricans</i> (Red beaks, Elephants ears)			
1128.	1701 <i>Thelymitra antennifera</i> (Vanilla Orchid)			
1129.	11032 <i>Thelymitra apiculata</i>		P4	
1130.	1702 <i>Thelymitra campanulata</i> (Shirt Orchid)			
1131.	20734 <i>Thelymitra pulcherima</i>		P2	
1132.	10862 <i>Thelymitra stellata</i> (Star Orchid)		T	
1133.	1717 <i>Thelymitra variegata</i> (Queen of Sheba)		P2	
1134.	1718 <i>Thelymitra villosa</i> (Custard Orchid)			
Orobanchaceae				
1135.	15037 <i>Bartsia trixago</i>	Y		
1136.	7122 <i>Orobanche minor</i> (Lesser Broomrape)	Y		
1137.	7089 <i>Parentucellia latifolia</i> (Common Bartsia)	Y		
Oxalidaceae				
1138.	30375 <i>Oxalis exilis</i>			
1139.	4352 <i>Oxalis glabra</i>	Y		
1140.	4355 <i>Oxalis perennans</i>			
Papaveraceae				
1141.	2969 <i>Fumaria capreolata</i> (Whiteflower Fumitory)	Y		
Philydraceae				
1142.	1173 <i>Philydrella pygmaea</i> (Butterfly Flowers)			
1143.	14306 <i>Philydrella pygmaea</i> subsp. <i>pygmaea</i>			
Phyllanthaceae				
1144.	4675 <i>Phyllanthus calycinus</i> (False Boronia)			
1145.	4691 <i>Poranthera microphylla</i> (Small Poranthera)			
Pittosporaceae				
1146.	25788 <i>Billardiera fraseri</i> (Elegant Pronaya)			
1147.	25779 <i>Billardiera venusta</i>			
1148.	19421 <i>Marianthus bicolor</i> (Painted Marianthus)			
1149.	17636 <i>Marianthus coeruleopunctatus</i> (Blue-spotted Marianthus)			
1150.	17633 <i>Marianthus erubescens</i>			
1151.	19745 <i>Pittosporum ligustrifolium</i>			
Poaceae				
1152.	196 <i>Amphipogon caricinus</i> (Long Greybeard Grass)			
1153.	12025 <i>Amphipogon caricinus</i> var. <i>caricinus</i>			
1154.	197 <i>Amphipogon debilis</i>			
1155.	20184 <i>Amphipogon laguroides</i> subsp. <i>laguroides</i>			
1156.	200 <i>Amphipogon turbinatus</i>			
1157.	<i>Aristida</i> sp.			
1158.	17234 <i>Austrostipa compressa</i>			
1159.	17237 <i>Austrostipa elegantissima</i>			
1160.	17240 <i>Austrostipa flavescens</i>			
1161.	17241 <i>Austrostipa hemipogon</i>			
1162.	17244 <i>Austrostipa macalpinei</i>			
1163.	19959 <i>Austrostipa</i> sp. <i>Cairn Hill</i> (M.E. Trudgen 21176)			

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			P3	
1164.	17254 <i>Austrostipa tenuifolia</i>			
1165.	17257 <i>Austrostipa variabilis</i>			
1166.	231 <i>Avellinia michelii</i>	Y		
1167.	233 <i>Avena barbata</i> (Bearded Oat)	Y		
1168.	8661 <i>Brachypodium distachyon</i> (False Brome)	Y		
1169.	244 <i>Briza maxima</i> (Blowfly Grass)	Y		
1170.	245 <i>Briza minor</i> (Shivery Grass)	Y		
1171.	249 <i>Bromus diandrus</i> (Great Brome)	Y		
1172.	250 <i>Bromus hordeaceus</i> (Soft Brome)	Y		
1173.	252 <i>Bromus madritensis</i> (Madrid Brome)	Y		
1174.	253 <i>Bromus rubens</i> (Red Brome)	Y		
1175.	283 <i>Cynodon dactylon</i> (Couch)	Y		
1176.	311 <i>Digitaria ciliaris</i> (Summer Grass)	Y		
1177.	347 <i>Ehrharta calycina</i> (Perennial Veldt Grass)	Y		
1178.	349 <i>Ehrharta longiflora</i> (Annual Veldt Grass)	Y		
1179.	379 <i>Eragrostis elongata</i> (Clustered Lovegrass)			
1180.	19954 <i>Lachnagrostis aemula</i>			
1181.	20019 <i>Lachnagrostis filiformis</i>			
1182.	19955 <i>Lachnagrostis plebeia</i>			
1183.	19956 <i>Lachnagrostis preissii</i>			
1184.	485 <i>Microlaena stipoides</i> (Weeping Grass)			
1185.	492 <i>Neurachne alopecuroidea</i> (Foxtail Mulga Grass)			
1186.	<i>Neurachne alopecuroidea</i>			
1187.	527 <i>Paspalum dilatatum</i>	Y		
1188.	40424 <i>Pentameris airoides</i> subsp. <i>airoides</i>	Y		
1189.	571 <i>Poa annua</i> (Winter Grass)	Y		
1190.	573 <i>Poa drummondiana</i> (Knotted Poa)			
1191.	578 <i>Poa porphyroclados</i>			
1192.	582 <i>Polypogon monspeliensis</i> (Annual Beardgrass)	Y		
1193.	583 <i>Polypogon tenellus</i>			
1194.	40431 <i>Rytidosperma acerosum</i>			
1195.	40425 <i>Rytidosperma caespitosum</i>			
1196.	40426 <i>Rytidosperma occidentale</i>			
1197.	635 <i>Sporobolus virginicus</i> (Marine Couch)			
1198.	673 <i>Themeda triandra</i>			
1199.	722 <i>Vulpia bromoides</i> (Squirrel Tail Fescue)	Y		
1200.	11137 <i>Vulpia fasciculata</i>	Y		
1201.	11018 <i>Vulpia muralis</i>	Y		
1202.	33101 <i>Vulpia myuros</i> forma <i>myuros</i>	Y		

Polygalaceae

1203.	4549 <i>Comesperma acerosum</i>			
1204.	4550 <i>Comesperma calymega</i> (Blue-spike Milkwort)			
1205.	4551 <i>Comesperma ciliatum</i>			
1206.	4552 <i>Comesperma confertum</i>			
1207.	4553 <i>Comesperma drummondii</i> (Drummond's Milkwort)			
1208.	4554 <i>Comesperma flavum</i>			
1209.	4561 <i>Comesperma scoparium</i> (Broom Milkwort)			
1210.	<i>Comesperma</i> sp.			
1211.	4564 <i>Comesperma virgatum</i> (Milkwort)			
1212.	4566 <i>Comesperma volubile</i> (Love Creeper)			

Polygonaceae

1213.	2412 <i>Muehlenbeckia adpressa</i> (Climbing Lignum)			
1214.	2415 <i>Muehlenbeckia polybotrya</i>			
1215.	13911 <i>Persicaria decipiens</i>			

Portulacaceae

1216.	44184 <i>Calandrinia baccata</i>			
1217.	2846 <i>Calandrinia calyptata</i> (Pink Purslane)			
1218.	2847 <i>Calandrinia composita</i>			
1219.	2848 <i>Calandrinia corrigioloides</i> (Strap Purslane)			
1220.	2860 <i>Calandrinia polyandra</i> (Parakeelya)			
1221.	2861 <i>Calandrinia polypetala</i>			
1222.	16365 <i>Calandrinia</i> sp. Kenwick (G.J. Keighery 10905)			

Primulaceae

1223.	36375 <i>Lysimachia arvensis</i> (Pimpernel)	Y		
1224.	6483 <i>Samolus junceus</i>			
1225.	6484 <i>Samolus repens</i> (Creeping Brookweed)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
Proteaceae				
1226.	1775 <i>Adenanthos cygnorum</i> (Common Woollybush)			
1227.	11837 <i>Adenanthos cygnorum</i> subsp. <i>cygnorum</i> (Common Woollybush)			
1228.	1779 <i>Adenanthos drummondii</i>			
1229.	1794 <i>Adenanthos sericeus</i> (Woolly Bush)			
1230.	32684 <i>Banksia arctotidis</i>			
1231.	32681 <i>Banksia armata</i> (Prickly Dryandra)			
1232.	32682 <i>Banksia armata</i> var. <i>armata</i>			
1233.	1800 <i>Banksia attenuata</i> (Slender Banksia, Piara)			
1234.	32679 <i>Banksia bipinnatifida</i> subsp. <i>multifida</i>			
1235.	1809 <i>Banksia candolleana</i> (Propeller Banksia)			
1236.	32623 <i>Banksia carlinoides</i> (Pink Dryandra)			
1237.	32622 <i>Banksia catoglypta</i>		T	
1238.	1810 <i>Banksia chamaephyton</i> (Fishbone Banksia)		P4	
1239.	32578 <i>Banksia dallanneyi</i> subsp. <i>media</i>			
1240.	1816 <i>Banksia elegans</i> (Elegant Banksia)		P4	
1241.	32524 <i>Banksia fraseri</i> var. <i>ashbyi</i>			
1242.	32527 <i>Banksia fraseri</i> var. <i>crebra</i>		P3	
1243.	32526 <i>Banksia fraseri</i> var. <i>effusa</i>		P2	Y
1244.	32523 <i>Banksia fraseri</i> var. <i>fraseri</i>			
1245.	32519 <i>Banksia glaucifolia</i>			
1246.	1819 <i>Banksia grandis</i> (Bull Banksia, Pulgarla)			
1247.	1820 <i>Banksia grossa</i>			
1248.	32518 <i>Banksia hewardiana</i>			
1249.	1821 <i>Banksia hookeriana</i> (Hooker's Banksia)			
1250.	1822 <i>Banksia ilicifolia</i> (Holly-leaved Banksia)			
1251.	1823 <i>Banksia incana</i>			
1252.	33398 <i>Banksia incana</i> var. <i>brachyphylla</i>			
1253.	33399 <i>Banksia incana</i> var. <i>incana</i>			
1254.	32214 <i>Banksia kippistiana</i>			
1255.	32215 <i>Banksia kippistiana</i> var. <i>kippistiana</i>			
1256.	32216 <i>Banksia kippistiana</i> var. <i>paenepeccata</i>		P3	
1257.	1825 <i>Banksia lanata</i>			
1258.	1828 <i>Banksia leptophylla</i>			
1259.	11714 <i>Banksia leptophylla</i> var. <i>leptophylla</i>			
1260.	11386 <i>Banksia leptophylla</i> var. <i>melletica</i>			
1261.	1830 <i>Banksia littoralis</i> (Swamp Banksia, Pungura)			
1262.	1834 <i>Banksia menziesii</i> (Firewood Banksia)			
1263.	1835 <i>Banksia micrantha</i>			
1264.	32206 <i>Banksia nana</i> (Dwarf Dryandra)			
1265.	32202 <i>Banksia nivea</i> (Honeypot Dryandra, Pudjarn)			
1266.	32203 <i>Banksia nivea</i> subsp. <i>nivea</i>			
1267.	32201 <i>Banksia nobilis</i> subsp. <i>fragrans</i>		P3	
1268.	32163 <i>Banksia platycarpa</i>			
1269.	1842 <i>Banksia prionotes</i> (Acorn Banksia)			
1270.	32086 <i>Banksia sclerophylla</i>			
1271.	32083 <i>Banksia serratuloides</i> subsp. <i>perissa</i>		T	
1272.	32077 <i>Banksia sessilis</i> var. <i>cygnorum</i>			
1273.	32079 <i>Banksia sessilis</i> var. <i>flabellifolia</i>			
1274.	32074 <i>Banksia shuttleworthiana</i> (Bearded Dryandra)			
1275.	<i>Banksia</i> sp.			
1276.	1851 <i>Banksia sphaerocarpa</i> (Round-fruit Banksia)			
1277.	33401 <i>Banksia sphaerocarpa</i> var. <i>pumilio</i>			
1278.	12111 <i>Banksia sphaerocarpa</i> var. <i>sphaerocarpa</i> (Fox Banksia)			
1279.	32073 <i>Banksia splendida</i> subsp. <i>macrocarpa</i>		P3	
1280.	32043 <i>Banksia stenoprion</i>			
1281.	32042 <i>Banksia strictifolia</i>			
1282.	32037 <i>Banksia subulata</i> (Awled Honeypot)		P3	
1283.	1852 <i>Banksia telmatiaea</i> (Swamp Fox Banksia)			
1284.	32033 <i>Banksia tortifolia</i>			
1285.	1853 <i>Banksia tricuspis</i> (Pine Banksia)		P4	
1286.	32032 <i>Banksia tridentata</i> (Yellow Honeypot)			
1287.	1857 <i>Conospermum acerosum</i> (Needle-leaved Smokebush)			
1288.	15511 <i>Conospermum boreale</i>			
1289.	15512 <i>Conospermum boreale</i> subsp. <i>ascendens</i>			
1290.	15513 <i>Conospermum boreale</i> subsp. <i>boreale</i>			
1291.	1859 <i>Conospermum brachyphyllum</i>			
1292.	1861 <i>Conospermum brownii</i> (Blue-eyed Smokebush)			
1293.	15041 <i>Conospermum canaliculatum</i>			
1294.	15517 <i>Conospermum canaliculatum</i> subsp. <i>apiculatum</i>			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
1295.	15516 <i>Conospermum canaliculatum</i> subsp. <i>canaliculatum</i>			
1296.	1864 <i>Conospermum crassinervium</i> (Summer Smokebush)			
1297.	1874 <i>Conospermum glumaceum</i> (Hooded Smokebush)			
1298.	1876 <i>Conospermum incurvum</i> (Plume Smokebush)			
1299.	1878 <i>Conospermum nervosum</i>			
1300.	1881 <i>Conospermum scaposum</i>		P3	
1301.	<i>Conospermum</i> sp.			
1302.	1882 <i>Conospermum stoechadis</i> (Common Smokebush)			
1303.	15520 <i>Conospermum stoechadis</i> subsp. <i>sclerophyllum</i>			
1304.	15611 <i>Conospermum stoechadis</i> subsp. <i>stoechadis</i> (Common Smokebush)			
1305.	1885 <i>Conospermum triplinervium</i> (Tree Smokebush)			
1306.	15521 <i>Conospermum unilaterale</i>			
1307.	15523 <i>Conospermum wycherleyi</i>			
1308.	15524 <i>Conospermum wycherleyi</i> subsp. <i>glabrum</i>			
1309.	15522 <i>Conospermum wycherleyi</i> subsp. <i>wycherleyi</i>			
1310.	1948 <i>Grevillea acrobotrya</i>			
1311.	1956 <i>Grevillea argyrophylla</i> (Silvery-leaved Grevillea)			
1312.	1960 <i>Grevillea batrachioides</i>		T	Y
1313.	15763 <i>Grevillea biformis</i> subsp. <i>biformis</i>			
1314.	15815 <i>Grevillea delta</i>		P2	Y
1315.	2001 <i>Grevillea eriostachya</i> (Flame Grevillea, Kaliny-kalinynga)			
1316.	19567 <i>Grevillea florida</i>		P3	
1317.	15987 <i>Grevillea humifusa</i>		T	
1318.	17440 <i>Grevillea metamorpha</i>		P1	Y
1319.	2054 <i>Grevillea olivacea</i> (Olive Grevillea)		P4	
1320.	8838 <i>Grevillea pinaster</i>			
1321.	8839 <i>Grevillea preissii</i>			
1322.	15838 <i>Grevillea preissii</i> subsp. <i>glabrilimba</i>			
1323.	15839 <i>Grevillea preissii</i> subsp. <i>preissii</i>			
1324.	2086 <i>Grevillea rudis</i>		P4	
1325.	2087 <i>Grevillea saccata</i> (Pouched Grevillea)		P4	
1326.	17745 <i>Grevillea shuttleworthiana</i> subsp. <i>canarina</i>			
1327.	<i>Grevillea</i> sp.			
1328.	2101 <i>Grevillea synapheae</i> (Catkin Grevillea)			
1329.	14420 <i>Grevillea synapheae</i> subsp. <i>pachyphylla</i>			
1330.	37180 <i>Grevillea thelemanniana</i> subsp. <i>Cooljarloo</i> (B.J. Keighery 28 B)		P1	
1331.	14422 <i>Grevillea thyrsooides</i> subsp. <i>pustulata</i>		P3	
1332.	14423 <i>Grevillea thyrsooides</i> subsp. <i>thyrsooides</i>		P3	
1333.	2115 <i>Grevillea umbellulata</i>			
1334.	2116 <i>Grevillea uncinulata</i> (Hook-leaf Grevillea)			
1335.	19231 <i>Grevillea uncinulata</i> subsp. <i>Coomallo</i> (S.J. Patrick 719)			
1336.	<i>Grevillea uncinulata</i> subsp. <i>coomallo</i> (s.j.patrick 719)			
1337.	13900 <i>Grevillea uniformis</i>		P3	
1338.	12824 <i>Grevillea vestita</i> subsp. <i>vestita</i>			
1339.	17670 <i>Hakea anadenia</i>			
1340.	2131 <i>Hakea auriculata</i>			
1341.	12225 <i>Hakea brownii</i>			
1342.	2140 <i>Hakea circumalata</i>			
1343.	2143 <i>Hakea conchifolia</i> (Shell-leaved Hakea)			
1344.	2146 <i>Hakea costata</i> (Ribbed Hakea)			
1345.	16908 <i>Hakea eneabba</i>			
1346.	2158 <i>Hakea erinacea</i> (Hedge-hog Hakea)			
1347.	2161 <i>Hakea flabellifolia</i> (Fan-leaved Hakea)			
1348.	2164 <i>Hakea gilbertii</i>			
1349.	2166 <i>Hakea incrassata</i> (Marble Hakea)			
1350.	2175 <i>Hakea lissocarpha</i> (Honey Bush)			
1351.	12230 <i>Hakea longiflora</i>		P3	
1352.	2179 <i>Hakea marginata</i>			
1353.	2180 <i>Hakea megalosperma</i> (Lesueur Hakea)		T	
1354.	45333 <i>Hakea neospathulata</i>			
1355.	2186 <i>Hakea neurophylla</i>		P4	
1356.	2197 <i>Hakea prostrata</i> (Harsh Hakea)			
1357.	12233 <i>Hakea psilorhyncha</i>			
1358.	2203 <i>Hakea ruscifolia</i> (Candle Hakea)			
1359.	2205 <i>Hakea smilacifolia</i>			
1360.	<i>Hakea</i> sp.			
1361.	2206 <i>Hakea stenocarpa</i> (Narrow-fruited Hakea)			
1362.	2214 <i>Hakea trifurcata</i> (Two-leaf Hakea)			
1363.	2216 <i>Hakea varia</i> (Variable-leaved Hakea)			
1364.	2219 <i>Isopogon adenanthoides</i> (Spider Coneflower)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
1365.	2221 <i>Isopogon asper</i>			
1366.	2227 <i>Isopogon divergens</i> (Spreading Coneflower)			
1367.	2228 <i>Isopogon drummondii</i>		P3	
1368.	2229 <i>Isopogon dubius</i> (Pincushion Coneflower)			
1369.	16873 <i>Isopogon inconspicuus</i>			
1370.	2232 <i>Isopogon linearis</i>			
1371.	37881 <i>Isopogon panduratus</i> subsp. <i>panduratus</i>			
1372.	2237 <i>Isopogon sphaerocephalus</i> (Drumstick Isopogon)			
1373.	14439 <i>Isopogon teretifolius</i> subsp. <i>teretifolius</i> (Nodding Coneflower)			
1374.	2239 <i>Isopogon tridens</i> (Three-toothed Coneflower)			
1375.	2249 <i>Lambertia multiflora</i> (Many-flowered Honeysuckle)			
1376.	15528 <i>Lambertia multiflora</i> var. <i>multiflora</i>			
1377.	2258 <i>Persoonia comata</i>			
1378.	14563 <i>Persoonia filiformis</i>		P2	
1379.	2271 <i>Persoonia rudis</i>		P3	
1380.	2272 <i>Persoonia rufiflora</i>			
1381.	2281 <i>Persoonia trinervis</i>			
1382.	14368 <i>Petrophile aculeata</i>			
1383.	20368 <i>Petrophile axillaris</i>			
1384.	2286 <i>Petrophile brevifolia</i>			
1385.	2288 <i>Petrophile chrysantha</i>			
1386.	2299 <i>Petrophile linearis</i> (Pixie Mops)			
1387.	2301 <i>Petrophile macrostachya</i>			
1388.	2303 <i>Petrophile megalostegia</i>			
1389.	19769 <i>Petrophile nivea</i>		T	Y
1390.	29208 <i>Petrophile pilostyla</i> subsp. <i>austrina</i>			
1391.	16874 <i>Petrophile recurva</i>			
1392.	2306 <i>Petrophile rigida</i>			
1393.	10784 <i>Petrophile scabriuscula</i>			
1394.	2308 <i>Petrophile seminuda</i>			
1395.	2309 <i>Petrophile serruriae</i>			
1396.	2310 <i>Petrophile shuttleworthiana</i>			
1397.	<i>Petrophile</i> sp.			
1398.	2312 <i>Petrophile striata</i>			
1399.	12856 <i>Stirlingia abrotanoides</i>			
1400.	2316 <i>Stirlingia latifolia</i> (Blueboy)			
1401.	2317 <i>Stirlingia simplex</i>			
1402.	<i>Stirlingia</i> sp.			
1403.	2319 <i>Strangea cynanchicarpa</i> (Heath Strangea)			
1404.	16882 <i>Synaphea aephyrsa</i>			
1405.	16858 <i>Synaphea endoctrinx</i>		P3	
1406.	15530 <i>Synaphea lesueurensis</i>		P2	
1407.	2329 <i>Synaphea spinulosa</i>			
1408.	15532 <i>Synaphea spinulosa</i> subsp. <i>spinulosa</i>			
1409.	30452 <i>Synaphea xela</i>		P2	
1410.	2330 <i>Xylomelum angustifolium</i> (Sandplain Woody Pear)			
Pteridaceae				
1411.	29 <i>Anogramma leptophylla</i> (Annual Fern)			
1412.	31 <i>Cheilanthes austrotenuifolia</i>			
1413.	12818 <i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>			
Ranunculaceae				
1414.	10804 <i>Clematis linearifolia</i>			
1415.	2932 <i>Ranunculus colonorum</i> (Common Buttercup)			
Restionaceae				
1416.	1056 <i>Alexgeorgea nitens</i>			
1417.	1057 <i>Alexgeorgea subterranea</i>			
1418.	17685 <i>Chaetanthus aristatus</i>			
1419.	17827 <i>Chordifex chaunocoleus</i>		P4	
1420.	17833 <i>Chordifex microcodon</i>			
1421.	17706 <i>Chordifex sinuosus</i>			
1422.	<i>Chordifex</i> sp.			
1423.	17826 <i>Chordifex stenandrus</i>			
1424.	17663 <i>Desmocladius asper</i>			
1425.	15831 <i>Desmocladius castaneus</i>			
1426.	15828 <i>Desmocladius elongatus</i>		P4	
1427.	17691 <i>Desmocladius fasciculatus</i>			
1428.	16595 <i>Desmocladius flexuosus</i>			
1429.	17662 <i>Desmocladius lateriticus</i>			
1430.	17846 <i>Desmocladius parthenicus</i>			

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1431.	17712 <i>Desmocladus semiplanus</i>			
1432.	16455 <i>Desmocladus virgatus</i>			
1433.	1068 <i>Harperia lateriflora</i>			
1434.	1070 <i>Hypolaena exsulca</i>			
1435.	17622 <i>Hypolaena robusta</i>		P4	
1436.	1073 <i>Lepidobolus chaetocephalus</i> (Bristle-headed Chaff Rush)			
1437.	1075 <i>Lepidobolus preissianus</i>			
1438.	18074 <i>Lepidobolus preissianus</i> subsp. <i>preissianus</i>			
1439.	13775 <i>Lepidobolus quadratus</i>		P3	
1440.	<i>Lepidobolus quadratus</i> MS			
1441.	<i>Lepidobolus</i> sp.			
1442.	19241 <i>Lepyrodia curvescens</i>		P2	
1443.	<i>Lepyrodia curvescens</i> MS			
1444.	17837 <i>Loxocarya gigas</i>		P2	
1445.	17683 <i>Meeboldina cana</i>			
1446.	17679 <i>Meeboldina coangustata</i>			

Rhamnaceae

1447.	31571 <i>Cryptandra intermedia</i>			
1448.	9076 <i>Cryptandra myriantha</i>			
1449.	4804 <i>Cryptandra nutans</i>			
1450.	4809 <i>Cryptandra pungens</i>			
1451.	4810 <i>Cryptandra scoparia</i>			
1452.	<i>Cryptandra</i> sp.			
1453.	4811 <i>Cryptandra spyridioides</i>			
1454.	29919 <i>Polianthion wichurae</i>			
1455.	<i>Pomaderris</i> sp.			
1456.	4828 <i>Spyridium globulosum</i> (Basket Bush)			
1457.	<i>Spyridium</i> sp.			
1458.	13475 <i>Stenanthemum humile</i>			
1459.	14236 <i>Stenanthemum limitatum</i>		P2	
1460.	16182 <i>Stenanthemum notiale</i>			
1461.	15065 <i>Stenanthemum notiale</i> subsp. <i>notiale</i>			
1462.	14240 <i>Stenanthemum reissekii</i>			
1463.	<i>Stenanthemum</i> sp.			
1464.	4839 <i>Trymalium angustifolium</i>			
1465.	11665 <i>Trymalium ledifolium</i> var. <i>ledifolium</i>			
1466.	13479 <i>Trymalium ledifolium</i> var. <i>rosmarinifolium</i>			
1467.	33418 <i>Trymalium odoratissimum</i> subsp. <i>odoratissimum</i>			
1468.	15757 <i>Trymalium spatulatum</i>			

Rubiaceae

1469.	7323 <i>Galium murale</i> (Small Goosegrass)	Y		
1470.	18255 <i>Opercularia vaginata</i> (Dog Weed)			

Rutaceae

1471.	4397 <i>Asterolasia drummondii</i> (Gairdner Range Starbush)		P4	
1472.	4400 <i>Asterolasia pallida</i>			
1473.	4406 <i>Boronia busselliana</i>			
1474.	4409 <i>Boronia coerulescens</i>			
1475.	4411 <i>Boronia crassifolia</i>			
1476.	4414 <i>Boronia cymosa</i> (Granite Boronia)			
1477.	4438 <i>Boronia ramosa</i>			
1478.	11381 <i>Boronia ramosa</i> subsp. <i>anethifolia</i>			
1479.	16625 <i>Boronia ramosa</i> subsp. <i>lesueurana</i>		P2	Y
1480.	11564 <i>Boronia ramosa</i> subsp. <i>ramosa</i>			
1481.	16637 <i>Boronia scabra</i> subsp. <i>condensata</i>		P2	
1482.	16639 <i>Boronia scabra</i> subsp. <i>scabra</i>			
1483.	4443 <i>Boronia subsessilis</i>			
1484.	4453 <i>Diplolaena angustifolia</i> (Yanchep Rose)			
1485.	15272 <i>Diplolaena cinerea</i>			
1486.	4454 <i>Diplolaena dampieri</i> (Southern Diplolaena)			
1487.	15271 <i>Diplolaena eneabbensis</i>			
1488.	4455 <i>Diplolaena ferruginea</i>			
1489.	15275 <i>Diplolaena obovata</i>			
1490.	4483 <i>Geleznovia verrucosa</i>			
1491.	18535 <i>Philothea pinoides</i>			
1492.	18529 <i>Philothea spicata</i> (Pepper and Salt)			

Santalaceae

1493.	10765 <i>Exocarpos sparteus</i> (Broom Ballart, Djuk)			
1494.	2344 <i>Leptomeria empetriformis</i>			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
1495.	2352 <i>Leptomeria preissiana</i>			
1496.	2356 <i>Santalum acuminatum</i> (Quandong, Warrga)			
Sapindaceae				
1497.	4746 <i>Diplopeltis huegelii</i>			
1498.	18541 <i>Diplopeltis huegelii</i> subsp. <i>huegelii</i>			
1499.	18589 <i>Diplopeltis huegelii</i> subsp. <i>lehmannii</i>			
1500.	18542 <i>Diplopeltis huegelii</i> subsp. <i>subintegra</i>			
1501.	4754 <i>Dodonaea aptera</i> (Coast Hop-bush)			
1502.	4761 <i>Dodonaea ericoides</i>			
1503.	<i>Dodonaea</i> sp.			
Scrophulariaceae				
1504.	7055 <i>Dischisma capitatum</i> (Woolly-headed <i>Dischisma</i>)	Y		
1505.	17175 <i>Eremophila glabra</i> subsp. <i>albicans</i>			
1506.	7289 <i>Myoporum caprarioides</i> (Slender <i>Myoporum</i>)			
1507.	7291 <i>Myoporum insulare</i> (Blueberry Tree, boobialla)			
1508.	7113 <i>Zaluzianskya divaricata</i> (Spreading Night Phlox)	Y		
Selaginellaceae				
1509.	6 <i>Selaginella gracillima</i> (Tiny Clubmoss)			
Solanaceae				
1510.	11725 <i>Anthocercis ilicifolia</i> subsp. <i>ilicifolia</i>			
1511.	6949 <i>Anthocercis littorea</i> (Yellow Tailflower)			
1512.	7013 <i>Solanum hoplopetalum</i> (Thorny Solanum)			
1513.	7018 <i>Solanum lasiophyllum</i> (Flannel Bush, Mindjulu)			
1514.	7022 <i>Solanum nigrum</i> (Black Berry Nightshade)	Y		
1515.	7034 <i>Solanum simile</i> (Ondoroo)			
1516.	<i>Solanum</i> sp.			
1517.	7037 <i>Solanum symonii</i>			
Stylidiaceae				
1518.	39820 <i>Levenhookia murfetii</i>			
1519.	7672 <i>Levenhookia octomaculata</i> (Eight-spotted Stylewort)			
1520.	7676 <i>Levenhookia pusilla</i> (Midget Stylewort)			
1521.	7677 <i>Levenhookia stipitata</i> (Common Stylewort)			
1522.	7679 <i>Stylidium adpressum</i> (Trigger-on-stilts)			
1523.	7680 <i>Stylidium aeonioides</i>		P4	
1524.	12846 <i>Stylidium albolilacinum</i>			
1525.	30278 <i>Stylidium androsaceum</i>			
1526.	25831 <i>Stylidium araeophyllum</i> (Stilt Walker)			
1527.	30276 <i>Stylidium bicolor</i>			
1528.	7693 <i>Stylidium brunonianum</i> (Pink Fountain Triggerplant)			
1529.	17187 <i>Stylidium burbidgeanum</i>			
1530.	7696 <i>Stylidium calcaratum</i> (Book Triggerplant)			
1531.	7699 <i>Stylidium carnosum</i> (Fleshy-leaved Triggerplant)			
1532.	30715 <i>Stylidium carnosum</i> subsp. <i>Narrow leaves</i> (J.A. Wege 490)		P1	
1533.	7709 <i>Stylidium crossocephalum</i> (Posy Triggerplant)			
1534.	7710 <i>Stylidium cygnorum</i>			
1535.	40944 <i>Stylidium decipiens</i>			
1536.	7712 <i>Stylidium despectum</i> (Dwarf Triggerplant)			
1537.	7713 <i>Stylidium dichotomum</i> (Pins-and-needles)			
1538.	20531 <i>Stylidium diplotrichum</i>		P2	
1539.	11808 <i>Stylidium diuroides</i> subsp. <i>diuroides</i>			
1540.	12848 <i>Stylidium diuroides</i> subsp. <i>paucifoliatum</i>			
1541.	7719 <i>Stylidium ecome</i> (Foot Triggerplant)			
1542.	7720 <i>Stylidium elongatum</i> (Tall Triggerplant)			
1543.	19251 <i>Stylidium eriopodium</i>			
1544.	18420 <i>Stylidium flagellum</i>			
1545.	25801 <i>Stylidium hesperium</i>			
1546.	7742 <i>Stylidium inundatum</i> (Hundreds and Thousands)			
1547.	7743 <i>Stylidium inversiflorum</i>		P4	
1548.	7745 <i>Stylidium junceum</i> (Reed Triggerplant)			
1549.	17412 <i>Stylidium kalbarriense</i>			
1550.	7749 <i>Stylidium leptophyllum</i> (Needle-leaved Triggerplant)			
1551.	7760 <i>Stylidium maitlandianum</i> (Fountain Triggerplant)			
1552.	13127 <i>Stylidium maritimum</i>		P3	
1553.	7762 <i>Stylidium miniatum</i> (Pink Butterfly Triggerplant)			
1554.	7766 <i>Stylidium nonscandens</i>		P3	
1555.	7768 <i>Stylidium obtusatum</i> (Pinafore Triggerplant)			
1556.	7771 <i>Stylidium periscelanthum</i> (Pantaloon Triggerplant)		P3	
1557.	7774 <i>Stylidium piliferum</i> (Common Butterfly Triggerplant)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
1558.	25837 <i>Stylidium purpureum</i> (Purple Fountain Triggerplant)			
1559.	<i>Stylidium purpureum</i> MS			
1560.	7783 <i>Stylidium pycnostachyum</i> (Downy Triggerplant)			
1561.	7785 <i>Stylidium repens</i> (Matted Triggerplant)			
1562.	20521 <i>Stylidium rigidulum</i>			
1563.	7790 <i>Stylidium roseoalatum</i> (Pink-wing Triggerplant)			
1564.	25806 <i>Stylidium scariosum</i>			
1565.	7798 <i>Stylidium schoenoides</i> (Cow Kicks)			
1566.	<i>Stylidium</i> sp.			
1567.	30275 <i>Stylidium</i> sp. Banovich Road (F. & J. Hort 1884)		P1	Y
1568.	20608 <i>Stylidium stenosepalum</i>			
1569.	17414 <i>Stylidium torticarpum</i>		P3	
1570.	17578 <i>Stylidium udusicola</i>			

Surianaceae

1571.	3181 <i>Stylobasium australe</i>			
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Thymelaeaceae

1572.	5231 <i>Pimelea angustifolia</i> (Narrow-leaved Pimelea)			
1573.	5232 <i>Pimelea argentea</i> (Silvery Leaved Pimelea)			
1574.	5244 <i>Pimelea floribunda</i>			
1575.	11402 <i>Pimelea imbricata</i> var. <i>piligera</i>			
1576.	5254 <i>Pimelea leucantha</i>			
1577.	<i>Pimelea ligustrina</i> subsp. <i>ligustrina</i>			
1578.	<i>Pimelea</i> sp.			
1579.	5266 <i>Pimelea suaveolens</i> (Scented Banjine)			
1580.	12041 <i>Pimelea suaveolens</i> subsp. <i>suaveolens</i>			
1581.	5268 <i>Pimelea sulphurea</i> (Yellow Banjine)			
1582.	5272 <i>Pimelea villifera</i>			

Typhaceae

1583.	98 <i>Typha domingensis</i> (Bulrush, Djandjidi)			
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Urticaceae

1584.	1762 <i>Parietaria debilis</i> (Pellitory)			
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Violaceae

1585.	5216 <i>Hybanthus calycinus</i> (Wild Violet)			
1586.	5221 <i>Hybanthus floribundus</i>			
1587.	15553 <i>Hybanthus floribundus</i> subsp. <i>Hill River</i> (E.M. Bennett 2252)			
1588.	12007 <i>Hybanthus floribundus</i> subsp. <i>floribundus</i>			

Vitaceae

1589.	4853 <i>Clematicissus angustissima</i>			
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Xanthorrhoeaceae

1590.	1249 <i>Xanthorrhoea acanthostachya</i>			
1591.	1256 <i>Xanthorrhoea preissii</i> (Grass tree, Palga)			
1592.	<i>Xanthorrhoea</i> sp.			
1593.	20658 <i>Xanthorrhoea</i> sp. <i>Lesueur</i> (G.J. Keighery 16404)			Y

Zamiaceae

1594.	18119 <i>Macrozamia fraseri</i>			
1595.	85 <i>Macrozamia riedlei</i> (<i>Zamia</i> , Djiridji)			

Conservation Codes

T - Rare or likely to become extinct
 X - Presumed extinct
 IA - Protected under international agreement
 S - Other specially protected fauna
 1 - Priority 1
 2 - Priority 2
 3 - Priority 3
 4 - Priority 4
 5 - Priority 5

¹ For NatureMap's purposes, species flagged as endemic are those whose records are wholly contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

Hill River Fauna NatureMap Species Report

Created By Guest user on 20/07/2016

Kingdom Animalia
Current Names Only Yes
Core Datasets Only Yes
Method 'By Circle'
Centre 115° 14' 11" E, 30° 11' 31" S
Buffer 20km
Group By Species Group

Species Group	Species	Records
Amphibian	11	140
Bird	137	2193
Fish	6	76
Invertebrate	152	260
Mammal	17	451
Reptile	50	1026
TOTAL	373	4146

Name ID	Species Name	Naturalised	Conservation Code	Endemic To Query Area
Amphibian				
1.	25401 <i>Crinia pseudinsignifera</i> (Bleating Froglet)			
2.	25408 <i>Heleioporus albopunctatus</i> (Western Spotted Frog)			
3.	25410 <i>Heleioporus eyrei</i> (Moaning Frog)			
4.	25412 <i>Heleioporus psammophilus</i> (Sand Frog)			
5.	<i>Heleioporus</i> sp.			
6.	25415 <i>Limnodynastes dorsalis</i> (Western Banjo Frog)			
7.	25378 <i>Litoria adelaidensis</i> (Slender Tree Frog)			
8.	25388 <i>Litoria moorei</i> (Motorbike Frog)			
9.	25420 <i>Myobatrachus gouldii</i> (Turtle Frog)			
10.	25426 <i>Neobatrachus pelobatoides</i> (Humming Frog)			
11.	25433 <i>Pseudophryne guentheri</i> (Crawling Toadlet)			
Bird				
12.	24559 <i>Acanthagenys rufogularis</i> (Spiny-cheeked Honeyeater)			
13.	24260 <i>Acanthiza apicalis</i> (Broad-tailed Thornbill, Inland Thornbill)			
14.	24261 <i>Acanthiza chrysorrhoa</i> (Yellow-rumped Thornbill)			
15.	24262 <i>Acanthiza inornata</i> (Western Thornbill)			
16.	24265 <i>Acanthiza uropygialis</i> (Chestnut-rumped Thornbill)			
17.	24560 <i>Acanthorhynchus superciliosus</i> (Western Spinebill)			
18.	25536 <i>Accipiter fasciatus</i> (Brown Goshawk)			
19.	24310 <i>Anas castanea</i> (Chestnut Teal)			
20.	24312 <i>Anas gracilis</i> (Grey Teal)			
21.	24315 <i>Anas rhynchotis</i> (Australasian Shoveler)			
22.	24316 <i>Anas superciliosa</i> (Pacific Black Duck)			
23.	24561 <i>Anthochaera carunculata</i> (Red Wattlebird)			
24.	24562 <i>Anthochaera lunulata</i> (Western Little Wattlebird)			
25.	<i>Aquila (Uroaetus) audax</i>			
26.	24285 <i>Aquila audax</i> (Wedge-tailed Eagle)			
27.	41324 <i>Ardea modesta</i> (Eastern Great Egret)		IA	
28.	24341 <i>Ardea pacifica</i> (White-necked Heron)			
29.	24610 <i>Ardeotis australis</i> (Australian Bustard)			
30.	25566 <i>Artamus cinereus</i> (Black-faced Woodswallow)			
31.	24353 <i>Artamus cyanopterus</i> (Dusky Woodswallow)			
32.	24356 <i>Artamus personatus</i> (Masked Woodswallow)			
33.	<i>Barnardius zonarius</i>			
34.	<i>Barnardius zonarius</i> subsp. <i>semitorquatus</i>			
35.	24319 <i>Biziura lobata</i> (Musk Duck)			
36.	<i>Cacatua (Licmetis) pastinator</i>			
37.	<i>Cacatua (Licmetis) pastinator</i> subsp. <i>derbyi</i>			
38.	<i>Cacatua (Licmetis) sanguinea</i> subsp. <i>sanguinea</i>			
39.	25714 <i>Cacatua pastinator</i> (Western Long-billed Corella)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
40.	24723 <i>Cacatua pastinator</i> subsp. <i>butleri</i> (Butler's Corella)			
41.	24725 <i>Cacatua roseicapilla</i> subsp. <i>assimilis</i> (Galah)			
42.	25716 <i>Cacatua sanguinea</i> (Little Corella)			
43.	<i>Cacatua</i> sp.			
44.	25598 <i>Cacomantis flabelliformis</i> (Fan-tailed Cuckoo)			
45.	42307 <i>Cacomantis pallidus</i> (Pallid Cuckoo)			
46.	<i>Calamanthus</i> (<i>Calamanthus</i>) <i>campestris</i> subsp. <i>montanellus</i>			
47.	24269 <i>Calamanthus campestris</i> (Rufous Fieldwren)			
48.	24779 <i>Calidris acuminata</i> (Sharp-tailed Sandpiper)		IA	
49.	24780 <i>Calidris alba</i> (Sanderling)		IA	
50.	<i>Calyptorhynchus</i> (<i>Zanda</i>) <i>baudinii</i>			
51.	<i>Calyptorhynchus</i> (<i>Zanda</i>) <i>latirostris</i>			
52.	24734 <i>Calyptorhynchus latirostris</i> (Carnaby's Cockatoo (short-billed black-cockatoo), Carnaby's Cockatoo)		T	
53.	<i>Calyptorhynchus</i> sp.			
54.	24377 <i>Charadrius ruficapillus</i> (Red-capped Plover)			
55.	24321 <i>Chenonetta jubata</i> (Australian Wood Duck, Wood Duck)			
56.	<i>Cheramoeca leucosterna</i>			
57.	<i>Chroicocephalus novaehollandiae</i>			
58.	24833 <i>Cincloramphus cruralis</i> (Brown Songlark)			
59.	24834 <i>Cincloramphus mathewsi</i> (Rufous Songlark)			
60.	24288 <i>Circus approximans</i> (Swamp Harrier)			
61.	25675 <i>Colluricincla harmonica</i> (Grey Shrike-thrush)			
62.	24613 <i>Colluricincla harmonica</i> subsp. <i>rufiventris</i> (Grey Shrike-thrush)			
63.	24399 <i>Columba livia</i> (Domestic Pigeon)	Y		
64.	25568 <i>Coracina novaehollandiae</i> (Black-faced Cuckoo-shrike)			
65.	24416 <i>Corvus bennetti</i> (Little Crow)			
66.	25592 <i>Corvus coronoides</i> (Australian Raven)			
67.	<i>Corvus coronoides</i> subsp. <i>coronoides</i>			
68.	<i>Corvus</i> sp.			
69.	24671 <i>Coturnix pectoralis</i> (Stubble Quail)			
70.	24420 <i>Cracticus nigrogularis</i> (Pied Butcherbird)			
71.	25595 <i>Cracticus tibicen</i> (Australian Magpie)			
72.	25596 <i>Cracticus torquatus</i> (Grey Butcherbird)			
73.	30901 <i>Dacelo novaeguineae</i> (Laughing Kookaburra)	Y		
74.	25673 <i>Daphoenositta chrysoptera</i> (Varied Sittella)			
75.	25607 <i>Dicaeum hirundinaceum</i> (Mistletoebird)			
76.	24470 <i>Dromaius novaehollandiae</i> (Emu)			
77.	<i>Egretta novaehollandiae</i>			
78.	<i>Elanus axillaris</i>			
79.	<i>Euseyornis melanops</i>			
80.	<i>Eolophus roseicapillus</i>			
81.	24652 <i>Eopsaltria georgiana</i> (White-breasted Robin)			
82.	24567 <i>Epthianura albiglans</i> (White-fronted Chat)			
83.	24570 <i>Epthianura tricolor</i> (Crimson Chat)			
84.	25621 <i>Falco berigora</i> (Brown Falcon)			
85.	25622 <i>Falco cenchroides</i> (Australian Kestrel)			
86.	25623 <i>Falco longipennis</i> (Australian Hobby)			
87.	25624 <i>Falco peregrinus</i> (Peregrine Falcon)		S	
88.	25727 <i>Fulica atra</i> (Eurasian Coot)			
89.	25530 <i>Gerygone fusca</i> (Western Gerygone)			
90.	24443 <i>Grallina cyanoleuca</i> (Magpie-lark)			
91.	24293 <i>Haliaeetus leucogaster</i> (White-bellied Sea-Eagle)		IA	
92.	24295 <i>Haliastur sphenurus</i> (Whistling Kite)			
93.	24491 <i>Hirundo neoxena</i> (Welcome Swallow)			
94.	<i>Hydroprogne caspia</i>			
95.	24557 <i>Leipoa ocellata</i> (Malleefowl)		T	
96.	25661 <i>Lichmera indistincta</i> (Brown Honeyeater)			
97.	<i>Lophoictinia isura</i>			
98.	24326 <i>Malacorhynchus membranaceus</i> (Pink-eared Duck)			
99.	25651 <i>Malurus lamberti</i> (Variegated Fairy-wren)			
100.	24544 <i>Malurus lamberti</i> subsp. <i>assimilis</i> (Variegated Fairy-wren)			
101.	25652 <i>Malurus leucopterus</i> (White-winged Fairy-wren)			
102.	24551 <i>Malurus pulcherrimus</i> (Blue-breasted Fairy-wren)			
103.	<i>Malurus</i> sp.			
104.	25654 <i>Malurus splendens</i> (Splendid Fairy-wren)			
105.	24583 <i>Manorina flavigula</i> (Yellow-throated Miner)			
106.	25663 <i>Melithreptus brevirostris</i> (Brown-headed Honeyeater)			
107.	24736 <i>Melopsittacus undulatus</i> (Budgerigar)			
108.	24598 <i>Merops ornatus</i> (Rainbow Bee-eater)		IA	

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
109.	<i>Microcarbo melanoleucos</i>			
110.	25693 <i>Microeca fascians</i> (Jacky Winter)			
111.	25747 <i>Ninox connivens</i> (Barking Owl)			
112.	25748 <i>Ninox novaeseelandiae</i> (Boobook Owl)			
113.	24820 <i>Ninox novaeseelandiae</i> subsp. <i>boobook</i> (Boobook Owl)			
114.	24407 <i>Ocyphaps lophotes</i> (Crested Pigeon)			
115.	24618 <i>Oreoica gutturalis</i> (Crested Bellbird)			
116.	25679 <i>Pachycephala pectoralis</i> (Golden Whistler)			
117.	24623 <i>Pachycephala pectoralis</i> subsp. <i>fuliginosa</i> (Golden Whistler)			
118.	25680 <i>Pachycephala rufiventris</i> (Rufous Whistler)			
119.	25681 <i>Pardalotus punctatus</i> (Spotted Pardalote)			
120.	25682 <i>Pardalotus striatus</i> (Striated Pardalote)			
121.	24659 <i>Petroica goodenovii</i> (Red-capped Robin)			
122.	41348 <i>Pezoporus flaviventris</i> (Western Ground Parrot)		T	
123.	25697 <i>Phalacrocorax carbo</i> (Great Cormorant)			
124.	24667 <i>Phalacrocorax sulcirostris</i> (Little Black Cormorant)			
125.	24409 <i>Phaps chalcoptera</i> (Common Bronzewing)			
126.	25587 <i>Phaps elegans</i> (Brush Bronzewing)			
127.	24596 <i>Phylidonyris novaehollandiae</i> (New Holland Honeyeater)			
128.	24383 <i>Pluvialis squatarola</i> (Grey Plover)		IA	
129.	24681 <i>Poliiocephalus poliocephalus</i> (Hoary-headed Grebe)			
130.	30854 <i>Polytelis anthopeplus</i> subsp. <i>westralis</i> (Regent Parrot)			
131.	25731 <i>Porphyrio porphyrio</i> (Purple Swamphen)			
132.	24771 <i>Porzana tabuensis</i> (Spotless Crane)			
133.	24716 <i>Puffinus pacificus</i> (Wedge-tailed Shearwater)		IA	
134.	25614 <i>Rhipidura leucophrys</i> (Willie Wagtail)			
135.	25534 <i>Sericornis frontalis</i> (White-browed Scrubwren)			
136.	30948 <i>Smicronis brevirostris</i> (Weebill)			
137.	25655 <i>Stipiturus malachurus</i> (Southern Emu-wren)			
138.	25597 <i>Strepera versicolor</i> (Grey Currawong)			
139.	25590 <i>Streptopelia senegalensis</i> (Laughing Turtle-Dove)	Y		
140.	24331 <i>Tadorna tadornoides</i> (Australian Shelduck, Mountain Duck)			
141.	<i>Thalasseus bergii</i>			
142.	24845 <i>Threskiornis spinicollis</i> (Straw-necked Ibis)			
143.	25549 <i>Todiramphus sanctus</i> (Sacred Kingfisher)			
144.	24309 <i>Todiramphus sanctus</i> subsp. <i>sanctus</i> (Sacred Kingfisher)			
145.	<i>Tribonyx ventralis</i>			
146.	24806 <i>Tringa glareola</i> (Wood Sandpiper)		IA	
147.	24386 <i>Vanellus tricolor</i> (Banded Lapwing)			
148.	25765 <i>Zosterops lateralis</i> (Grey-breasted White-eye, Silvereye)			

Fish

149.	<i>Bostockia porosa</i>			
150.	<i>Carcharhinus brevipinna</i>			
151.	<i>Carcharhinus obscurus</i>			
152.	34028 <i>Galaxias occidentalis</i> (Western Minnow)			
153.	<i>Negaprion</i> sp.			Y
154.	<i>Pseudogobius olorum</i>			

Invertebrate

155.	<i>Aedes</i> sp. 4			Y
156.	<i>Aedes</i> sp. 4 (SAP)			Y
157.	<i>Agraptocorixa eurynome</i>			
158.	<i>Agriopocoscelis elongatus</i>			Y
159.	<i>Alboa worooa</i>			
160.	<i>Alona rectangula novaeseelandiae</i>			
161.	<i>Amblyomma triguttatum</i>			
162.	<i>Amitermes conformis</i>			
163.	<i>Amitermes germanus</i>			
164.	<i>Amphidelus</i> sp.			
165.	<i>Aname tepperi</i>			
166.	<i>Anatonchus</i> sp.			
167.	<i>Anisops hyperion</i>			
168.	<i>Anisops thienemanni</i>			
169.	<i>Antichiropus sulcatus</i>			
170.	<i>Araneus cyphoxis</i>			
171.	<i>Archargiolestes pusillus</i>			
172.	<i>Austracantha minax</i>			
173.	<i>Australocamptus near</i> sp. 5 (SAP)			
174.	<i>Australothis rubescens</i>			
175.	<i>Austrolestes analis</i>			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
176.	<i>Austrolestes annulosus</i>			
177.	<i>Austrosimulium furiosum</i>			Y
178.	<i>Austrotrombella</i> sp. nov.			
179.	<i>Austrotrombella</i> sp. nov. (SAP)			
180.	<i>Ballarra longipalpus</i>			
181.	<i>Bassianobdella</i> sp.			Y
182.	<i>Berosus</i> sp.			
183.	<i>Bezzia</i> sp. 2			
184.	<i>Bezzia</i> sp. 2 (SAP)			
185.	<i>Candonocypris novaezelandiae</i>			
186.	<i>Castiarina bucolica</i>			
187.	<i>Castiarina gravis</i>			
188.	<i>Catasarcus pallidiventris</i>			Y
189.	<i>Cephalodella gibba</i>			
190.	<i>Cercophonius granulatus</i>			
191.	<i>Cercophonius sulcatus</i>			
192.	<i>Chironomus</i> aff. <i>alternans</i> (V24)			
193.	<i>Chironomus</i> aff. <i>alternans</i> (V24) (CB)			
194.	<i>Clynotis albobarbatus</i>			
195.	<i>Coccus hesperidum</i> subsp. <i>hesperidum</i>			Y
196.	<i>Copelatus ater</i>			
197.	<i>Coptotermes acinaciformis</i> subsp. <i>raffrayi</i>			
198.	<i>Coptotermes frenchi</i>			
199.	<i>Cormocephalus novaehollandiae</i>			
200.	<i>Cormocephalus strigosus</i>			
201.	<i>Corynoneura</i> sp. (V49)			
202.	<i>Corynoneura</i> sp. (V49) (SAP)			
203.	<i>Cryptochironomus griseidorsum</i>			
204.	<i>Culicoides</i> sp.			
205.	<i>Cypretta baylyi</i>			
206.	<i>Dexerra turpis</i>			
207.	<i>Enchytraeidae</i> sp.			
208.	<i>Eretes australis</i>			
209.	<i>Ethmostigmus rubripes</i>			
210.	<i>Euhesma</i> sp.			
211.	<i>Eulimnadia</i> sp.			
212.	<i>Exocelina ater</i>			
213.	<i>Eylais</i> sp.			
214.	<i>Geogarypus taylori</i>			
215.	<i>Gymnometriocnemus</i> spp. (not V44 or V45)			
216.	<i>Helicotylenchus</i> sp.			
217.	<i>Hemicordulia tau</i>			
218.	<i>Hemicriconemoides</i> sp.			
219.	<i>Hemisaga denticulata</i>			
220.	<i>Henicops dentatus</i>			
221.	<i>Heterocypris tatei</i>			
222.	<i>Hyderodes</i> sp.			
223.	33977 <i>Hylaeus globuliferus</i> (bee)		P3	
224.	<i>Hyphydrys elegans</i>			
225.	<i>Hypomegalopsalis tanisphyros</i>			
226.	<i>Idiommata blackwalli</i>			
227.	<i>Isopeda leishmani</i>			
228.	<i>Kawanaphila gidya</i>			
229.	<i>Kawanaphila goolwa</i>			
230.	<i>Kawanaphila nartee</i>			
231.	<i>Laryngodus cervantes</i>			
232.	<i>Latrodectus hasseltii</i>			
233.	<i>Lepidoptera</i> (non-pyralid) sp. 3 (SAP)			
234.	<i>Leptus minno</i>			Y
235.	<i>Limbodessus inornatus</i>			
236.	<i>Liodessus inornatus</i>			
237.	<i>Lynceus tatei</i>			
238.	<i>Megachile</i> (Austrochile) <i>resinifera</i>			
239.	<i>Megachile</i> sp.			
240.	<i>Megachile speluncarum</i>			
241.	<i>Melobasis</i> sp.			
242.	<i>Mesocyclops brooksi</i>			
243.	<i>Mesostigmata</i> sp.			
244.	<i>Metaballus frontalis</i>			
245.	<i>Metaballus litus</i>			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
246.	<i>Metaballus mucronatus</i>			
247.	<i>Metacyclops</i> sp. 434 (<i>arnaudi sensu Sars</i>)			
248.	<i>Metacyclops</i> sp. 434 (<i>arnaudi sensu Sars</i>) (CB)			
249.	<i>Missulena hoggi</i>			
250.	<i>Monohelea</i> sp. 3			
251.	<i>Monohelea</i> sp. 3 (SAP)			
252.	<i>Myrmecia elegans</i>			
253.	<i>Myrmecia gratiosa</i>			
254.	<i>Naididae</i> (ex <i>Tubificidae</i>)			
255.	<i>Necterosoma darwini</i>			
256.	<i>Necterosoma penicillatus</i>			
257.	<i>Neotemnopteryx douglasi</i>			
258.	<i>Onthophagus ferox</i>			
259.	<i>Onthophagus rupicapra</i>			
260.	<i>Opisthopsis</i> sp.			
261.	<i>Oribatida</i> sp.			
262.	<i>Orthetrum caledonicum</i>			
263.	<i>Orthocladinae</i> SO3 sp. A (SAP)			
264.	<i>Paracyclops chiltoni</i>			
265.	<i>Paramerina levidensis</i>			
266.	<i>Paranacaena littoralis</i>			
267.	<i>Parastenocarididae</i> sp.			
268.	<i>Parentia</i> sp.			
269.	<i>Phasmodes ranatriliformis</i>			
270.	<i>Philosciidae</i> sp.			
271.	<i>Pinkfloydia harveii</i>			
272.	<i>Platynectes aenescens</i>			
273.	<i>Platynectes decempunctatus</i> var. <i>polygrammus</i>			
274.	<i>Platynectes decempunctatus</i> var. <i>polygrammus</i>			
275.	<i>Procladius paludicola</i>			
276.	<i>Protocheilifer cavernarum</i>			
277.	<i>Psacadonotus diurnus</i>			
278.	<i>Radopholus</i> sp.			
279.	<i>Raveniella cirrata</i>			
280.	<i>Rhantus suturalis</i>			
281.	S03 S03 sp. A			
282.	<i>Sarscypridopsis aculeata</i>			
283.	<i>Sauertylenchus</i> sp.			
284.	<i>Scirtidae</i> sp.			
285.	<i>Simulium ornatipes</i>			
286.	<i>Stigmodera roei</i>			
287.	33992 <i>Synemon gratiosa</i> (<i>Graceful Sunmoth</i>)		P4	
288.	<i>Synemon</i> sp.			
289.	<i>Syrphidae</i> sp.			
290.	<i>Tamopsis circumvidens</i>			
291.	<i>Tanytarsus fuscithorax/semibarbitarsus</i>			
292.	<i>Tasmanicosa leuckartii</i>			
293.	<i>Temognatha reichei</i>			
294.	<i>Temognatha</i> sp.			
295.	<i>Thereuopoda lesueurii</i>			
296.	<i>Thienemanniella</i> sp. (V19)			
297.	<i>Thienemanniella</i> sp. (V19) (SAP)			
298.	<i>Tipulidae</i> type I (SAP)			
299.	<i>Tripyla</i> sp.			
300.	<i>Trombidioidea</i> sp.			
301.	<i>Tumulitermes westraliensis</i>			
302.	<i>Tylenchorhynchus</i> sp.			
303.	<i>Tylodorus</i> sp.			Y
304.	<i>Venator immansueta</i>			
305.	<i>Venator koyuga</i>			
306.	<i>Xanthagrion erythroneurum</i>			
Mammal				
307.	24186 <i>Chalinolobus gouldii</i> (<i>Gould's Wattled Bat</i>)			
308.	24187 <i>Chalinolobus morio</i> (<i>Chocolate Wattled Bat</i>)			
309.	24041 <i>Felis catus</i> (<i>Cat</i>)	Y		
310.	25478 <i>Isodon obesulus</i> (<i>Southern Brown Bandicoot</i>)		P5	
311.	24180 <i>Macroderma gigas</i> (<i>Ghost Bat</i>)		P4	
312.	24132 <i>Macropus fuliginosus</i> (<i>Western Grey Kangaroo</i>)			
313.	24133 <i>Macropus irma</i> (<i>Western Brush Wallaby</i>)		P4	
314.	24223 <i>Mus musculus</i> (<i>House Mouse</i>)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
		Y		
315.	24230 <i>Pseudomys albocinereus</i> (Ash-grey Mouse)			
316.	24173 <i>Pteropus scapulatus</i> (Little Red Flying-fox)			
317.	24243 <i>Rattus fuscipes</i> (Western Bush Rat)			
318.	24108 <i>Sminthopsis crassicaudata</i> (Fat-tailed Dunnart)			
319.	24112 <i>Sminthopsis granulipes</i> (White-tailed Dunnart)			
320.	25515 <i>Sminthopsis griseoventer</i> (Grey-bellied Dunnart)			
321.	24167 <i>Tarsipes rostratus</i> (Honey Possum, Noolbenger)			
322.	24206 <i>Vespadelus regulus</i> (Southern Forest Bat)			
323.	24040 <i>Vulpes vulpes</i> (Red Fox)	Y		
Reptile				
324.	25241 <i>Antaresia stimsoni</i> subsp. <i>stimsoni</i> (Stimson's Python)			
325.	24980 <i>Christinus marmoratus</i> (Marbled Gecko)			
326.	24918 <i>Crenadactylus ocellatus</i> subsp. <i>ocellatus</i> (Clawless Gecko)			
327.	30893 <i>Cryptoblepharus buchananii</i>			
328.	30899 <i>Ctenophorus adelaidensis</i> (Southern Heath Dragon, Western Heath Dragon)			
329.	25460 <i>Ctenophorus maculatus</i> (Spotted Military Dragon)			
330.	24881 <i>Ctenophorus maculatus</i> subsp. <i>maculatus</i> (Spotted Military Dragon)			
331.	25027 <i>Ctenotus australis</i>			
332.	25039 <i>Ctenotus fallens</i>			
333.	25047 <i>Ctenotus impar</i>			
334.	25065 <i>Ctenotus pantherinus</i> subsp. <i>pantherinus</i> (Leopard Ctenotus)			
335.	25086 <i>Cyclodomorphus branchialis</i> (Gilled Slender Blue-tongue Skink)		T	
336.	25087 <i>Cyclodomorphus celatus</i> (Western Slender Blue-tongue)			
337.	30905 <i>Delma concinna</i> subsp. <i>concinna</i> (Javelin Legless Lizard)			
338.	25766 <i>Delma fraseri</i> (Fraser's Legless Lizard)			
339.	24999 <i>Delma grayii</i>			
340.	25296 <i>Demansia psammophis</i> subsp. <i>reticulata</i> (Yellow-faced Whipsnake)			
341.	24938 <i>Diplodactylus ornatus</i>			
342.	24939 <i>Diplodactylus polyophthalmus</i>			
343.	<i>Diplodactylus</i> sp.			
344.	25251 <i>Echiopsis curta</i> (Bardick)			
345.	25100 <i>Egernia napoleonis</i>			
346.	25107 <i>Egernia stokesii</i> subsp. <i>badia</i> (Western Spiny-tailed Skink (interior WA & Shark Bay), Gidgee Skink)		T	
347.	24959 <i>Gehyra variegata</i>			
348.	25131 <i>Lerista distinguenda</i>			
349.	25133 <i>Lerista elegans</i>			
350.	25148 <i>Lerista lineopunctulata</i>			
351.	25160 <i>Lerista planiventralis</i> subsp. <i>decora</i>			
352.	25165 <i>Lerista praepedita</i>			
353.	25005 <i>Lialis burtonis</i>			
354.	41413 <i>Liopholis multiscutata</i> (Bull Skink)			
355.	42414 <i>Lucasium alboguttatum</i>			
356.	25184 <i>Menetia greyii</i>			
357.	25191 <i>Morethia lineocellata</i>			
358.	25192 <i>Morethia obscura</i>			
359.	<i>Morethia</i> sp.			
360.	25248 <i>Neelaps bimaculatus</i> (Black-naped Snake)			
361.	25253 <i>Parasuta gouldii</i>			
362.	25007 <i>Pletholax gracilis</i> subsp. <i>gracilis</i> (Keeled Legless Lizard)			
363.	24907 <i>Pogona minor</i> subsp. <i>minor</i> (Dwarf Bearded Dragon)			
364.	25261 <i>Pseudechis australis</i> (Mulga Snake)			
365.	42416 <i>Pseudonaja mengdeni</i> (Western Brown Snake)			
366.	25008 <i>Pygopus lepidopodus</i> (Common Scaly Foot)			
367.	25267 <i>Simoselaps littoralis</i> (West Coast Banded Snake)			
368.	24942 <i>Strophurus spinigerus</i> subsp. <i>spinigerus</i>			
369.	25203 <i>Tiliqua occipitalis</i> (Western Bluetongue)			
370.	25207 <i>Tiliqua rugosa</i> subsp. <i>rugosa</i>			
371.	24983 <i>Underwoodisaurus milii</i> (Barking Gecko)			
372.	25218 <i>Varanus gouldii</i> (Bungarra or Sand Monitor)			
373.	25526 <i>Varanus tristis</i> (Racehorse Monitor)			

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

Name ID Species Name

Naturalised

Conservation Code

¹Endemic To Query
Area

¹ For NatureMap's purposes, species flagged as endemic are those whose records are wholly contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

Appendix D – Flora Data

Flora species list

Flora Likelihood of Occurrence assessment guidelines

Flora Likelihood of Occurrence assessment

Quadrat data

TPFL Forms

Flora species list for survey area

Family	Taxon	Status
Amaranthaceae	<i>Ptilotus polystachyus</i>	
Anarthriaceae	Anarthriaceae sp.	
Anarthriaceae	<i>Lyginia barbata</i>	
Anarthriaceae	<i>Lyginia imberbis</i>	
Anarthriaceae	<i>Lyginia</i> sp.	
Apiaceae	Apiaceae sp.	
Apiaceae	? <i>Centella asiatica</i>	
Apiaceae	<i>Daucus glochidiatus</i>	
Araliaceae	<i>Hydrocotyle</i> ? <i>alata</i>	
Araliaceae	? <i>Hydrocotyle alata</i>	
Araliaceae	<i>Trachymene pilosa</i>	
Asparagaceae	<i>Chamaescilla corymbosa</i>	
Asparagaceae	? <i>Chamaescilla corymbosa</i>	
Asparagaceae	<i>Laxmannia sessiliflora</i>	
Asparagaceae	<i>Lomandra hastilis</i>	
Asparagaceae	<i>Lomandra sericea</i>	
Asparagaceae	<i>Lomandra</i> sp.	
Asparagaceae	<i>Sowerbaea laxiflora</i>	
Asparagaceae	<i>Thysanotus</i> ? <i>patersonii</i>	
Asparagaceae	<i>Thysanotus</i> sp.	
Asteraceae	<i>Arctotheca calendula</i>	*
Asteraceae	? <i>Craspedia</i> sp.	
Asteraceae	<i>Hypochaeris glabra</i>	*
Asteraceae	<i>Lagenophora huegelii</i>	
Asteraceae	<i>Olearia</i> sp.	
Asteraceae	<i>Olearia</i> sp. Kennedy Range (G. Byrne 66)	
Asteraceae	<i>Podolepis</i> ? <i>lessonii</i>	
Asteraceae	<i>Quinetia urvillei</i>	
Asteraceae	<i>Senecio</i> sp.	
Asteraceae	? <i>Senecio</i> sp.	
Asteraceae	? <i>Siloxerus</i> sp.	
Asteraceae	<i>Sonchus oleraceus</i>	*
Asteraceae	<i>Ursinia anthemoides</i>	*
Boryaceae	<i>Borya sphaerocephala</i>	
Brassicaceae	<i>Brassica tournefortii</i>	*
Brassicaceae	<i>Raphanus raphanistrum</i>	*
Casuarinaceae	<i>Allocasuarina fraseriana</i>	
Casuarinaceae	<i>Allocasuarina humilis</i>	
Casuarinaceae	<i>Allocasuarina microstachya</i>	
Celastraceae	<i>Stackhousia monogyna</i>	
Celastraceae	<i>Stackhousia</i> sp.	
Celastraceae	<i>Tripterococcus brunonis</i>	

Family	Taxon	Status
Colchicaceae	<i>Burchardia</i> sp.	
Colchicaceae	<i>Wurmbea</i> sp.	
Cupressaceae	<i>Callitris</i> ? <i>acuminata</i>	
Cyperaceae	<i>Caustis dioica</i>	
Cyperaceae	<i>Ficinia nodosa</i>	
Cyperaceae	<i>Lepidosperma gladiatum</i>	
Cyperaceae	<i>Lepidosperma</i> ? <i>squamatum</i>	
Cyperaceae	<i>Lepidosperma</i> sp.	
Cyperaceae	<i>Mesomelaena pseudostygia</i>	
Cyperaceae	<i>Mesomelaena tetragona</i>	
Cyperaceae	<i>Schoenus</i> ? <i>brevisetis</i>	
Cyperaceae	<i>Schoenus</i> ? <i>clandestinus</i>	
Cyperaceae	<i>Schoenus</i> ? <i>nanus/latitans</i>	
Cyperaceae	<i>Schoenus</i> sp.	
Cyperaceae	<i>Schoenus subflavus</i>	
Cyperaceae	<i>Tetraria octandra</i>	
Dasygogonaceae	<i>Calectasia narragara</i>	
Dasygogonaceae	<i>Dasygogon bromeliifolius</i>	
Dasygogonaceae	<i>Dasygogon obliquifolius</i>	
Dasygogonaceae	<i>Kingia australis</i>	
Dilleniaceae	<i>Hibbertia acerosa</i>	
Dilleniaceae	<i>Hibbertia hypericoides</i>	
Dilleniaceae	<i>Hibbertia hypericoides</i> subsp. <i>septentrionalis</i>	
Dilleniaceae	<i>Hibbertia</i> sp.	
Dilleniaceae	<i>Hibbertia subvaginata</i>	
Droseraceae	<i>Drosera erythrorhiza</i> subsp. <i>erythrorhiza</i>	
Droseraceae	<i>Drosera</i> ? <i>glanduligera</i>	
Droseraceae	<i>Drosera</i> ? <i>macrantha</i>	
Droseraceae	<i>Drosera</i> ? <i>menziesii</i>	
Droseraceae	<i>Drosera porrecta</i>	
Droseraceae	<i>Drosera</i> sp.	
Ecdeiocoleaceae	<i>Ecdeiocolea monostachya</i>	
Elaeocarpaceae	<i>Tetratheca paucifolia</i>	
Ericaceae	<i>Andersonia lehmanniana</i> subsp. <i>lehmanniana</i>	
Ericaceae	<i>Astroloma</i> ? <i>serratifolium</i>	
Ericaceae	<i>Astroloma</i> sp.	
Ericaceae	<i>Astroloma xerophyllum</i>	
Ericaceae	<i>Conostephium pendulum</i>	
Ericaceae	<i>Conostephium preissii</i>	
Ericaceae	Ericaceae sp.	
Ericaceae	<i>Leucopogon</i> ? <i>oldfieldii</i>	
Ericaceae	<i>Leucopogon polymorphus</i>	
Ericaceae	<i>Leucopogon</i> sp.	
Ericaceae	<i>Lysinema ciliatum</i>	

Family	Taxon	Status
Ericaceae	<i>Lysinema pentapetalum</i>	
Fabaceae	<i>Acacia ?alata</i> var. <i>tetrantha</i>	
Fabaceae	<i>Acacia ?ericifolia</i>	
Fabaceae	<i>Acacia auronitens</i>	
Fabaceae	<i>Acacia cochlearis</i>	
Fabaceae	<i>Acacia dilatata</i>	
Fabaceae	<i>Acacia incrassata</i>	
Fabaceae	<i>Acacia lasiocarpa</i> var. <i>lasiocarpa</i>	
Fabaceae	<i>Acacia moirii</i> subsp. <i>recurvistipula</i>	
Fabaceae	<i>Acacia pulchella</i>	
Fabaceae	<i>Acacia retrorsa</i>	P2
Fabaceae	<i>Acacia saligna</i>	
Fabaceae	<i>Acacia stenoptera</i>	
Fabaceae	<i>Bossiaea eriocarpa</i>	
Fabaceae	? <i>Bossiaea eriocarpa</i>	
Fabaceae	<i>Chorizema cordatum</i>	
Fabaceae	<i>Daviesia decurrens</i>	
Fabaceae	<i>Daviesia divaricata</i>	
Fabaceae	<i>Daviesia nudiflora</i>	
Fabaceae	<i>Daviesia pedunculata</i>	
Fabaceae	<i>Daviesia physodes</i>	
Fabaceae	<i>Daviesia podophylla</i>	
Fabaceae	<i>Daviesia preissii</i>	
Fabaceae	<i>Gastrolobium capitatum</i>	
Fabaceae	<i>Gastrolobium plicatum</i>	
Fabaceae	<i>Gastrolobium polystachyum</i>	
Fabaceae	<i>Gastrolobium</i> sp.	
Fabaceae	<i>Gastrolobium spinosum</i>	
Fabaceae	<i>Gompholobium knightianum</i>	
Fabaceae	<i>Gompholobium marginatum</i>	
Fabaceae	<i>Gompholobium preissii</i>	
Fabaceae	<i>Gompholobium tomentosum</i>	
Fabaceae	<i>Hovea</i> sp.	
Fabaceae	<i>Hovea stricta</i>	
Fabaceae	<i>Isotropis ?cuneifolia</i>	
Fabaceae	? <i>Isotropis</i> sp.	
Fabaceae	<i>Isotropis</i> sp.	
Fabaceae	<i>Jacksonia floribunda</i>	
Fabaceae	<i>Jacksonia hakeoides</i>	
Fabaceae	<i>Jacksonia sternbergiana</i>	
Fabaceae	<i>Kennedia prostrata</i>	
Fabaceae	<i>Mirbelia floribunda</i>	
Fabaceae	<i>Sphaerolobium drummondii</i>	
Fabaceae	<i>Sphaerolobium macranthum</i>	

Family	Taxon	Status
Fabaceae	<i>Sphaerolobium medium</i>	
Fabaceae	? <i>Sphaerolobium</i> sp.	
Geraniaceae	<i>Pelargonium capitatum</i>	*
Goodeniaceae	<i>Dampiera</i> sp.	
Goodeniaceae	<i>Dampiera spicigera</i>	
Goodeniaceae	<i>Lechenaultia biloba</i>	
Goodeniaceae	<i>Lechenaultia floribunda</i>	
Goodeniaceae	<i>Scaevola canescens</i>	
Goodeniaceae	<i>Scaevola</i> sp.	
Goodeniaceae	? <i>Scaevola</i> sp.	
Goodeniaceae	<i>Verreauxia ?reinwardtii</i>	
Haemodoraceae	<i>Anigozanthos ?manglesii</i>	
Haemodoraceae	<i>Anigozanthos humilis</i>	
Haemodoraceae	<i>Anigozanthos</i> sp.	
Haemodoraceae	<i>Blancoa canescens</i>	
Haemodoraceae	<i>Conostylis aculeata</i> subsp. <i>rhpidion</i>	
Haemodoraceae	<i>Conostylis androstemma</i>	
Haemodoraceae	<i>Conostylis aurea</i>	
Haemodoraceae	<i>Conostylis ?crassinervia</i>	
Haemodoraceae	<i>Conostylis crassinervia</i> ?subsp. <i>crassinervia</i>	
Haemodoraceae	<i>Conostylis setigera</i>	
Haemodoraceae	<i>Conostylis ?hiemalis</i>	
Haemodoraceae	<i>Conostylis</i> sp.	
Haemodoraceae	<i>Conostylis ?teretiuscula</i>	
Haemodoraceae	<i>Haemodorum</i> sp.	
Haemodoraceae	<i>Haemodorum spicatum</i>	
Haemodoraceae	<i>Haemodorum ?venosum</i>	
Haemodoraceae	<i>Macropidia fuliginosa</i>	
Haemodoraceae	<i>Tribonanthes ?australis</i>	
Haloragaceae	? <i>Glischrocaryon aureum</i>	
Haloragaceae	<i>Glischrocaryon</i> sp.	
Hemerocallidaceae	<i>Arnocrinum preissii</i>	
Hemerocallidaceae	<i>Corynotheca micrantha</i> var. <i>micrantha</i>	
Hemerocallidaceae	<i>Dianella revoluta</i>	
Hemerocallidaceae	Hemerocallidaceae sp.	
Hemerocallidaceae	<i>Hensmania stoniella</i>	P3
Hemerocallidaceae	<i>Johnsonia pubescens</i> subsp. <i>pubescens</i>	
Hemerocallidaceae	<i>Tricoryne elatior</i>	
Iridaceae	<i>Orthrosanthus laxus</i>	
Iridaceae	<i>Patersonia occidentalis</i>	
Iridaceae	<i>Romulea rosea</i>	*
Juncaginaceae	? <i>Triglochin striata</i>	
Lamiaceae	<i>Hemiandra</i> sp.	
Lamiaceae	<i>Hemiandra</i> sp. Jurien (B.J. Conn & M.E. Tozer BJC 3885)	

Family	Taxon	Status
Lamiaceae	<i>Hemigenia diplanthera</i>	
Lamiaceae	<i>Hemigenia incana</i>	
Lamiaceae	<i>Hemiphora bartlingii</i>	
Lamiaceae	<i>Lachnostachys albicans</i>	
Lauraceae	<i>Cassytha</i> sp.	
Loranthaceae	<i>Amyema miquelii</i>	
Loranthaceae	<i>Nuytsia floribunda</i>	
Lythraceae	Lythraceae sp.	
Malvaceae	<i>Lasiopetalum floribundum</i>	
Malvaceae	<i>Malva parviflora</i>	*
Malvaceae	<i>Thomasia</i> ? <i>grandiflora</i>	
Myrtaceae	? <i>Baeckea</i> sp.	
Myrtaceae	<i>Baeckea</i> sp.	
Myrtaceae	<i>Calothamnus quadrifidus</i>	
Myrtaceae	<i>Calothamnus sanguineus</i>	
Myrtaceae	<i>Calothamnus torulosus</i>	
Myrtaceae	<i>Calytrix</i> sp.	
Myrtaceae	? <i>Calytrix</i> sp.	
Myrtaceae	<i>Conothamnus trinervis</i>	
Myrtaceae	<i>Corymbia calophylla</i>	
Myrtaceae	<i>Darwinia neildiana</i>	
Myrtaceae	<i>Darwinia sanguinea</i>	
Myrtaceae	<i>Eremaea asterocarpa</i>	
Myrtaceae	<i>Eremaea beaufortioides</i>	
Myrtaceae	<i>Eremaea</i> sp.	
Myrtaceae	<i>Eucalyptus drummondii</i>	
Myrtaceae	<i>Eucalyptus gittinsii</i> subsp. <i>illucida</i>	
Myrtaceae	<i>Eucalyptus marginata</i>	
Myrtaceae	<i>Eucalyptus rudis</i>	
Myrtaceae	<i>Eucalyptus todtiana</i>	
Myrtaceae	<i>Eucalyptus wandoo</i> subsp. <i>pulverea</i>	
Myrtaceae	<i>Hypocalymma angustifolium</i>	
Myrtaceae	<i>Hypocalymma xanthopetalum</i>	
Myrtaceae	<i>Leptospermum erubescens</i>	
Myrtaceae	<i>Leptospermum laevigatum</i>	*
Myrtaceae	<i>Leptospermum spinescens</i>	
Myrtaceae	<i>Melaleuca</i> ? <i>concreta</i>	
Myrtaceae	<i>Melaleuca</i> ? <i>delta</i>	
Myrtaceae	<i>Melaleuca</i> ? <i>longistaminea</i>	
Myrtaceae	<i>Melaleuca platycalyx</i>	
Myrtaceae	<i>Melaleuca preissiana</i>	
Myrtaceae	<i>Melaleuca raphiophylla</i>	
Myrtaceae	<i>Melaleuca</i> sp.	
Myrtaceae	<i>Melaleuca</i> ? <i>tinkeri</i>	

Family	Taxon	Status
Myrtaceae	<i>Melaleuca ?trichophylla</i>	
Myrtaceae	<i>Melaleuca viminea</i>	
Myrtaceae	<i>Scholtzia</i> sp.	
Myrtaceae	? <i>Scholtzia</i> sp.	
Myrtaceae	<i>Verticordia grandis</i>	
Myrtaceae	<i>Verticordia</i> sp.	
Orchidaceae	? <i>Leporella fimbriata</i>	
Orchidaceae	<i>Caladenia ?exilis</i>	
Orchidaceae	<i>Caladenia flava</i>	
Orchidaceae	<i>Caladenia longicauda</i> subsp. <i>borealis</i>	
Orchidaceae	<i>Caladenia lorea</i>	
Orchidaceae	<i>Caladenia</i> sp.	
Orchidaceae	<i>Leporella fimbriata</i>	
Orchidaceae	Orchidaceae sp.	
Orchidaceae	<i>Pheladenia deformis</i>	
Orchidaceae	? <i>Pheladenia deformis</i>	
Orchidaceae	<i>Prasophyllum parvifolium</i>	
Orchidaceae	<i>Pterostylis sanguinea</i>	
Orchidaceae	<i>Thelymitra variegata</i>	P2
Oxalidaceae	<i>Oxalis</i> sp.	*
Poaceae	<i>Neurachne alopecuroidea</i>	
Poaceae	Poaceae sp.	*
Poaceae	<i>Rytidosperma</i> sp.	
Polygalaceae	? <i>Comesperma</i> sp.	
Polygalaceae	<i>Comesperma ?acerosum</i>	
Polygalaceae	<i>Comesperma scoparium</i>	
Polygalaceae	<i>Comesperma</i> sp.	
Polygonaceae	<i>Muehlenbeckia adpressa</i>	
Primulaceae	<i>Lysimachia arvensis</i>	*
Proteaceae	<i>Adenanthos cygnorum</i> subsp. <i>cygnorum</i>	
Proteaceae	<i>Banksia armata</i>	
Proteaceae	<i>Banksia attenuata</i>	
Proteaceae	<i>Banksia bipinnatifida</i> subsp. <i>multifida</i>	
Proteaceae	<i>Banksia candolleana</i>	
Proteaceae	<i>Banksia dallanneyi</i> subsp. <i>media</i>	
Proteaceae	<i>Banksia ?dallanneyi</i> subsp. <i>media</i>	
Proteaceae	<i>Banksia grandis</i>	
Proteaceae	<i>Banksia grossa</i>	
Proteaceae	<i>Banksia ?leptophylla</i> var. <i>melletica</i>	
Proteaceae	<i>Banksia littoralis</i>	
Proteaceae	<i>Banksia menziesii</i>	
Proteaceae	<i>Banksia micrantha</i>	
Proteaceae	<i>Banksia prionotes</i>	
Proteaceae	<i>Banksia ?sclerophylla</i>	

Family	Taxon	Status
Proteaceae	<i>Banksia sessilis</i> var. <i>cygnorum</i>	
Proteaceae	<i>Banksia shuttleworthiana</i>	
Proteaceae	<i>Conospermum ?nervosum</i>	
Proteaceae	<i>Conospermum</i> sp.	
Proteaceae	<i>Conospermum triplinervium</i>	
Proteaceae	<i>Grevillea delta</i>	P2
Proteaceae	<i>Grevillea synapheae</i> subsp. <i>pachyphylla</i>	
Proteaceae	<i>Hakea anadenia</i>	
Proteaceae	<i>Hakea auriculata</i>	
Proteaceae	<i>Hakea conchifolia</i>	
Proteaceae	<i>Hakea costata</i>	
Proteaceae	<i>Hakea eneabba</i>	
Proteaceae	<i>Hakea erinacea</i>	
Proteaceae	<i>Hakea flabellifolia</i>	
Proteaceae	<i>Hakea incrassata</i>	
Proteaceae	<i>Hakea lissocarpha</i>	
Proteaceae	<i>Hakea megalosperma</i>	T
Proteaceae	<i>Hakea neospathulata</i>	
Proteaceae	<i>Hakea neurophylla</i>	P4
Proteaceae	<i>Hakea obliqua</i>	
Proteaceae	<i>Hakea prostrata</i>	
Proteaceae	<i>Hakea ruscifolia</i>	
Proteaceae	<i>Hakea smilacifolia</i>	
Proteaceae	<i>Hakea stenocarpa</i>	
Proteaceae	<i>Hakea trifurcata</i>	
Proteaceae	<i>Hakea varia</i>	
Proteaceae	<i>Isopogon asper</i>	
Proteaceae	<i>Isopogon drummondii</i>	
Proteaceae	<i>Isopogon dubius</i>	
Proteaceae	<i>Isopogon inconspicuus</i>	
Proteaceae	<i>Isopogon</i> sp.	
Proteaceae	<i>Lambertia multiflora</i>	
Proteaceae	<i>Petrophile ?brevifolia</i>	
Proteaceae	<i>Petrophile chrysantha</i>	
Proteaceae	<i>Petrophile ?drummondii</i>	
Proteaceae	<i>Petrophile linearis</i>	
Proteaceae	<i>Petrophile macrostachya</i>	
Proteaceae	<i>Petrophile seminuda</i>	
Proteaceae	<i>Petrophile shuttleworthiana</i>	
Proteaceae	<i>Stirlingia latifolia</i>	
Proteaceae	<i>Strangea cynanchicarpa</i>	
Proteaceae	<i>Synaphea aephynsa</i>	
Proteaceae	<i>Synaphea</i> sp.	
Proteaceae	<i>Synaphea spinulosa</i>	

Family	Taxon	Status
Pteridaceae	<i>Cheilanthes austrotenuifolia</i>	
Restionaceae	<i>Alexgeorgea subterranea</i>	
Restionaceae	<i>Desmocladus ?lateriticus</i>	
Restionaceae	<i>Lepidobolus quadratus</i>	P3
Restionaceae	<i>Lepidobolus</i> sp.	
Restionaceae	? <i>Lepidobolus</i> sp.	
Restionaceae	? <i>Leptocarpus</i> sp.	
Restionaceae	Restionaceae sp.	
Rhamnaceae	<i>Cryptandra myriantha</i>	
Rhamnaceae	<i>Cryptandra pungens</i>	
Rhamnaceae	<i>Cryptandra spyridioides</i>	
Rhamnaceae	<i>Stenanthemum humile</i>	
Rhamnaceae	<i>Trymalium odoratissimum</i>	
Rubiaceae	<i>Opercularia vaginata</i>	
Rutaceae	<i>Boronia cymosa</i>	
Rutaceae	<i>Boronia ramosa</i>	
Rutaceae	<i>Boronia ramosa</i> subsp. <i>anethifolia</i>	
Rutaceae	<i>Diplolaena ferruginea</i>	
Rutaceae	<i>Diplolaena</i> sp.	
Rutaceae	<i>Philotheca spicata</i>	
Rutaceae	Rutaceae sp.	
Santalaceae	<i>Leptomeria empetriformis</i>	
Santalaceae	<i>Santalum acuminatum</i>	
Stylidiaceae	<i>Levenhookia</i> sp.	
Stylidiaceae	<i>Stylidium ?hymenocraspedum</i>	P3
Stylidiaceae	<i>Stylidium ?piliferum</i>	
Stylidiaceae	<i>Stylidium ?repens</i>	
Stylidiaceae	<i>Stylidium ?torticarpum</i>	P3
Stylidiaceae	<i>Stylidium</i> sp.	
Thymelaeaceae	<i>Pimelea ?angustifolia</i>	
Thymelaeaceae	<i>Pimelea argentea</i>	
Thymelaeaceae	<i>Pimelea floribunda</i>	
Thymelaeaceae	<i>Pimelea</i> sp.	
Xanthorrhoeaceae	<i>Xanthorrhoea drummondii</i>	
Xanthorrhoeaceae	<i>Xanthorrhoea preissii</i>	
Xanthorrhoeaceae	<i>Xanthorrhoea</i> sp.	
Zamiaceae	<i>Macrozamia fraseri</i>	

Refer to Appendix A for conservation codes; * denotes introduced species

Flora Likelihood of Occurrence assessment guidelines

Likelihood of Occurrence	Guideline
Known	Species recorded within study area from field survey results.
Likely	Species previously recorded within 10 km and large areas of suitable habitat occur in the study area.
Possible	Species previously recorded within 10 km and areas of suitable habitat occur/may occur in the study area.
Unlikely	Species previously recorded within 10 km, but suitable habitat does not occur in the study area.
Highly unlikely	Species not previously recorded within 10 km, suitable habitat does not occur in the study area and/or the study area is outside the natural distribution of the species.
Other considerations	Intensity of survey, availability of access, growth form type, recorded flowering times, cryptic nature of species

Definitions

Study area = a 20 km buffer around the survey area

Source information - desktop searches

PMST – DotE Protected Matters Search Tool (PMST) to identify flora listed under the EPBC Act potentially occurring within the study area (accessed July 2016)

DPaW – DPaW (2007-2016) records of threatened flora, database search within the study area (accessed July 2016)

NM – DPaW NatureMap (accessed July 2016)

Survey – recorded within the survey area during the 2016 assessment

References

Davis, RW, Hammer, T and Thiele, KR 2014, Two new and rare species of *Ptilotus* (Amaranthaceae) from the Eneabba sandplains, Western Australia, *Nuytsia* 24: 123–129.

Thompson, IR 2010, A revision of *Cristonia* (Fabaceae: Brongniartieae), *Muelleria* 28(1): 66-73.

Flora Likelihood of Occurrence assessment

Family	Taxon	Status		Description	Habitat	Flowering	Likelihood of Occurrence	Source
		EPBC Act	WC Act /DPaW					
Amaranthaceae	<i>Ptilotus clivicola</i>	-	P2	Prostrate to ascending perennial herb to 0.1 m high with reddish purple flowers (Davis <i>et al.</i> 2014).	Kwongan heath on gently sloping gravelly rises with a shallow covering of coarse sand.	Late October and early November.	Possible – suitable habitat present within survey area.	NM
Amaranthaceae	<i>Ptilotus falcatus</i>	-	P1	Prostrate to ascending perennial herb to 0.1 m high with greenish brown flowers becoming white on the apex (Davis <i>et al.</i> 2014).	North-east facing slope in low heath on gravelly, grey to light brown, sandy loam soils.	Mid to late October.	Possible – suitable habitat present within survey area.	DPaW
Anarthriaceae	<i>Lyginia excelsa</i>	-	P1	Dioecious rhizomatous, erect, tufted herb, 0.6-1.5 m high with rhizomes on surface.	Sand with dry heath and <i>Banksia</i> woodland.	March to November.	Possible – suitable habitat present within survey area.	NM
Apiaceae	<i>Platysace ramosissima</i>	-	P3	Perennial herb to 0.3 m high with white-cream flowers.	Sandy soils.	October to November.	Possible – suitable habitat present within survey area.	NM
Apiaceae	<i>Xanthosia tomentosa</i>	-	P4	Prostrate to ascending perennial herb, 0.2-0.5 m high to 2 m wide with white-cream-pink flowers.	Lateritic gravelly soils.	September to December.	Possible – suitable habitat present within survey area.	NM
Asparagaceae	<i>Thysanotus anceps</i>	-	P3	Rhizomatous, leafless perennial herb to 0.4 m high with purple flowers.	White or grey sand, lateritic gravel or laterite.	October to December.	Possible – suitable habitat present within survey area.	NM DPaW

Family	Taxon	Status		Description	Habitat	Flowering	Likelihood of Occurrence	Source
		EPBC Act	WC Act /DPaW					
Asparagaceae	<i>Thysanotus glaucus</i>	-	P4	Caespitose, glaucose perennial herb, 0.1-0.2 m high with purple flowers.	White, grey or yellow sand, sandy gravel.	October to December or January to March.	Possible – suitable habitat present within survey area.	NM DPaW
Asparagaceae	<i>Thysanotus</i> sp. Badgingarra (E.A. Griffin 2511)	-	P2	Perennial herb to 0.35 m high with blue flowers.	Grey sand with lateritic gravel.	December.	Possible – suitable habitat present within survey area.	NM DPaW
Asparagaceae	<i>Thysanotus vernalis</i>	-	P3	Perennial herb to 0.3 m high with purple flowers.	Sandy loam.	September to October.	Possible – suitable habitat present within survey area.	NM DPaW
Asteraceae	<i>Rhadinocarpus suffruticosa</i>	-	P1	Woody perennial herb to 0.8 m high with white-cream flowers.	Red-brown loamy clay, gravelly loam or clay loam over laterite. Slopes and small ridges.	November to December	Unlikely – limited habitat present within the survey area.	DPaW
Brassicaceae	<i>Lepidium pseudotasmanicum</i>	-	P4	Erect annual or biennial herb, 0.2-0.4 m high with white-green flowers.	Loam or sand.	February or December.	Possible – suitable habitat present within survey area.	NM
Byblidaceae	<i>Byblis gigantea</i>	-	P3	Small, branched perennial herb to 0.45 m high with pink-purple/white flowers.	Sandy-peat swamps. Seasonally wet areas	September to December or January.	Highly Unlikely – No sandy peat swamps recorded within the survey area.	NM
Casuarinaceae	<i>Allocasuarina grevilleoides</i>	-	P3	Dioecious, lignotuberous shrubs, 0.15-0.4 m high.	Sand over laterite, gravel.	No information available.	Possible – suitable habitat present within survey area.	NM
Casuarinaceae	<i>Allocasuarina ramosissima</i>	-	P3	Dioecious, somewhat divaricate shrub, 0.3-1.2 m high.	Lateritic soils, gravel.	No information available.	Possible – suitable habitat present within survey area.	NM DPaW
Celastraceae	<i>Stackhousia</i> sp. Red-blotched corolla (A. Markey 911)	-	P3	Perennial, erect herb with yellow flowers.	Sandy clay.	No information available.	Possible – suitable habitat present within survey area.	NM DPaW

Family	Taxon	Status		Description	Habitat	Flowering	Likelihood of Occurrence	Source
		EPBC Act	WC Act /DPaW					
Centrolepidaceae	<i>Centrolepis milleri</i>	-	P3	Annual herb to 0.06 m tall.	White sand or grey-brown sandy clay.	No information available.	Possible – suitable habitat present within survey area.	NM
Cyperaceae	<i>Caustis gigas</i>	-	P2	Rhizomatous, robust perennial sedge to 2 m high.	White or grey sand.	May.	Possible – suitable habitat present within survey area.	NM
Cyperaceae	<i>Eleocharis keigheryi</i>	VU	VU	Rhizomatous, clumped perennial sedge to 0.4 m high with green flowers.	Clay, sandy loam. Emergent in freshwater creeks or claypans.	August to November.	Unlikely – minimal suitable habitat present within the survey area.	NM PMST DPaW
Dasypogonaceae	<i>Calectasia browneana</i>	-	P2	Spreading, caespitose perennial herb, 0.2-0.5 m high to 0.4 m wide with blue-purple flowers.	White-grey sand, laterite. Adjacent to wet areas of creek line.	June to August.	Possible – suitable habitat present within survey area.	NM DPaW
Dasypogonaceae	<i>Calectasia cyanea</i>	CR	CR	Rhizomatous, clump forming, woody perennial herb, 0.1-0.6 m high to 0.3 m high with blue/purple flowers.	White, grey or yellow sand, gravel.	June to October.	Possible – suitable habitat present within survey area.	NM
Dasypogonaceae	<i>Calectasia palustris</i>	-	P2	Stilt-rooted herb, stems to 0.7 m high with blue flowers.	White or grey sand. Seasonally inundated swamplands.	July to October.	Unlikely – minimal to no suitable seasonally inundated swamplands present within survey area.	DPaW
Dilleniaceae	<i>Hibbertia helianthemoides</i>	-	P4	Spreading to erect, low or prostrate shrub to 0.3 m high with yellow flowers.	Clayey sand over sandstone or loam over quartzite. Hill and scree slopes.	July or September to October.	Highly Unlikely – Species records are 100 km north of Albany, not within the same Bioregion.	NM
Dilleniaceae	<i>Hibbertia propinqua</i>	-	P4	Spreading shrub to 0.5 m high with yellow flowers.	Gravelly sand on slopes.	August to October.	Possible – suitable habitat present within survey area.	NM DPaW

Family	Taxon	Status		Description	Habitat	Flowering	Likelihood of Occurrence	Source
		EPBC Act	WC Act /DPaW					
Droseraceae	<i>Drosera allantostigma</i>	-	P1	Fibrous-rooted, rosette perennial herb to 0.08 m high with white flowers.	Loam, silica sand or peaty soils. Margins of winter-wet depressions.	November to December.	Unlikely – minimal suitable habitat present within the survey area.	NM DPaW
Droseraceae	<i>Drosera marchantii</i> subsp. <i>prophylla</i>	-	P3	Erect, tuberous, perennial herb, 0.1-0.3 m high with white flowers.	Laterite-silica sand soils on hilltops.	June to July.	Possible – suitable habitat present within survey area.	NM DPaW
Elaeocarpaceae	<i>Tetratheca angulata</i>	-	P3	Lax to erect, slender shrub, 0.2-0.3 m high with pink/purple flowers.	Sandy to gravelly laterite soils. Low hill crests, breakaways with massive laterite boulders.	September to December.	Unlikely – minimal suitable habitat present within the survey area.	NM DPaW
Elaeocarpaceae	<i>Tetratheca nephelioides</i>	CR	EN	Caespitose, dwarf shrub, to 0.3 m high with purple flowers.	White-grey sand, yellow-brown clayey sand, gravel, laterite. Outcrops, undulating hills, ridges.	September.	Possible – suitable habitat present within survey area.	NM PMST
Elaeocarpaceae	<i>Tetratheca remota</i>	-	P1	Small, slender shrub to 0.4 m high with pink flowers.	Sandy gravel.	November.	Possible – suitable habitat present within survey area.	NM DPaW
Ericaceae	<i>Andersonia gracilis</i>	EN	VU	Slender erect or open straggly shrub, 0.1-0.5 m high with white-pink-purple flowers.	White/grey sand, sandy clay, gravelly loam. Winter-wet areas, near swamps.	September to November.	Possible – suitable habitat present within survey area.	PMST DPaW
Ericaceae	<i>Andersonia</i> sp. Mt Lesueur (E.A. Griffin 5536)	-	P2	Open, straggly shrub to 0.6 m high with cream flowers.	Sandy clay over sandstone. Breakaway slope.	March to May.	Possible – suitable habitat present within survey area.	NM DPaW

Family	Taxon	Status		Description	Habitat	Flowering	Likelihood of Occurrence	Source
		EPBC Act	WC Act /DPaW					
Ericaceae	<i>Conostephium magnum</i>	-	P4	Erect, compact shrub to 2 m high with pint-purple flowers.	White-grey sands sometimes associated with laterite gravels. Sand dunes, swampland, disturbed roadside, drainage channels, open woodland.	July to September.	Possible – suitable habitat present within survey area.	NM DPaW
Ericaceae	<i>Leucopogon obtectus</i>	EN	EN	Erect shrub, 0.5-1.7 m high with cream-yellow flowers.	Grey sand.	August to October.	Possible – suitable habitat present within survey area.	NM PMST
Ericaceae	<i>Leucopogon ozothamnoides</i>	-	P1	Shrub to 0.2 m high with white flowers.	Gravelly soils, sandy clay loam.	October.	Highly Unlikely – Species records are 150 km north of Albany, not within the same Bioregion.	NM
Ericaceae	<i>Leucopogon plumuliflorus</i>	-	P2	Slender, multi-stemmed shrub, 0.1-0.4 m high with white/white-pink flowers.	Lateritic sandy soils. Amongst lateritic boulders, hillslopes.	April or July to November.	Unlikely – minimal suitable habitat present within the survey area.	NM DPaW
Ericaceae	<i>Leucopogon</i> sp. Badgingarra (R. Davis 421)	-	P2	Open, erect shrub, 0.7-1 m high with white flowers.	Grey sand, dry white sand. Hills and plains.	December.	Possible – suitable habitat present within survey area.	DPaW
Euphorbiaceae	<i>Beyeria cinerea</i> subsp. <i>cinerea</i>	-	P3	Shrub.	Sand or sandy loam.	No information available.	Possible – suitable habitat present within survey area.	NM
Euphorbiaceae	<i>Beyeria gardneri</i>	-	P3	Shrub, 0.25-0.5 m high with yellow flowers.	Yellow sand.	August to September.	Unlikely – no yellow sand observed within the survey area.	DPaW
Euphorbiaceae	<i>Beyeria similis</i>	-	P2	Erect, compact shrub, 0.25-0.7 m high with yellow flowers.	Yellow or red clayey sand. Sandplains.	August to September.	Unlikely – no suitable habitat present within the survey area.	NM DPaW

Family	Taxon	Status		Description	Habitat	Flowering	Likelihood of Occurrence	Source
		EPBC Act	WC Act /DPaW					
Fabaceae	<i>Acacia carens</i>	-	P2	Open, broom-like shrub, 0.35-0.6 m high with yellow flowers.	Gravel or sandy gravel. Lateritic uplands.	April to June.	Possible – suitable habitat present within survey area.	NM
Fabaceae	<i>Acacia cummingiana</i>	-	P3	Sprawling, straggly shrub, 0.3-0.5 m high with yellow flowers.	Grey or yellow sand, lateritic gravel. Sandplains, lateritic breakaways.	May to June or August.	Possible – suitable habitat present within survey area.	NM DPaW
Fabaceae	<i>Acacia epacantha</i>	-	P3	Dense, bushy, spiny shrub, 0.2-0.5 m high with yellow flowers.	Lateritic gravelly loam or clay.	July to August.	Possible – suitable habitat present within survey area.	NM DPaW
Fabaceae	<i>Acacia forrestiana</i>	VU	VU	Erect, open, prickly shrub, 0.4-1 m high with yellow flowers.	Lateritic gravelly soils, clay loam over sandstone. Gullies, hills, breakaways.	November to December.	Possible – suitable habitat present within survey area.	NM PMST DPaW
Fabaceae	<i>Acacia lasiocarpa</i> var. <i>lasiocarpa</i> Cockleshell Gully variant (E.A. Griffin 2039)	-	P2	Shrub, 0.35-0.5 m high with yellow flowers.	Grey-yellow sand with laterite. Low open heath.	August.	Possible – suitable habitat present within survey area.	NM DPaW
Fabaceae	<i>Acacia plicata</i>	-	P3	Erect shrub, 0.9-2 m high with yellow flowers.	Loamy and clayey soils, often over sandstone or siltstone. Along drainage lines.	August to October.	Unlikely – suitable habitat not present within the survey area.	NM DPaW
Fabaceae	<i>Acacia retrorsa</i>	-	P2	Prostrate, sprawling shrub, 0.05-0.5 m high with yellow flowers.	Grey sand and lateritic gravel, sandy loam.	August to September.	Known – species recorded within the survey area.	NM DPaW
Fabaceae	<i>Acacia tayloriana</i>	-	P4	Prostrate shrub with cream-white flowers.	Grey or yellow/orange sandy soils, lateritic gravel, clay loam. Winter-wet areas.	January.	Highly Unlikely – Not recorded within the same Bioregion. Recorded along the south coast.	NM
Fabaceae	<i>Acacia wilsonii</i>	-	EN	Low, spreading, wiry shrub, 0.2-0.5 m high with yellow flowers.	White/yellow sand and lateritic gravel, sandy clay over laterite.	December to February.	Possible – suitable habitat present within survey area.	NM DPaW

Family	Taxon	Status		Description	Habitat	Flowering	Likelihood of Occurrence	Source
		EPBC Act	WC Act /DPaW					
Fabaceae	<i>Cristonia biloba</i> subsp. <i>pubescens</i>	-	P2	Shrub to 0.5 m high with purple-brown flowers (Thompson 2010).	Brown sandy loam over laterite and grey and white sands over clay, in shrubland and heathland.	June to August.	Possible – suitable habitat present within survey area.	DPaW
Fabaceae	<i>Daviesia debilior</i> subsp. <i>debilior</i>	-	P2	Straggling shrub, 0.3-0.6 m high with yellow and red/purple flowers.	Sand over lateritic gravel.	May to July.	Possible – suitable habitat present within survey area.	NM DPaW
Fabaceae	<i>Daviesia pteroclada</i>	-	P3	Erect, broom-like shrub, 0.6-1.8 m high with orange and red flowers.	Sandy or clay gravelly soils over laterite. Hills.	July to August.	Possible – suitable habitat present within survey area.	NM DPaW
Fabaceae	<i>Gastrolobium hamulosum</i>	EN	CR	Low shrub, 0.2-0.45 m high with yellow, orange, red and purple flowers.	Sandy, often gravelly soils or clay. Flats, slopes and ridges.	August to October.	Possible – suitable habitat present within survey area.	NM
Fabaceae	<i>Gompholobium gairdnerianum</i>	-	P3	Erect, slender, multi-stemmed shrub to 0.5 m high with yellow flowers.	White, cream or brown sandy clay, white sand over sandstone, brown or grey sand over laterite, gravel. Hill summits and slopes, ridges.	September to November.	Possible – suitable habitat present within survey area.	NM DPaW
Fabaceae	<i>Jacksonia anthoclada</i>	-	P3	Erect shrub, 1.5-2.5 m high with yellow and red flowers.	White or grey sand. Sandplains.	April.	Possible – suitable habitat present within survey area.	NM DPaW
Fabaceae	<i>Jacksonia carduacea</i>	-	P3	Bushy shrub, 0.2-0.5 m high with yellow and red flowers.	Grey sand, sandy clay.	August to December.	Possible – suitable habitat present within survey area.	DPaW
Fabaceae	<i>Jacksonia rubra</i>	-	P2	Tangled dwarf shrub, to 0.2 m high with orange flowers.	Clayey sand.	October.	Possible – suitable habitat present within survey area.	DPaW

Family	Taxon	Status		Description	Habitat	Flowering	Likelihood of Occurrence	Source
		EPBC Act	WC Act /DPaW					
Goodeniaceae	<i>Dampiera</i> sp. Jurien (G. Lullfitz s.n. 10/7/1986)	-	P2	Erect, open shrub, 0.27-0.5 m high with blue flowers.	Brown sand over limestone or yellow sandy clay. Open shrubland.	August.	Possible – suitable habitat present within survey area.	NM
Goodeniaceae	<i>Dampiera tephrea</i>	-	P2	Ascending to erect perennial, herb or shrub, 0.3-0.6 m high with blue flowers.	Sand, gravelly loam.	July.	Possible – suitable habitat present within survey area.	NM
Goodeniaceae	<i>Goodenia xanthotricha</i>	-	P2	Viscid shrub to 0.5 m high with blue flowers.	Sandy soils. Gravelly hills.	November to February.	Possible – suitable habitat present within survey area.	NM DPaW
Gyrostemonaceae	<i>Walteranthus erectus</i>	-	P2	Erect shrub, to 2 m high with orange-brown flowers.	Sand over limestone. Coastal limestone ridges.	February.	Possible – suitable habitat present within survey area.	NM
Haemodoraceae	<i>Anigozanthos viridis</i> subsp. <i>terraspectans</i>	VU	VU	Rhizomatous perennial herb, 0.05-0.2 m high with green/yellow-green flowers.	Grey sand, clay loam. Winter-wet depressions.	August to September	Possible – suitable habitat present within survey area.	PMST
Haemodoraceae	<i>Haemodorum loratum</i>	-	P3	Bulbaceous, perennial herb, 0.45-1.2 m high with black/brown-black/green flowers.	Grey or yellow sand, gravel.	November.	Possible – suitable habitat present within survey area.	NM
Haemodoraceae	<i>Phlebocarya pilosissima</i> subsp. <i>pilosissima</i>	-	P3	Shortly rhizomatous, compactly tufted perennial herb, 0.15-0.4 m high with cream-white flowers.	White or grey sand, lateritic gravel.	August to October.	Possible – suitable habitat present within survey area.	NM DPaW
Haemodoraceae	<i>Phlebocarya pilosissima</i> subsp. <i>teretifolia</i>	-	P2	Shortly rhizomatous, loosely tufted perennial herb, 0.15-0.4 m high with cream-white flowers.	White or grey sand.	August to October.	Possible – suitable habitat present within survey area.	NM

Family	Taxon	Status		Description	Habitat	Flowering	Likelihood of Occurrence	Source
		EPBC Act	WC Act /DPaW					
Haloragaceae	<i>Haloragis foliosa</i>	-	P3	Perennial herb or shrub, 0.2-0.5 m high.	White/grey sand over limestone.	-	Possible – suitable habitat present within survey area.	DPaW
Hemerocallidaceae	<i>Arnocrinum gracillimum</i>	-	P2	Rhizomatous, perennial herb, 0.2-0.4 m high with purple flowers.	White, grey, yellow or lateritic sand.	October to November.	Possible – suitable habitat present within survey area.	NM DPaW
Hemerocallidaceae	<i>Hensmania stoniella</i>	-	P3	Tufted, stilt-rooted perennial herb, 0.1-0.2 m high with yellow-cream-white flowers.	White, grey or lateritic sand, often winter-wet.	September to November.	Known – species was recorded from within the survey area.	NM DPaW
Iridaceae	<i>Patersonia argyrea</i>	-	P3	Rhizomatous, tufted perennial herb to 0.4 m high with violet-purple flowers.	Grey sand and lateritic gravel.	September to November.	Possible – suitable habitat present within survey area.	NM DPaW
Iridaceae	<i>Patersonia spirifolia</i>	EN	EN	Spreading, woody, tussock-forming rhizomatous herb growing to 0.3 m high and 0.4 m across with blue-violet flowers.	Sand over laterite. Low hills.	-	Possible – suitable habitat present within survey area.	DPaW
Lamiaceae	<i>Hemiandra gardneri</i>	EN	CR	Prostrate, pungent shrub, 0.1-0.2 m high, to 1 m wide with red/pink-red flowers.	Grey or yellow sand, clayey sand. Sandplains.	August to October.	Possible – suitable habitat present within survey area.	NM PMST
Lamiaceae	<i>Hemiandra</i> sp. Watheroo (S. Hancocks 4)	-	P4	Shrub to 0.5 m high with red/orange/purple flowers.	White, yellow or grey sand on sandplains or slopes.	December.	Possible – suitable habitat present within survey area.	NM
Lamiaceae	<i>Hemigenia curvifolia</i>	-	P2	Shrub, 0.2-0.7 m high with blue flowers.	Sandy soils.	September to October.	Possible – suitable habitat present within survey area.	NM

Family	Taxon	Status		Description	Habitat	Flowering	Likelihood of Occurrence	Source
		EPBC Act	WC Act /DPaW					
Malvaceae	<i>Guichenotia alba</i>	-	P3	Slender, lax, few-branched shrub, 0.1-0.45 m high with white flowers.	Sandy and gravelly soils. Low-lying flats, depressions.	July to August.	Possible – suitable habitat present within survey area.	NM DPaW
Malvaceae	<i>Lasiopetalum ogilvieanum</i>	-	P1	Shrub, 0.45-1.5 m high with pink-white flowers.	White/grey or yellow sand, stony loam. Undulating plains, lateritic rises.	July to October.	Possible – suitable habitat present within survey area.	NM
Malvaceae	<i>Lasiopetalum</i> sp. Badgingarra (E.A. Griffin 5278)	-	P2	Erect multi-stemmed shrub to 1.5 m high with pink flowers.	Slopes and gullies with dry brown loam, clay gravel over laterite.	October to December.	Possible – suitable habitat present within survey area.	DPaW
Malvaceae	<i>Lasiopetalum</i> sp. Hill River (T.N. Stoate 5)	-	P1	Shrub to 1 m high with lilac flowers.	Dry brown loam over laterite.	September.	Possible – suitable habitat present within survey area.	DPaW
Malvaceae	<i>Lasiopetalum</i> sp. Mount Lesueur (E.A. Griffin 1997)	-	P2	Shrub to 1.1 m high with pink/red/purple flowers.	Slopes, clayey sand and gravelly sand.	September to December.	Possible – suitable habitat present within survey area.	NM DPaW
Malvaceae	<i>Thomasia tenuivestita</i>	-	P3	Shrub, 0.6-2.5 m high with purple-pink flowers.	Granite, loam.	July to October.	Unlikely – No granite was observed within the survey area.	DPaW
Myrtaceae	<i>Babingtonia cherticola</i>	-	P3	Shrub, 1-1.5 m high with white/pink flowers.	Sandy loam, lateritic sand or clay. Flats or slopes at base of hills.	November to December.	Possible – suitable habitat present within survey area.	NM DPaW
Myrtaceae	<i>Beaufortia bicolor</i>	-	P3	Dense shrub, 0.3-1 m high with red and yellow and orange flowers.	White sand over laterite. Sandplains.	November to December.	Possible – suitable habitat present within survey area.	NM
Myrtaceae	<i>Beaufortia eriocephala</i>	-	P3	Erect, compact shrub, 0.3-0.6 m high with red flowers.	Lateritic sandy soils. Slopes.	September to November.	Possible – suitable habitat present within survey area.	NM DPaW
Myrtaceae	<i>Calytrix chrysantha</i>	-	P4	Shrub, 0.3-1.3 m high with yellow flowers.	White, grey or yellow/brown sand. Flats.	December to February.	Possible – suitable habitat present within survey area.	NM

Family	Taxon	Status		Description	Habitat	Flowering	Likelihood of Occurrence	Source
		EPBC Act	WC Act /DPaW					
Myrtaceae	<i>Calytrix ecalycata</i> subsp. <i>brevis</i>	-	P3	Upright shrub, to 1 m high with yellow flowers.	Dry yellow sand. Sandplains, low rises.	August to September.	Possible – suitable habitat present within survey area.	NM DPaW
Myrtaceae	<i>Darwinia pimelioides</i>	-	P4	Erect shrub, 0.25-0.5 m high with red/pink and green flowers.	Loam, sandy loam. Granite outcrops.	September to October.	Unlikely – No granite was observed within the survey area.	NM
Myrtaceae	<i>Eucalyptus abdita</i>	-	P2	Mallee or shrub, 2-3 m high, bark smooth, grey.	Laterite, sandy clay with gravel over laterite. Slopes, breakaways.	No information available.	Possible – suitable habitat present within survey area.	NM
Myrtaceae	<i>Eucalyptus absita</i>	EN	CR	Mallee or tree, 2.3-10 m high with fibrous rough bark and white flowers.	White lateritic sand. Paddocks.	April to July.	Possible – suitable habitat present within survey area.	PMST DPaW
Myrtaceae	<i>Eucalyptus angularis</i>	-	P2	Mallee to 3 m high, bark rough or flaky.	Lateritic breakaways.	No information available.	Possible – suitable habitat present within survey area.	NM DPaW
Myrtaceae	<i>Eucalyptus argutifolia</i>	VU	VU	Mallee, 1.5-4 m high, bark smooth with white flowers.	Shallow soils over limestone. Slopes or gullies of limestone ridges, outcrops.	March to April.	Unlikely – Records occur greater than 100 km south of survey area.	NM
Myrtaceae	<i>Eucalyptus balanites</i>	EN	CR	Mallee, to 5 m high with flaky rough bark and white flowers.	Sandy soils with lateritic gravel.	October to December or January to February.	Possible – suitable habitat present within survey area.	PMST
Myrtaceae	<i>Eucalyptus beardiana</i>	VU	EN	Mallee, 3-5 m high, bark smooth with cream-white flowers.	Red or yellow sand. Sand dunes and ridges.	August to September.	Highly Unlikely – Records occur north of Geraldton.	NM
Myrtaceae	<i>Eucalyptus crispata</i>	VU	EN	Mallee, 3-7 m high, bark rough on the trunk in partly decorticated curls with yellow-cream flowers.	Sand, loam with lateritic gravel. Lateritic breakaways.	March to June.	Possible – suitable habitat present within survey area.	NM PMST

Family	Taxon	Status		Description	Habitat	Flowering	Likelihood of Occurrence	Source
		EPBC Act	WC Act /DPaW					
Myrtaceae	<i>Eucalyptus exilis</i>	-	P4	Whipstick mallee, 2-6 m high, bark smooth with white flowers.	Grey sand, gravelly loam. Lateritic ridges.	August to October.	Possible – suitable habitat present within survey area.	NM DPaW
Myrtaceae	<i>Eucalyptus impensa</i>	EN	EN	Straggly mallee to 1.5 m high, bark smooth with pink flowers.	Yellow sand. Lateritic hills.	June to July.	Unlikely – yellow sand was not observed within the survey area.	NM PMST
Myrtaceae	<i>Eucalyptus johnsoniana</i>	VU	VU	Mallee, forming dense clumps, 1-3.5 m high, bark flaky to 0.5 m then smooth with white-cream flowers.	White/grey sand with lateritic gravel. Sandplain, lateritic breakaways.	July to August or December to May.	Possible – suitable habitat present within survey area.	NM PMST
Myrtaceae	<i>Eucalyptus lateritica</i>	VU	EN	Mallee, 2-3 m high, bark rough at base with white flowers.	White or grey sand with gravel. Lateritic breakaways and mesas.	August to October.	Possible – suitable habitat present within survey area.	NM PMST
Myrtaceae	<i>Eucalyptus leprophloia</i>	EN	EN	Mallee, 2-5 m high, bark rough, loose and flaky to 1 m with cream-white flowers.	White or grey sand over laterite. Valley slopes.	August to October.	Possible – suitable habitat present within survey area.	NM PMST
Myrtaceae	<i>Eucalyptus macrocarpa</i> subsp. <i>elachantha</i>	-	P4	Spreading or sprawling mallee, 0.8-4 m high, bark smooth, grey over salmon pink with red-pink flowers.	White or grey sand over laterite. Hillslopes, ridges and sandplains.	August to September or November to December.	Possible – suitable habitat present within survey area.	NM DPaW
Myrtaceae	<i>Eucalyptus pendens</i>	-	P4	Slender, pendulous mallee, 2-5 m high, bark smooth with white flowers.	White or grey sand with lateritic gravel. Hillsides, breakaways, sandplains.	August to November.	Possible – suitable habitat present within survey area.	NM DPaW

Family	Taxon	Status		Description	Habitat	Flowering	Likelihood of Occurrence	Source
		EPBC Act	WC Act /DPaW					
Myrtaceae	<i>Eucalyptus pruiniramis</i>	EN	EN	Mallee or tree, 2.5-7 m high, often with straggly, tumbledown crown; bark rough and ribbon at base, smooth above with cream flowers.	Skeletal soils over sandstone or laterite. Rocky hillsides.	December.	Unlikely – skeletal soils not observed in survey area.	NM PMST
Myrtaceae	<i>Eucalyptus rhodantha</i> .	VU	VU	Spreading mallee, 1.5-4 m high, bark smooth, with red/cream-white flowers.	Grey/yellow/red sand over laterite. Undulating country, hill slopes.	July or September to January.	Highly Unlikely – Nearest record is located approximately 60 km to the north of the survey area.	PMST
Myrtaceae	<i>Eucalyptus suberea</i>	VU	VU	Mallee, 1-4 m high, bark rough and flaky with white flowers.	Grey sand. Near or on lateritic breakaways.	November to January.	Possible – suitable habitat present within survey area.	NM PMST
Myrtaceae	<i>Eucalyptus x balanites</i>	-	CR	Mallee to 5 m high, bark rough, flaky with white flowers.	Sandy soils with lateritic gravel.	October to February.	Possible – suitable habitat present within survey area.	DPaW
Myrtaceae	<i>Eucalyptus zopherophloia</i>	-	P4	Spreading mallee, 2.5-4 m high, bark rough, fibrous with cream-white flowers.	Grey/white sand with limestone rubble. Coastal areas.	October to January.	Unlikely – little to no limestone rubble was observed within the survey area.	DPaW
Myrtaceae	<i>Hypocalymma gardneri</i>	-	P3	Shrub to 0.3 m high with yellow flowers.	Grey-brown sand, laterite. Sandplains, upper slopes, heathland.	August to September.	Possible – suitable habitat present within survey area.	NM DPaW
Myrtaceae	<i>Hypocalymma serrulatum</i>	-	P3	Erect shrub, 0.45-1.7 m high with white-pink flowers.	Grey or white sand along drainage lines.	April to May.	Possible – suitable habitat present within survey area.	DPaW
Myrtaceae	<i>Hypocalymma</i> sp. Cataby (G.J. Keighery 5151)	-	P2	Erect, spreading shrub, 0.5-1 m high.	Grey sand.	August.	Possible – suitable habitat present within survey area.	DPaW
Myrtaceae	<i>Hypocalymma</i> sp. Dandaragan (C.A. Gardner 9014)	-	P1	Multi-stemmed shrub to 0.3 m high with yellow flowers.	Grey sand with lateritic pebbles.	September.	Possible – suitable habitat present within survey area.	DPaW

Family	Taxon	Status		Description	Habitat	Flowering	Likelihood of Occurrence	Source
		EPBC Act	WC Act /DPaW					
Myrtaceae	<i>Hypocalymma</i> sp. Gairdner Range (C.A. Gardner 9091)	-	P2	Yellow flowers.	Stony soil.	August.	Possible – suitable habitat present within survey area.	NM DPaW
Myrtaceae	<i>Hypocalymma tenuatum</i>	-	P2	Shrub, 0.2-0.35 m high with cream-yellow flowers.	Sandy loam over sandstone. Outcrops, ridges.	July to August.	Possible – suitable habitat present within survey area.	NM DPaW
Myrtaceae	<i>Hypocalymma tetrapterum</i>	-	P3	Shrub, 0.4-0.9 m high with white flowers.	Grey sand, loam, lateritic gravel on riverbanks and breakaways.	August.	Possible – suitable habitat present within survey area.	DPaW
Myrtaceae	<i>Verticordia amphigia</i>	-	P3	Shrub, 0.6-1.3 m high with yellow flowers.	Sandy loam, clay and rocky loam. Winter-wet depressions.	October to November.	Possible – suitable habitat present within survey area.	NM
Myrtaceae	<i>Verticordia argentea</i>	-	P2	Erect, open shrub, 0.9-2 m high with pink and white flowers.	White, grey or yellow sand. Sand ridges, undulating plains.	November to April.	Possible – suitable habitat present within survey area.	DPaW
Myrtaceae	<i>Verticordia aurea</i>	-	P4	Shrub, 0.6-1.5 m high with yellow-orange flowers.	Deep sand. Sandplains.	September to December.	Possible – suitable habitat present within survey area.	NM
Myrtaceae	<i>Verticordia fragrans</i>	-	P3	Openly branched shrub, 1-3 m high with pink-white flowers.	White, grey or yellow sand, clay loam. Low-lying areas, sandplains.	September to November.	Possible – suitable habitat present within survey area.	NM DPaW
Myrtaceae	<i>Verticordia insignis</i> subsp. <i>eomagis</i>	-	P3	Erect shrub, 0.2-1 m high with white-pink/white flowers.	Sandy soils over laterite. Sandplains, rocky rises.	August to November.	Possible – suitable habitat present within survey area.	NM
Myrtaceae	<i>Verticordia luteola</i> var. <i>rosea</i>	-	P1	Slender shrub, 0.3-2 m high with pink/green-cream-brown flowers.	White sand. Flats.	December or January.	Possible – suitable habitat present within survey area.	NM

Family	Taxon	Status		Description	Habitat	Flowering	Likelihood of Occurrence	Source
		EPBC Act	WC Act /DPaW					
Myrtaceae	<i>Verticordia muelleriana</i> subsp. <i>muelleriana</i>	-	P3	Spindly shrub, 0.45-2 m high with pink-purple-red/brown flowers.	White/grey or yellow sand. Sandplains.	September to January.	Possible – suitable habitat present within survey area.	NM
Myrtaceae	<i>Verticordia rutilastra</i>	-	P3	Shrub, 0.2-0.9 m high with yellow flowers.	Sand and lateritic gravel. Hills.	September to November.	Possible – suitable habitat present within survey area.	NM
Myrtaceae	<i>Verticordia venusta</i>	-	P3	Erect, spreading shrub, 0.2-2 m high with pink-purple/red-brown flowers.	Yellow sand, sandy gravel. Sandplains.	September to January.	Possible – suitable habitat present within survey area.	NM
Orchidaceae	<i>Caladenia hoffmanii</i>	EN	EN	Tuberous, perennial herb, 0.13-0.3 m high with green and yellow and red flowers.	Clay, loam, laterite, granite. Rocky outcrops and hillsides, ridges, swamps and gullies.	August to October.	Highly Unlikely – Records show this species occurs north of the survey area around Geraldton.	PMST
Orchidaceae	<i>Caladenia huegelii</i>	EN	CR	Tuberous, perennial herb, 0.25-0.6 m high with green and cream and red flowers.	Grey or brown sand, clay loam.	September to October.	Highly Unlikely – Records show this species occurs south of the survey area along the coast south of Perth.	PMST
Orchidaceae	<i>Calandrinia oraria</i>	-	P3	Annual herb to 0.3 m high with pink flowers.	Grey sand, sand dunes over limestone.	August to October.	Possible – suitable habitat present within survey area.	DPaW
Orchidaceae	<i>Drakaea elastica</i>	EN	CR	Tuberous, perennial herb, 0.12-0.3 m high with red and green and yellow flowers.	White or grey sand. Low lying situations adjoining winter-wet swamps.	October to November.	Highly Unlikely – Majority of records show this species occurs south of the survey area along the coast south of Perth.	PMST
Orchidaceae	<i>Paracaleana dixonii</i>	EN	VU	Tuberous, perennial herb, 0.09-0.2 m high with yellow-brown flowers.	Grey sand over granite.	October to January.	Unlikely – No granite observed within the survey area.	NM PMST DPaW

Family	Taxon	Status		Description	Habitat	Flowering	Likelihood of Occurrence	Source
		EPBC Act	WC Act /DPaW					
Orchidaceae	<i>Thelymitra apiculata</i>	-	P4	Tuberous, perennial herb, 0.2-0.35 m high with purple and yellow flowers.	Grey sand, lateritic gravel.	May to July.	Possible – suitable habitat present within survey area.	NM DPaW
Orchidaceae	<i>Thelymitra pulcherrima</i>	-	P2	Tuberous perennial herb to 0.15 m high.	Sand. Gravel.	August.	Possible – suitable habitat present within survey area.	NM DPaW
Orchidaceae	<i>Thelymitra stellata</i>	EN	EN	Tuberous, perennial herb, 0.15-0.25 m high with yellow and brown flowers.	Sand, gravel, lateritic loam.	October to November.	Possible – suitable habitat present within survey area.	NM PMST DPaW
Orchidaceae	<i>Thelymitra variegata</i>	-	P2	Tuberous, perennial herb, 0.1-0.35 m high with orange and red and purple and pink flowers.	Sandy clay, sand, laterite.	June to September.	Known – species was recorded from within the survey area.	NM
Poaceae	<i>Austrostipa</i> sp. Cairn Hill (M.E. Trudgen 21176)	-	P3	Perennial grass to 0.6 m high.	Yellow sand, sandy loam. Flats and slopes.	September.	Unlikely – No yellow sand observed within the survey area.	NM DPaW
Proteaceae	<i>Banksia catoglypta</i>	-	VU	Non-lignotuberous shrub to 1 m high, to 1 m wide with orange-brown flowers.	Lateritic breakaways.	June to July.	Possible – suitable habitat present within survey area.	NM DPaW
Proteaceae	<i>Banksia chamaephyton</i>	-	P4	Low, lignotuberous shrub, to 0.4 m high, up to 2 m wide with cream and brown flowers.	Grey or white sand over laterite.	October to December.	Possible – suitable habitat present within survey area.	NM DPaW
Proteaceae	<i>Banksia elegans</i>	-	P4	Shrub, 1-4 m high with yellow/green-yellow flowers.	Yellow, white or red sand. Sandplains, low consolidated dunes.	October to November.	Unlikely – suitable habitat not present within survey area.	NM
Proteaceae	<i>Banksia fraseri</i> var. <i>crebra</i>	-	P3	Shrub to 0.7 m high with yellow-brown flowers.	Sand, sandy gravel, lateritic soils. Slopes.	July to August.	Possible – suitable habitat present within survey area.	NM DPaW

Family	Taxon	Status		Description	Habitat	Flowering	Likelihood of Occurrence	Source
		EPBC Act	WC Act /DPaW					
Proteaceae	<i>Banksia fraseri</i> var. <i>effusa</i>	-	P2	Sprawling shrub to 0.3 m high pink/cream flowers.	Laterite, gravelly loam on slopes.	July to August.	Possible – suitable habitat present within survey area.	NM DPaW
Proteaceae	<i>Banksia kippistiana</i> var. <i>paenepeccata</i>	-	P3	Erect, prickly, lignotuberous shrub, 0.3-1.2 m high with yellow-cream flowers.	Lateritic gravelly soils.	October to November.	Possible – suitable habitat present within survey area.	NM DPaW
Proteaceae	<i>Banksia nobilis</i> subsp. <i>fragrans</i>	-	P3	Erect, non-lignotuberous shrub, 0.6-2 m high with yellow-green/pink flowers.	Lateritic rises.	July to September.	Possible – suitable habitat present within survey area.	NM DPaW
Proteaceae	<i>Banksia serratuloides</i> subsp. <i>perissa</i>	CR	EN	Bushy, lignotuberous shrub to 1 m high with yellow flowers.	Gravelly lateritic soils.	August to September.	Possible – suitable habitat present within survey area.	NM PMST DPaW
Proteaceae	<i>Banksia serratuloides</i> subsp. <i>serratuloides</i>	VU	VU	Low, bushy, lignotuberous shrub, 0.3-1 m high with yellow flowers.	Loam or clay loam over laterite, sandy gravel.	July to September.	Highly Unlikely – Majority of records show this species occurs south east of the survey area in a different Bioregion.	DPaW
Proteaceae	<i>Banksia splendida</i> subsp. <i>macrocarpa</i>	-	P3	Bushy, non-lignotuberous shrub, 0.3-1.5 m high with yellow/orange-red flowers.	Lateritic gravel.	July to August.	Possible – suitable habitat present within survey area.	NM DPaW
Proteaceae	<i>Banksia subulata</i>	-	P3	Bushy, non-lignotuberous shrub, to 0.35 m high with yellow flowers.	White/grey or yellow sand over laterite, gravelly laterite.	September.	Possible – suitable habitat present within survey area.	NM DPaW
Proteaceae	<i>Banksia tricuspis</i>	-	P4	Stunted tree or shrub, 1.2-4 m high with epicormics buds and yellow-orange flowers.	Lateritic rocky soils. Sides and hilltops, breakaway edges.	March to July.	Possible – suitable habitat present within survey area.	NM DPaW

Family	Taxon	Status		Description	Habitat	Flowering	Likelihood of Occurrence	Source
		EPBC Act	WC Act /DPaW					
Proteaceae	<i>Conospermum scaposum</i>	-	P3	Erect shrub, 0.2-0.45 m high with blue flowers.	White-grey sand, sandy clay. Low swampy areas, road verges.	October to February.	Possible – suitable habitat present within survey area.	NM DPaW
Proteaceae	<i>Grevillea batrachioides</i>	EN	CR	Shrub, 0.5-1.5 m high with orange-red flowers.	Sandy loam. Sandstone outcrops.	October.	Possible – suitable habitat present within survey area.	NM PMST DPaW
Proteaceae	<i>Grevillea delta</i>	-	P2	Shrub, 0.3-1.8 m high with red flowers.	Sandy clay, loam, gravelly soils, often over sandstone. Sandstone outcrops, creek beds.	June to October.	Known – species was recorded within the survey area.	NM DPaW
Proteaceae	<i>Grevillea florida</i>	-	P3	Erect shrub, to 0.9 m high with cream-yellow flowers.	Sand, sandy clay, gravel, laterite. Sandplain, slopes, road verges.	July to September.	Possible – suitable habitat present within survey area.	NM
Proteaceae	<i>Grevillea humifusa</i>	EN	CR	Prostrate to decumbent, lignotuberous shrub with red flowers.	Gravelly loam over laterite.	September to November.	Possible – suitable habitat present within survey area.	NM PMST
Proteaceae	<i>Grevillea metamorpha</i>	-	P1	Erect, spindly shrub to 1.5 m high with white flowers.	White sand. Along creek line.	September.	Possible – suitable habitat present within survey area.	NM DPaW
Proteaceae	<i>Grevillea olivacea</i>	-	P4	Erect, non-lignotuberous shrub, 1 -4.5 m high with red/red-pink flowers.	White or grey sand. Coastal dunes, limestone rocks.	June to September.	Possible – suitable habitat present within survey area.	NM DPaW
Proteaceae	<i>Grevillea rudis</i>	-	P4	Loose, spreading to erect shrub, 0.2-1.2 m high with white-cream/cream-yellow flowers.	White, grey, yellow or red sand, often with gravel and over laterite.	January or April or June to December.	Possible – suitable habitat present within survey area.	NM
Proteaceae	<i>Grevillea saccata</i>	-	P4	Diffuse scrambling or trailing shrub, 0.25-0.5 m high, 1-2 m wide with red flowers.	Yellow or brown sand, often with lateritic gravel.	April or June to November.	Possible – suitable habitat present within survey area.	NM DPaW

Family	Taxon	Status		Description	Habitat	Flowering	Likelihood of Occurrence	Source
		EPBC Act	WC Act /DPaW					
Proteaceae	<i>Grevillea thelemanniana</i> subsp. Cooljarloo (B.J. Keighery 28 B)	-	P1	Spreading shrub to 0.6 m with red flowers.	Seasonally wet area with clay, sandy clay or loam soil.	July to November.	Possible – suitable habitat present within survey area.	NM DPaW
Proteaceae	<i>Grevillea thyrsoides</i> subsp. <i>pustulata</i>	-	P3	Spreading or procumbent shrub, 0.3-0.7 m high with red-pink flowers.	Sand or sandy gravel.	March or July to September.	Possible – suitable habitat present within survey area.	NM
Proteaceae	<i>Grevillea thyrsoides</i> subsp. <i>thyrsoides</i>	-	P3	Spreading or procumbent shrub, 0.3-0.7 m high with red-pink flowers.	Sand or sandy lateritic gravel.	February or August to September.	Possible – suitable habitat present within survey area.	NM DPaW
Proteaceae	<i>Grevillea uniformis</i>	-	P3	Shrub 0.8-1.8 m high with white-cream flowers.	Sand or sandy loam on sandstone, lateritic gravel. Sandstone outcrops, creeklines.	July or September to November.	Unlikely – sandstone outcropping not observed within survey area.	NM DPaW
Proteaceae	<i>Hakea longiflora</i>	-	P3	Erect, pungent shrub, 0.6-0.75 m high with yellow flowers.	White sand, loam, gravel, laterite. Breakaways.	June to September.	Possible – suitable habitat present within survey area.	NM DPaW
Proteaceae	<i>Hakea megalosperma</i>	VU	VU	Spreading, lignotuberous shrub, 1-2 m high with white-cream/pink flowers.	Grey sand, loam. Lateritic hills and rocks.	May to June.	Known – species was recorded from within the survey area.	NM PMST
Proteaceae	<i>Hakea neurophylla</i>	-	P4	Erect shrub, 0.3-2 m high with pink-red flowers.	Lateritic sandy soils. Hillsides.	August.	Known – species was recorded from within the survey area.	NM DPaW
Proteaceae	<i>Isopogon drummondii</i>	-	P3	Erect, lignotuberous shrub, 0.4-1 m high with yellow/cream-yellow flowers.	White, grey or yellow sand, often over laterite.	February to June.	Possible – suitable habitat present within survey area.	NM DPaW

Family	Taxon	Status		Description	Habitat	Flowering	Likelihood of Occurrence	Source
		EPBC Act	WC Act /DPaW					
Proteaceae	<i>Persoonia filiformis</i>	-	P2	Erect, spreading, lignotuberous shrub, 0.07-0.4 m high with yellow flowers.	Yellow or white sand over laterite.	November to December.	Possible – suitable habitat present within survey area.	NM DPaW
Proteaceae	<i>Persoonia rudis</i>	-	P3	Erect, often spreading shrub, 0.2-1 m high with yellow flowers.	White, grey or yellow sand, often over laterite.	September to January.	Possible – suitable habitat present within survey area.	NM DPaW
Proteaceae	<i>Petrophile nivea</i>	-	VU	Erect, rigid shrub to 0.6 m high with white flowers.	Dry bare white sand over gravel over laterite. Uplands.	May or July.	Possible – suitable habitat present within survey area.	NM DPaW
Proteaceae	<i>Petrophile septemfida</i>	-	P3	Erect, prickly shrub to 1.2 m high with pale cream-yellow flowers.	Grey/white sand over laterite. Sandy plain between hills.	March to June or August to September.	Possible – suitable habitat present within survey area.	DPaW
Proteaceae	<i>Synaphea endothis</i>	-	P3	Erect, clumped shrub, to 0.6 m high with yellow flowers.	Gravelly loam, sand. Lateritic rises.	August to September.	Possible – suitable habitat present within survey area.	NM DPaW
Proteaceae	<i>Synaphea lesueurensis</i>	-	P2	Shrub, 0.25-0.6 m high with yellow flowers.	Laterite, sandy soils over laterite or sandstone. Hillslopes.	August to October.	Possible – suitable habitat present within survey area.	NM DPaW
Proteaceae	<i>Synaphea xela</i>	-	P2	Sprawling shrub, to 0.4 m high with yellow flowers.	Red-brown gravelly sand, white-pink, grey-brown clayey sand and loam, over laterite. Undulating sites.	August.	Possible – suitable habitat present within survey area.	NM DPaW
Restionaceae	<i>Catacolea enodis</i>	-	P2	Rhizomatous, perennial herb, 0.1-0.3 m high with brown flowers.	Depp white sand over laterite. Tall heath.	-	Possible – suitable habitat present within survey area.	DPaW
Restionaceae	<i>Chordifex chaunocoleus</i>	-	P4	Rhizomatous, erect perennial herb, 0.15-0.5 m high with frown flowers.	Grey, siliceous or peaty sand, well to poorly drained. Drainage lines, depressions.	September.	Possible – suitable habitat present within survey area.	NM DPaW

Family	Taxon	Status		Description	Habitat	Flowering	Likelihood of Occurrence	Source
		EPBC Act	WC Act /DPaW					
Restionaceae	<i>Chordifex reseminans</i>	-	P2	Rhizomatous, erect, tufted herb, 0.6-0.9 m high.	Dry sand. Heath.	March to May.	Possible – suitable habitat present within survey area.	DPaW
Restionaceae	<i>Desmocladius biformis</i>	-	P3	Rhizomatous, densely tufted perennial herb, 0.1-0.2 m high.	Sand, sandy clay, lateritic soils. Dry sites.	September to October.	Possible – suitable habitat present within survey area.	DPaW
Restionaceae	<i>Desmocladius elongatus</i>	-	P4	Rhizomatous, perennial herb, 0.25-0.5 m high.	White or grey sand. Dry kwongan.	August to December.	Possible – suitable habitat present within survey area.	NM
Restionaceae	<i>Desmocladius microcarpus</i>	-	P2	Small clumping herb to 0.06 m.	White/grey sandy soils over lateritic gravel.	-	Possible – suitable habitat present within survey area.	DPaW
Restionaceae	<i>Desmocladius nodatus</i>	-	P3	Small herb to 0.1 m high.	Grey and brown sand, sandy loam. Rocky plain, wetland area.	-	Possible – suitable habitat present within survey area.	DPaW
Restionaceae	<i>Hypolaena robusta</i>	-	P4	Dioecious rhizomatous, perennial herb to 0.5 m high.	White sand. Sandplains.	September to October.	Possible – suitable habitat present within survey area.	NM DPaW
Restionaceae	<i>Lepidobolus quadratus</i>	-	P3	Rhizomatous, caespitose perennial herb, 0.15-0.3 m high with brown/red flowers.	Lateritic gravel, grey/white sand. Dry kwongan.	August to September.	Known – species was recorded from within the survey area.	NM DPaW
Restionaceae	<i>Lepyrodia curvescens</i>	-	P2	Dioecious, shortly creeping, tufted rhizomatous herb, 0.24-0.4 m high.	Sand, laterite. Seasonally inundated swampland.	September to November.	Possible – suitable habitat present within survey area.	NM DPaW
Restionaceae	<i>Loxocarya gigas</i>	-	P2	Rhizomatous, clumped perennial herb, 0.8-2 m high.	Sandy gravelly lateritic soils. Low hills and ridges, sandplains.	No information available.	Possible – suitable habitat present within survey area.	NM DPaW
Rhamnaceae	<i>Stenanthemum limitatum</i>	-	P2	Erect or decumbent shrub, 0.15-1 m high with white/cream flowers.	Sand and lateritic gravel, sandstone.	October to November.	Possible – suitable habitat present within survey area.	NM DPaW

Family	Taxon	Status		Description	Habitat	Flowering	Likelihood of Occurrence	Source
		EPBC Act	WC Act /DPaW					
Rutaceae	<i>Asterolasia drummondii</i>	-	P4	Slender erect shrub, 0.2-0.5 m high with white flowers.	Lateritic gravel and sand or loam. Lateritic hills and sandplains, breakaways.	July to September.	Possible – suitable habitat present within survey area.	NM
Rutaceae	<i>Boronia ramosa</i> subsp. <i>lesueurana</i>	-	P2	Compact, woody perennial herb, 0.15-0.3 m high with white flowers.	Sand or gravel over laterite.	July to August.	Possible – suitable habitat present within survey area.	NM DPaW
Rutaceae	<i>Boronia scabra</i> subsp. <i>condensata</i>	-	P2	Erect shrub, 0.25-0.7 m high with pink flowers.	Sandy clay or gravel. Upper slopes, edges of lateritic breakaways.	August.	Possible – suitable habitat present within survey area.	NM DPaW
Stylidiaceae	<i>Stylidium aeonioides</i>	-	P4	Rosetted, perennial herb, 0.05-0.4 m high with cream-yellow flowers.	Sandy clay loam over laterite. Hillsides and breakaways. Low heath, open woodland.	September to November.	Possible – suitable habitat present within survey area.	NM DPaW
Stylidiaceae	<i>Stylidium carnosum</i> subsp. <i>Narrow leaves</i> (J.A. Wege 490)	-	P1	Tall, perennial herb to 0.8 m high with white flowers.	White/grey sand. Lateritic soils. Slopes of laterite hill.	September to November.	Possible – suitable habitat present within survey area.	NM
Stylidiaceae	<i>Stylidium cornuatum</i>	-	P2	Herb to 0.08 m high with pale-dark pink flowers.	Moist soils, orange-brown clay loam or brown sandy clay.	September.	Possible – suitable habitat present within survey area.	DPaW
Stylidiaceae	<i>Stylidium diplotrichum</i>	-	P2	Rosetted perennial herb, 0.15-0.4 m high with white flowers.	Clayey sand or clay loam over laterite. Hillslopes and gullies. <i>Acacia</i> and myrtaceous shrubland, low heath.	September to November.	Possible – suitable habitat present within survey area.	NM DPaW
Stylidiaceae	<i>Stylidium hymenocraspedum</i>	-	P3	Rosetted, perennial herb, 0.7 m high with yellow flowers.	Sand over laterite. Hillslopes. Heath, <i>Banksia</i> and <i>Eucalyptus</i> low open woodland.	September to October.	Likely – infertile specimen of this species was potentially recorded from within the survey area.	DPaW
Stylidiaceae	<i>Stylidium inversiflorum</i>	-	P4	Rosetted perennial herb, 0.08-0.25 m high with yellow flowers.	White or grey sand over laterite. Sandplains, hillslopes and gullies. Heath, open woodland.	September to November.	Possible – suitable habitat present within survey area.	NM DPaW

Family	Taxon	Status		Description	Habitat	Flowering	Likelihood of Occurrence	Source
		EPBC Act	WC Act /DPaW					
Stylidiaceae	<i>Stylidium maritimum</i>	-	P3	Caespitose perennial herb, 0.3-0.7 m high with white/purple flowers.	Sand over limestone. Dune slopes and flats. Coastal heath and shrubland, open <i>Banksia</i> woodland.	September to November.	Possible – suitable habitat present within survey area.	NM DPaW
Stylidiaceae	<i>Stylidium nonscandens</i>	-	P3	Erect perennial herb, 0.18-0.46 m high with pink flowers.	Sand over laterite. Hillslopes and crests. <i>Banksia</i> woodland, heath, mallee shrubland.	September to November.	Possible – suitable habitat present within survey area.	NM DPaW
Stylidiaceae	<i>Stylidium periscelanthum</i>	-	P3	Bulb-forming perennial herb, 0.07-0.15 m high with pink flowers.	Loamy clay, moist soil pockets. Wet flats, low granitic hills.	September to October.	Possible – suitable habitat present within survey area.	NM DPaW
Stylidiaceae	<i>Stylidium</i> sp. Banovich Road (F. & J. Hort 1884)	-	P1	Rosetted perennial herb to 0.2 m high with pink/yellow flowers.	Gravelly sand, clayey sand, sandy loam and sand over laterite on slopes and near creeklines.	September to November.	Possible – suitable habitat present within survey area.	NM DPaW
Stylidiaceae	<i>Stylidium torticarpum</i>	-	P3	Caespitose perennial herb, 0.12-0.27 m high with pink flowers.	Sandy clay and clay loam over laterite. Adjacent to creeklines, depressions, and beneath breakaways. Heaths or mallee shrubland.	September to November.	Likely – infertile specimen of this species was potentially recorded from within the survey area.	NM DPaW

Site:	HR01	Project: Hill River Offset Property	
Type:	Quadrat	Size:	10 x 10 m
Date:	01/08/2016	Described by:	MG/JF
Co-ordinates:	MGA 50J	331527 mE	6659221 mN
Location:	Lot 1, 1395 Banovich Road, Hill River		
Landform and slope:	Mid slope, gentle slope		
Drainage:	Good drainage		
Soil colour & type:	Brown loamy clay		
Vegetation condition:	1		
Fire age & intensity:	Old, no damage		
Disturbances:	None		
Leaf litter:	Sparse	Wood litter:	Sparse
Coarse gravel/pebbles 2-6 cm (%):	<2	Humus/Litter (%):	2-10



Species List

Species	Status	Stratum	% Cover	Height (cm)
<i>?Craspedia</i> sp.		G2	2-10%	20
<i>Allocasuarina humilis</i>		M1	<2%T	120
<i>Allocasuarina microstachya</i>		M1	30-70%	130
<i>Anigozanthos</i> sp.		G1	<2%T	30
<i>Astroloma</i> sp.		M2	<2%T	40
<i>Banksia armata</i>		M1	<2%T	130
<i>Borya nitida</i>		G1	10-30%	15
<i>Caladenia</i> sp.		G2	<2%T	5
<i>Calytrix</i> sp.		M2	<2%T	35
<i>Cassytha</i> sp.		G2	<2%T	C
<i>Conostylis ?crassinervia</i>		G1	<2%T	15
<i>Conostylis androstemma</i>		G1	<2%N	15

Species	Status	Stratum	% Cover	Height (cm)
<i>Cryptandra pungens</i>		M2	<2%T	40
<i>Diplolaena ferruginea</i>		M2	<2%T	50
<i>Drosera ?macrantha</i>		G2	<2%N	80
<i>Drosera erythrorhiza</i> subsp. <i>erythrorhiza</i>		G2	<2%N	10
<i>Haemodorum ?venosum</i>		G1	<2%T	30
<i>Hakea incrassata</i>		M2	<2%T	50
<i>Hakea neospathulata</i>		M2	<2%T	20
<i>Hibbertia acerosa</i>		M2	<2%T	20
<i>Hibbertia hypericoides</i>		M2	2-10%	50
<i>Hibbertia</i> sp.		M2	<2%T	45
<i>Hypocalymma xanthopetalum</i>		M2	<2%N	50
<i>Lepidobolus quadratus</i>	P3	G1	<2%T	15
<i>Lepidosperma</i> sp.		G1	<2%N	65
<i>Leporella fimbriata</i>		G2	<2%N	2
<i>Melaleuca ?trichophylla</i>		M2	<2%T	80
<i>Neurachne alopecuroidea</i>		G1	<2%N	20
<i>Opercularia vaginata</i>		M2	<2%T	15
<i>Petrophile chrysantha</i>		M2	<2%T	85
<i>Schoenus ?nanus/latitans</i>		G1	30-70%	5
<i>Schoenus subflavus</i>		G2	<2%T	10
<i>Stylidium ?repens</i>		G2	<2%T	10
<i>Stylidium</i> sp.		G2	<2%N	30
<i>Tetradlea paucifolia</i>		M2	<2%T	40
<i>Thomasia ?grandiflora</i>		M2	<2%T	30
<i>Verticordia</i> sp.		M2	<2%T	90
<i>Xanthorrhoea drummondii</i>		G1	<2%T	110

Site:	HR02	Project: Hill River Offset Property	
Type:	Quadrat	Size:	10 x 10 m
Date:	01/08/2016	Described by:	MG/JF
Co-ordinates:	MGA 50J	330757 mE	6659587 mN
Location:	Lot 1, 1395 Banovich Road, Hill River		
Landform and slope:	Drainage line, negligible slope		
Drainage:	Seasonal wet		
Soil colour & type:	Grey sand		
Vegetation condition:	2		
Fire age & intensity:	Nil, no damage		
Disturbances:	Weeds		
Leaf litter:	Moderate	Wood litter:	Sparse
Humus/Litter (%):	11-30		



Species List

Species	Status	Stratum	% Cover	Height (cm)
? <i>Hydrocotyle alata</i>		G2	<2%T	1
? <i>Pheladenia deformis</i>		G2	<2%N	15
? <i>Siloxerus</i> sp.		G2	<2%T	5
<i>Acacia saligna</i>		M1	<2%T	190
<i>Arctotheca calendula</i>	*	G2	<2%N	10
<i>Caladenia longicauda</i> subsp. <i>borealis</i>		G2	<2%T	30
<i>Calothamnus quadrifidus</i>		M2	<2%T	90
<i>Cassytha</i> sp.		G2	<2%N	C
<i>Chamaescilla corymbosa</i>		G1	<2%N	10
<i>Comesperma scoparium</i>		M2	<2%T	30
<i>Conostylis aculeata</i> subsp. <i>hipidion</i>		G1	<2%T	15
<i>Drosera ?glanduligera</i>		G2	<2%T	1

Species	Status	Stratum	% Cover	Height (cm)
<i>Drosera ?macrantha</i>		G2	2-10%	30
<i>Haemodorum</i> sp.		G1	<2%T	30
<i>Hakea erinacea</i>		M2	<2%T	70
<i>Hakea varia</i>		M1	<2%T	110
<i>Hypochaeris glabra</i>	*	G2	2-10%	5
<i>Lagenophora huegelii</i>		G2	<2%T	30
<i>Lomandra</i> sp.		G1	<2%T	70
<i>Lysimachia arvensis</i>	*	G2	<2%N	10
<i>Melaleuca ?delta</i>		M1	2-10%	170
<i>Melaleuca preissiana</i>		U1	2-10%	400
<i>Neurachne alopecuroidea</i>		G1	<2%T	10
<i>Pheladenia deformis</i>		G2	<2%T	2
<i>Pimelea argentea</i>		M2	<2%T	50
Poaceae sp.	*	G1	<2%N	10
<i>Podolepis ?lessonii</i>		G2	<2%N	10
Restionaceae sp.		G2	2-10%	80
<i>Trachymene pilosa</i>		G2	<2%N	10
<i>Tribonanthes ?australis</i>		G1	<2%N	10
<i>Tricoryne elatior</i>		G2	<2%N	10
<i>Ursinia anthemoides</i>	*	G2	<2%N	20
<i>Verticordia</i> sp.		M1	10-30%	130

Site:	HR03		Project: Hill River Offset Property	
Type:	Quadrat	Size:	10 x 10 m	
Date:	01/08/2016	Described by:	MG/JF	
Co-ordinates:	MGA 50J	331366 mE	6659859 mN	
Location:	Lot 1, 1395 Banovich Road, Hill River			
Landform and slope:	Hillcrest, negligible slope			
Drainage:	Good drainage			
Soil colour & type:	Orange clayey sand			
Vegetation condition:	1			
Fire age & intensity:	Old, no damage			
Disturbances:	None			
Leaf litter:	Moderate	Wood litter:	Sparse	
Humus/Litter (%):	2-10	Coarse gravel/pebbles 2-6 cm (%):	2-10	
Cobbly/cobbles 6-20 cm (%):	2-10			



Species List

Species	Status	Stratum	% Cover	Height (cm)
? <i>Craspedia</i> sp.		G2	<2%T	10
<i>Acacia lasiocarpa</i> var. <i>lasiocarpa</i>		M2	<2%T	50
<i>Banksia armata</i>		M1	<2%N	40
<i>Borya nitida</i>		G1	<2%T	15
<i>Bossiaea eriocarpa</i>		M1	<2%T	40
<i>Calothamnus sanguineus</i>		M1	<2%N	50
<i>Calothamnus torulosus</i>		M1	<2%T	50
<i>Conostylis androstemma</i>		G1	<2%T	20
<i>Diplolaena ferruginea</i>		M1	<2%T	50
<i>Drosera erythrorhiza</i> subsp. <i>erythrorhiza</i>		G2	<2%N	1
Ericaceae sp.		M2	<2%T	30

Species	Status	Stratum	% Cover	Height (cm)
<i>Eucalyptus wandoo</i>		U1	10-30%	750
<i>Eucalyptus wandoo</i>		U2	<2%T	200
<i>Gastrolobium polystachyum</i>		M1	30-70%	80
<i>Gastrolobium spinosum</i>		M1	<2%N	100
<i>Gompholobium marginatum</i>		M1	<2%T	40
<i>Haemodorum ?venosum</i>		G1	<2%T	30
<i>Hakea incrassata</i>		M1	<2%T	40
<i>Hakea neospathulata</i>		M1	<2%T	70
<i>Hibbertia hypericoides</i>		M1	<2%N	30
<i>Hypocalymma xanthopetalum</i>		M1	<2%T	30
<i>Leucopogon ?oldfieldii</i>		M2	<2%T	50
<i>Neurachne alopecuroidea</i>		G1	2-10%	20
<i>Olearia</i> sp.		M2	<2%T	20
<i>Opercularia vaginata</i>		G2	<2%T	15
Orchidaceae sp.		G2	<2%N	20
<i>Petrophile ?brevifolia</i>		M2	<2%T	40
<i>Schoenus ?nanus/latitans</i>		G1	<2%T	5
<i>Tetralochea paucifolia</i>		M1	<2%N	30
<i>Verticordia</i> sp.		M2	<2%T	50
<i>Xanthorrhoea drummondii</i>		G1	10-30%	110

Site:	HR04	Project: Hill River Offset Property	
Type:	Quadrat	Size:	10 x 10 m
Date:	02/08/2016	Described by:	MG/JF
Co-ordinates:	MGA 50J	329935 mE	6658244 mN
Location:	Lot 1, 1395 Banovich Road, Hill River		
Landform and slope:	Mid slope, gentle slope		
Drainage:	Good drainage		
Soil colour & type:	Grey sandy clay		
Vegetation condition:	1		
Fire age & intensity:	Nil, no damage		
Disturbances:	None		
Leaf litter:	Sparse	Wood litter:	Negligible
Humus/Litter (%):	2-10	Coarse gravel/pebbles 2-6 cm (%):	2-10
Cobbly/cobbles 6-20 cm (%):	2-10		



Species List

Species	Status	Stratum	% Cover	Height (cm)
<i>?Chamaescilla corymbosa</i>		G2	2-10%	30
<i>?Craspedia sp.</i>		G2	<2%N	5
<i>Acacia ?ericifolia</i>		M2	<2%T	80
<i>Acacia incrassata</i>		M2	<2%T	30
<i>Allocasuarina humilis</i>		M2	<2%T	90
<i>Anigozanthos humilis</i>		G1	<2%T	20
<i>Banksia armata</i>		M1	<2%T	120
<i>Borya nitida</i>		G1	<2%T	10
<i>Burchardia sp.</i>		G2	<2%N	60
<i>Calothamnus sanguineus</i>		M2	2-10%	80
<i>Cassytha sp.</i>		G2	<2%T	C

Species	Status	Stratum	% Cover	Height (cm)
<i>Conostylis</i> sp.		G1	<2%T	20
<i>Cryptandra pungens</i>		M2	<2%N	90
<i>Dampiera</i> sp.		M2	<2%T	20
<i>Daviesia nudiflora</i>		M2	2-10%	80
<i>Drosera ?macrantha</i>		G2	<2%N	50
<i>Drosera erythrorhiza</i> subsp. <i>erythrorhiza</i>		G2	<2%N	2
<i>Gastrolobium capitatum</i>		M2	<2%T	90
<i>Hakea anadenia</i>		M2	2-10%	90
<i>Hakea erinacea</i>		M1	<2%N	120
<i>Hibbertia hypericoides</i>		M2	<2%N	60
<i>Hibbertia subvaginata</i>		M2	<2%T	30
<i>Hypocalymma xanthopetalum</i>		M2	<2%N	80
<i>Lepidobolus quadratus</i>	P3	G1	<2%T	20
<i>Lepidosperma ?squamatum</i>		G1	<2%T	30
<i>Lepidosperma</i> sp.		G1	<2%T	60
<i>Melaleuca platycalyx</i>		M2	<2%N	90
<i>Melaleuca</i> sp.		M2	<2%T	90
<i>Mirbelia floribunda</i>		M2	<2%T	90
<i>Neurachne alopecuroidea</i>		G1	<2%N	10
<i>Opercularia vaginata</i>		G2	<2%T	20
<i>Petrophile chrysantha</i>		M2	2-10%	80
<i>Schoenus ?nanus/latitans</i>		G1	10-30%	5
<i>Stenanthemum humile</i>		M2	<2%T	20
<i>Stylidium ?repens</i>		G2	<2%T	10
<i>Tetratheca paucifolia</i>		M2	<2%N	80
<i>Thomasia ?grandiflora</i>		M2	<2%T	80
<i>Verticordia</i> sp.		M1	<2%T	120

Site:	HR05	Project: Hill River Offset Property	
Type:	Quadrat	Size:	10 x 10 m
Date:	02/08/2016	Described by:	MG/JF
Co-ordinates:	MGA 50J	330148 mE	6657081 mN
Location:	Lot 1, 1395 Banovich Road, Hill River		
Landform and slope:	Valley, gentle slope		
Drainage:	Poor drainage		
Soil colour & type:	Brown clay		
Vegetation condition:	3		
Fire age & intensity:	Old, no damage		
Disturbances:	Pigs and weeds		
Leaf litter:	Moderate	Wood litter:	Sparse
Humus/Litter (%):	11-30		



Species List

Species	Status	Stratum	% Cover	Height (cm)
<i>?Bossiaea eriocarpa</i>		M2	<2%T	40
<i>?Craspedia sp.</i>		G2	<2%N	5
<i>?Glischrocaryon aureum</i>		G2	<2%T	40
<i>?Lepidobolus sp.</i>		G1	<2%T	20
<i>Acacia pulchella</i>		M2	<2%T	30
<i>Astroloma ?serratifolium</i>		M2	<2%T	20
<i>Banksia armata</i>		M1	<2%T	120
<i>Banksia armata</i>		M2	<2%N	80
<i>Borya nitida</i>		G1	<2%N	10
<i>Burchardia sp.</i>		G2	<2%N	40
<i>Conospermum sp.</i>		M2	<2%T	10
<i>Conostylis aculeata subsp. rhipidion</i>		G1	2-10%	20
<i>Conostylis sp.</i>		G1	<2%T	30

Species	Status	Stratum	% Cover	Height (cm)
<i>Daviesia nudiflora</i>		M2	<2%T	50
<i>Desmocladius ?lateriticus</i>		G1	<2%N	20
<i>Drosera ?macrantha</i>		G2	<2%N	25
<i>Drosera erythrorhiza</i> subsp. <i>erythrorhiza</i>		G2	<2%N	2
<i>Drosera erythrorhiza</i> subsp. <i>erythrorhiza</i>		G2	<2%T	5
<i>Eucalyptus wandoo</i>		U1	10-30%	1200
<i>Eucalyptus wandoo</i>		U2	2-10%	800
<i>Gompholobium knightianum</i>		M2	<2%T	15
<i>Hakea lissocarpha</i>		M2	<2%T	40
<i>Hemerocallidaceae</i> sp.		G1	<2%T	20
<i>Hypocalymma angustifolium</i>		M2	<2%T	20
<i>Lagenophora huegelii</i>		G2	<2%N	2
<i>Lomandra</i> sp.		G1	<2%T	15
<i>Macrozamia fraseri</i>		G1	<2%T	90
<i>Mirbelia floribunda</i>		M2	<2%T	20
<i>Neurachne alopecuroidea</i>		G1	2-10%	20
<i>Opercularia vaginata</i>		G2	<2%T	15
<i>Romulea rosea</i>	*	G2	2-10%	40
<i>Rytidosperma</i> sp.		G1	<2%T	15
<i>Scaevola</i> sp.		M2	2-10%	30
<i>Stackhousia monogyna</i>		G2	<2%T	30
<i>Tetralochea paucifolia</i>		M2	<2%T	10
<i>Trachymene pilosa</i>		G2	2-10%	5
<i>Wurmbea</i> sp.		G2	<2%T	5
<i>Xanthorrhoea drummondii</i>		G1	2-10%	130

Site:	HR06	Project: Hill River Offset Property	
Type:	Quadrat	Size:	10 x 10 m
Date:	02/08/2016	Described by:	MG/JF
Co-ordinates:	MGA 50J	329128 mE	6657463 mN
Location:	Lot 1, 1395 Banovich Road, Hill River		
Landform and slope:	Mid slope, gentle slope		
Drainage:	Good drainage		
Soil colour & type:	Grey sand		
Vegetation condition:	1		
Fire age & intensity:	Old, minor impact		
Disturbances:	None		
Leaf litter:	Moderate	Wood litter:	Negligible
Humus/Litter (%):	2-10		



Species List

Species	Status	Stratum	% Cover	Height (cm)
? <i>Comesperma</i> sp.		G2	<2%T	40
? <i>Isotropis</i> sp.		M2	<2%T	10
? <i>Leptocarpus</i> sp.		G1	<2%T	50
? <i>Senecio</i> sp.		G2	<2%T	20
<i>Acacia cochlearis</i>		M2	<2%T	90
<i>Acacia pulchella</i>		M2	<2%T	30
<i>Acacia stenoptera</i>		M2	<2%T	50
<i>Allocasuarina humilis</i>		M2	<2%T	100
<i>Anigozanthos humilis</i>		G1	<2%T	40
<i>Arctotheca calendula</i>	*	G2	<2%T	2
<i>Banksia shuttleworthiana</i>		M2	10-30%	30
<i>Burchardia</i> sp.		G2	<2%T	50
<i>Caladenia flava</i>		G2	<2%N	5

Species	Status	Stratum	% Cover	Height (cm)
<i>Caustis dioica</i>		G1	<2%T	50
<i>Conospermum</i> sp.		M1	10-30%	120
<i>Conospermum triplinervium</i>		M2	<2%N	40
<i>Conostephium pendulum</i>		M2	<2%T	50
<i>Conostylis aculeata</i> subsp. <i>hipidion</i>		G1	30-70%	20
<i>Conostylis setigera</i>		G1	<2%T	15
<i>Corymbia calophylla</i>		U1	10-30%	1100
<i>Corymbia calophylla</i>		M2	<2%T	30
<i>Drosera ?macrantha</i>		G2	<2%T	40
<i>Drosera erythrorhiza</i> subsp. <i>erythrorhiza</i>		G2	2-10%	2
<i>Gompholobium tomentosum</i>		M2	<2%T	80
<i>Hakea costata</i>		M1	<2%T	130
<i>Hakea costata</i>		M2	2-10%	90
<i>Hemiandra</i> sp. Jurien (B.J. Conn & M.E. Tozer BJC 3885)		M1	<2%T	110
<i>Hemiandra</i> sp. Jurien (B.J. Conn & M.E. Tozer BJC 3885)		M2	<2%T	70
<i>Hibbertia hypericoides</i>		M2	<2%N	40
<i>Hypocalymma xanthopetalum</i>		M2	<2%T	40
<i>Hypochoeris glabra</i>	*	G2	<2%N	2
<i>Lagenophora huegelii</i>		G2	<2%T	5
<i>Lepidobolus</i> sp.		G1	<2%N	40
<i>Lysimachia arvensis</i>	*	G2	<2%N	5
<i>Macrozamia fraseri</i>		G1	<2%T	110
<i>Melaleuca ?trichophylla</i>		M2	<2%T	60
<i>Mesomelaena pseudostygia</i>		G1	2-10%	50
<i>Opercularia vaginata</i>		G2	<2%T	60
<i>Pimelea floribunda</i>		M2	<2%T	60
<i>Ursinia anthemoides</i>	*	G2	<2%N	15
<i>Verticordia</i> sp.		M2	<2%T	80
<i>Xanthorrhoea drummondii</i>		G1	<2%T	140

Site:	HR07	Project: Hill River Offset Property	
Type:	Quadrat	Size:	10 x 10 m
Date:	02/08/2016	Described by:	MG/JF
Co-ordinates:	MGA 50J	328792 mE	6659297 mN
Location:	Lot 1, 1395 Banovich Road, Hill River		
Landform and slope:	Mid slope, gentle slope		
Drainage:	Good drainage		
Soil colour & type:	Orange loamy sand		
Vegetation condition:	1		
Fire age & intensity:	Old, no damage		
Disturbances:	None		
Leaf litter:	Sparse	Wood litter:	Negligible
Humus/Litter (%):	2-10	Fine rocks 2-6 mm (%):	<2



Species List

Species	Status	Stratum	% Cover	Height (cm)
? <i>Baeckea</i> sp.		M2	<2%T	70
? <i>Craspedia</i> sp.		G2	<2%N	15
? <i>Leporella fimbriata</i>		G2	<2%T	2
<i>Acacia cochlearis</i>		M1	<2%T	110
<i>Acacia cochlearis</i>		M2	<2%T	90
<i>Allocasuarina humilis</i>		M2	2-10%	90
<i>Anigozanthos</i> sp.		G1	<2%T	15
<i>Banksia armata</i>		M1	<2%T	110
<i>Banksia armata</i>		M2	<2%T	70
<i>Borya nitida</i>		G1	<2%T	10
<i>Calothamnus quadrifidus</i>		M1	<2%T	120
<i>Cassytha</i> sp.		G2	<2%N	C
<i>Chamaescilla corymbosa</i>		G1	2-10%	15

Species	Status	Stratum	% Cover	Height (cm)
<i>Comesperma</i> sp.		M2	<2%T	50
<i>Conostephium preissii</i>		M2	<2%N	70
<i>Conostylis</i> sp.		G1	<2%T	15
<i>Cryptandra pungens</i>		M2	2-10%	80
<i>Drosera ?glanduligera</i>		G2	<2%T	1
<i>Drosera ?macrantha</i>		G2	<2%T	40
<i>Drosera erythrorhiza</i> subsp. <i>erythrorhiza</i>		G2	2-10%	2
<i>Gastrolobium capitatum</i>		M2	<2%T	70
<i>Hakea anadenia</i>		M1	<2%T	120
<i>Hakea anadenia</i>		M2	2-10%	90
<i>Hakea neospathulata</i>		M2	<2%T	40
<i>Hibbertia hypericoides</i>		M2	2-10%	70
<i>Hibbertia</i> sp.		M2	<2%N	40
<i>Hypocalymma xanthopetalum</i>		M2	<2%N	50
<i>Isopogon dubius</i>		M2	<2%T	80
<i>Lambertia multiflora</i>		M2	<2%T	70
<i>Lepidosperma</i> sp.		G1	<2%T	40
<i>Leptospermum spinescens</i>		M2	<2%T	70
<i>Melaleuca ?trichophylla</i>		M2	<2%T	80
<i>Neurachne alopecuroidea</i>		G1	<2%N	15
<i>Nuytsia floribunda</i>		M1	<2%T	140
<i>Opercularia vaginata</i>		G2	<2%N	20
<i>Orchidaceae</i> sp.		G2	<2%T	25
<i>Petrophile chrysantha</i>		M2	<2%T	50
<i>Petrophile macrostachya</i>		M2	<2%T	80
<i>Schoenus ?nanus/latitans</i>		G1	2-10%	5
<i>Schoenus</i> sp.		G1	<2%N	15
<i>Stylidium</i> sp.		G2	<2%N	15
<i>Tetratheca paucifolia</i>		M2	<2%T	40
<i>Xanthorrhoea drummondii</i>		G1	2-10%	90

Site:	HR08	Project: Hill River Offset Property	
Type:	Quadrat	Size:	10 x 10 m
Date:	02/08/2016	Described by:	MG/JF
Co-ordinates:	MGA 50J	328113 mE	6659659 mN
Location:	Lot 1, 1395 Banovich Road, Hill River		
Landform and slope:	Gully, negligible slope		
Drainage:	Seasonal wet		
Soil colour & type:	Brown clayey loam		
Vegetation condition:	1		
Fire age & intensity:	Old, no damage		
Disturbances:	None		
Leaf litter:	Moderate	Wood litter:	Sparse
Humus/Litter (%):	2-10		



Species List

Species	Status	Stratum	% Cover	Height (cm)
? <i>Scholtzia</i> sp.		M3	<2%T	50
<i>Acacia retrorsa</i>	P2	M3	<2%T	30
<i>Arnocrinum preissii</i>		G1	<2%N	10
<i>Baeckea</i> sp.		M3	<2%T	70
<i>Bossiaea eriocarpa</i>		M2	<2%T	110
<i>Caladenia</i> sp.		G2	<2%T	10
<i>Calothamnus quadrifidus</i>		M2	<2%N	140
<i>Calothamnus quadrifidus</i>		M3	<2%T	50
<i>Cassytha</i> sp.		G2	2-10%	C
<i>Cheilanthes austrotenuifolia</i>		G2	<2%N	20
<i>Eucalyptus rudis</i>		U1	10-30%	1400
<i>Hakea lissocarpa</i>		M3	<2%T	70
<i>Hypocalymma angustifolium</i>		M3	2-10%	40

Species	Status	Stratum	% Cover	Height (cm)
<i>Hypochaeris glabra</i>	*	G2	<2%N	10
<i>Lagenophora huegelii</i>		G2	<2%N	10
<i>Lysimachia arvensis</i>	*	G2	2-10%	5
Lythraceae sp.		G2	<2%N	15
<i>Melaleuca raphiophylla</i>		M1	10-30%	350
<i>Melaleuca raphiophylla</i>		M2	10-30%	180
<i>Melaleuca raphiophylla</i>		M3	<2%T	50
<i>Muehlenbeckia adpressa</i>		G2	<2%N	C
Orchidaceae sp.		G2	<2%N	20
<i>Orthrosanthus laxus</i>		G1	<2%T	20
<i>Oxalis</i> sp.	*	G2	<2%N	10
<i>Pimelea argentea</i>		M2	<2%N	160
Poaceae sp.		G1	30-70%	20
<i>Ptilotus polystachyus</i>		G2	<2%T	25
<i>Romulea rosea</i>	*	G1	<2%N	20
<i>Senecio</i> sp.		G2	<2%N	20
<i>Sonchus oleraceus</i>	*	G2	2-10%	10
<i>Stylidium</i> sp.		G2	<2%T	10
<i>Thysanotus</i> sp.		G2	<2%T	20
<i>Trachymene pilosa</i>		G2	<2%N	10
<i>Tricoryne elatior</i>		G1	<2%T	10
<i>Trymalium odoratissimum</i>		M2	2-10%	180
<i>Trymalium odoratissimum</i>		M3	<2%N	80
<i>Ursinia anthemoides</i>	*	G2	<2%N	10
<i>Xanthorrhoea</i> sp.		G1	<2%T	110

Site:	HR09	Project: Hill River Offset Property	
Type:	Quadrat	Size:	10 x 10 m
Date:	02/08/2016	Described by:	MG/JF
Co-ordinates:	MGA 50J	328673 mE	6660199 mN
Location:	Lot 1, 1395 Banovich Road, Hill River		
Landform and slope:	Ridge, gentle slope		
Drainage:	Good drainage		
Soil colour & type:	White loamy sand		
Vegetation condition:	1		
Fire age & intensity:	Old, no damage		
Disturbances:	None		
Leaf litter:	Sparse	Wood litter:	Negligible
Humus/Litter (%):	2-10	Coarse gravel/pebbles 2-6 cm (%):	<2



Species List

Species	Status	Stratum	% Cover	Height (cm)
? <i>Craspedia</i> sp.		G2	2-10%	20
<i>Allocasuarina humilis</i>		M1	<2%T	120
Apiaceae sp.		M2	2-10%	20
<i>Banksia ?dallanneyi</i> subsp. <i>media</i>		M2	<2%N	20
<i>Banksia armata</i>		M2	<2%T	90
<i>Borya nitida</i>		G1	<2%N	5
<i>Callitris ?acuminata</i>		M2	2-10%	80
<i>Calothamnus quadrifidus</i>		M2	<2%T	40
<i>Calothamnus sanguineus</i>		M2	2-10%	80
<i>Conostylis androstemma</i>		G1	<2%N	15
<i>Conothamnus trinervis</i>		M2	<2%T	40
<i>Cryptandra pungens</i>		M2	<2%T	50

Species	Status	Stratum	% Cover	Height (cm)
<i>Drosera ?macrantha</i>		G2	<2%T	10
<i>Drosera ?menziesii</i>		G2	<2%N	2
<i>Drosera erythrorhiza</i> subsp. <i>erythrorhiza</i>		G2	2-10%	5
<i>Eremaea</i> sp.		M2	<2%T	80
<i>Hakea anadenia</i>		M1	2-10%	130
<i>Hakea anadenia</i>		M2	10-30%	80
<i>Hakea erinacea</i>		M2	<2%T	70
<i>Hakea ruscifolia</i>		M2	<2%T	40
<i>Hibbertia acerosa</i>		M2	<2%T	30
<i>Hibbertia hypericoides</i>		M2	10-30%	70
<i>Hypocalymma xanthopetalum</i>		M2	2-10%	60
<i>Kingia australis</i>		G1	<2%T	100
<i>Lambertia multiflora</i>		M2	<2%T	50
<i>Leporella fimbriata</i>		G2	<2%N	2
<i>Melaleuca ?trichophylla</i>		M2	<2%T	50
<i>Neurachne alopecuroidea</i>		G1	<2%N	5
Orchidaceae sp.		G2	<2%N	15
<i>Petrophile chrysantha</i>		M2	<2%T	60
<i>Petrophile macrostachya</i>		M2	<2%T	60
Restionaceae sp.		G1	<2%T	10
<i>Schoenus ?nanus/latitans</i>		G1	<2%N	5
<i>Schoenus</i> sp.		G1	<2%T	10
<i>Stylidium ?repens</i>		G2	<2%T	10
<i>Tetralthea paucifolia</i>		M2	<2%T	40
<i>Xanthorrhoea drummondii</i>		G1	<2%N	80

Site:	HR10	Project: Hill River Offset Property	
Type:	Quadrat	Size:	10 x 10 m
Date:	02/08/2016	Described by:	MG/JF
Co-ordinates:	MGA 50J	329633 mE	6659497 mN
Location:	Lot 1, 1395 Banovich Road, Hill River		
Landform and slope:	Plain, negligible slope		
Drainage:	Good drainage		
Soil colour & type:	White sand		
Vegetation condition:	1		
Fire age & intensity:	Old, no damage		
Disturbances:	None		
Leaf litter:	Moderate	Wood litter:	Sparse
Humus/Litter (%):	2-10		



Species List

Species	Status	Stratum	% Cover	Height (cm)
<i>Alexgeorgea subterranea</i>		G1	<2%N	15
<i>Banksia attenuata</i>		U1	<2%T	300
<i>Banksia menziesii</i>		U1	<2%T	200
<i>Blancoa canescens</i>		G1	2-10%	20
<i>Calothamnus sanguineus</i>		M2	2-10%	120
<i>Cassytha</i> sp.		G2	<2%T	C
<i>Conostylis aculeata</i> subsp. <i>rhpidion</i>		G1	<2%T	40
<i>Darwinia sanguinea</i>		M3	<2%T	20
<i>Dasyogon obliquifolius</i>		G1	<2%T	20
<i>Drosera ?glanduligera</i>		G2	<2%T	2
<i>Drosera erythrorhiza</i> subsp. <i>erythrorhiza</i>		G2	<2%T	2
<i>Eremaea beaufortioides</i>		M2	2-10%	120
<i>Eremaea beaufortioides</i>		M3	2-10%	90

Species	Status	Stratum	% Cover	Height (cm)
<i>Eucalyptus todtiana</i>		U1	10-30%	600
<i>Gompholobium tomentosum</i>		M3	<2%T	70
<i>Haemodorum</i> sp.		G1	<2%T	30
<i>Hibbertia hypericoides</i>		M3	2-10%	70
<i>Hibbertia subvaginata</i>		M3	<2%T	20
<i>Hypocalymma xanthopetalum</i>		M2	<2%T	110
<i>Isotropis ?cuneifolia</i>		M3	<2%T	10
<i>Jacksonia floribunda</i>		M3	2-10%	90
<i>Lepidosperma</i> sp.		G1	<2%T	40
<i>Leptospermum spinescens</i>		M3	<2%T	70
<i>Leucopogon polymorphus</i>		M3	<2%T	70
<i>Lomandra</i> sp.		G1	<2%T	20
<i>Lyginia imberbis</i>		G1	<2%T	80
<i>Macrozamia fraseri</i>		G1	<2%T	180
<i>Melaleuca</i> sp.		M2	<2%T	120
<i>Mesomelaena pseudostygia</i>		G1	<2%T	40
<i>Opercularia vaginata</i>		G2	<2%N	15
<i>Pimelea</i> sp.		M3	<2%T	70
<i>Pterostylis sanguinea</i>		G2	<2%T	20
<i>Schoenus ?brevisetis</i>		G1	<2%T	150
<i>Scholtzia</i> sp.		M1	2-10%	230
<i>Scholtzia</i> sp.		M2	<2%N	130
<i>Sphaerolobium macranthum</i>		M3	<2%T	20
<i>Stirlingia latifolia</i>		M3	<2%T	60
<i>Thysanotus</i> sp.		G2	<2%T	C
<i>Verreauxia ?reinwardtii</i>		G2	<2%T	40

Site:	HR11	Project: Hill River Offset Property	
Type:	Quadrat	Size:	10 x 10 m
Date:	02/08/2016	Described by:	MG/JF
Co-ordinates:	MGA 50J	329843 mE	6659663 mN
Location:	Lot 1, 1395 Banovich Road, Hill River		
Landform and slope:	Upper slope, negligible slope		
Drainage:	Good drainage		
Soil colour & type:	Grey sand		
Vegetation condition:	1		
Fire age & intensity:	Old, no damage		
Disturbances:	None		
Leaf litter:	Sparse	Wood litter:	Negligible
Coarse gravel/pebbles 2-6 cm (%):	2-10	Humus/Litter (%):	2-10
Cobbly/cobbles 6-20 cm (%):	<2		



Species List

Species	Status	Stratum	% Cover	Height (cm)
? <i>Calytrix</i> sp.		G1	10-30%	80
<i>Acacia stenoptera</i>		M2	<2%T	40
<i>Banksia ?dallanneyi</i> subsp. <i>media</i>		M2	<2%T	20
<i>Banksia armata</i>		M1	<2%T	110
<i>Banksia armata</i>		M2	10-30%	90
<i>Banksia bipinnatifida</i> subsp. <i>multifida</i>		M2	<2%T	40
<i>Banksia shuttleworthiana</i>		M2	<2%T	60
<i>Blancoa canescens</i>		G1	<2%T	15
<i>Calothamnus sanguineus</i>		M1	<2%T	110
<i>Calothamnus sanguineus</i>		M2	2-10%	90

Species	Status	Stratum	% Cover	Height (cm)
<i>Calothamnus torulosus</i>		M2	2-10%	60
<i>Cassytha</i> sp.		G2	<2%T	C
<i>Caustis dioica</i>		G1	<2%T	80
<i>Conostylis ?hiemalis</i>		G1	<2%T	40
<i>Conostylis ?hiemalis</i>		G2	<2%N	10
<i>Conostylis setigera</i>		G1	<2%T	10
<i>Conothamnus trinervis</i>		M2	<2%T	60
<i>Cryptandra myriantha</i>		M2	<2%T	20
<i>Drosera ?macrantha</i>		G2	<2%N	5
<i>Drosera erythrorhiza</i> subsp. <i>erythrorhiza</i>		G2	<2%N	1
<i>Gastrolobium capitatum</i>		M2	<2%T	30
<i>Gastrolobium polystachyum</i>		M2	2-10%	80
<i>Haemodorum ?venosum</i>		G1	<2%N	40
<i>Hakea incrassata</i>		M2	<2%T	90
<i>Hakea lissocarpha</i>		M2	<2%T	90
<i>Hakea stenocarpa</i>		M2	<2%T	60
<i>Hibbertia acerosa</i>		M2	<2%T	30
<i>Hibbertia hypericoides</i>		M2	2-10%	80
<i>Hovea</i> sp.		M2	<2%T	20
<i>Hypocalymma xanthopetalum</i>		M2	<2%T	40
<i>Isopogon dubius</i>		M1	<2%T	110
<i>Kingia australis</i>		G1	<2%T	140
<i>Lepidosperma</i> sp.		G1	<2%T	50
<i>Leptomeria empetriformis</i>		M2	<2%T	30
<i>Melaleuca ?trichophylla</i>		M2	<2%T	20
<i>Neurachne alopecuroidea</i>		G1	2-10%	10
<i>Opercularia vaginata</i>		G2	<2%T	10
<i>Patersonia occidentalis</i>		G1	<2%T	50
<i>Petrophile ?brevifolia</i>		M2	<2%T	70
<i>Petrophile chrysantha</i>		M2	<2%T	50
<i>Philothea spicata</i>		M2	<2%T	40
<i>Pimelea ?angustifolia</i>		M2	<2%N	40
<i>Scaevola</i> sp.		M2	<2%T	10
<i>Schoenus</i> sp.		G1	<2%T	10
<i>Stackhousia monogyna</i>		G2	<2%T	50
<i>Stylidium ?piliferum</i>		G2	<2%T	5
<i>Thomasia ?grandiflora</i>		M2	<2%T	50
<i>Tricoryne elatior</i>		G1	<2%T	50
<i>Verticordia</i> sp.		M1	<2%T	110
<i>Verticordia</i> sp.		M2	<2%N	70

Site:	HR12	Project: Hill River Offset Property	
Type:	Quadrat	Size:	10 x 10 m
Date:	03/08/2016	Described by:	MG/JF
Co-ordinates:	MGA 50J	330847 mE	6656140 mN
Location:	Lot 1, 1395 Banovich Road, Hill River		
Landform and slope:	Upper slope, negligible slope		
Drainage:	Good drainage		
Soil colour & type:	White sand		
Vegetation condition:	1		
Fire age & intensity:	Old, no damage		
Disturbances:	None		
Leaf litter:	Sparse	Wood litter:	Negligible
Humus/Litter (%):	2-10		



Species List

Species	Status	Stratum	% Cover	Height (cm)
<i>Adenanthos cygnorum</i> subsp. <i>cygnorum</i>		M1	2-10%	300
<i>Alexgeorgea subterranea</i>		G1	<2%N	20
<i>Allocasuarina humilis</i>		M1	<2%T	210
<i>Allocasuarina humilis</i>		M2	<2%T	150
<i>Banksia attenuata</i>		M2	10-30%	130
<i>Banksia attenuata</i>		M3	<2%T	70
<i>Banksia candolleana</i>		M2	2-10%	120
<i>Banksia menziesii</i>		U1	<2%T	300
<i>Blancoa canescens</i>		G1	<2%N	30
<i>Cassytha</i> sp.		G2	<2%T	C
<i>Conostephium pendulum</i>		M3	<2%T	40
<i>Conostylis aculeata</i> subsp. <i>hipidion</i>		G1	<2%T	30
<i>Conostylis crassinervia</i> ?subsp. <i>crassinervia</i>		G1	2-10%	20

Species	Status	Stratum	% Cover	Height (cm)
<i>Conostylis setigera</i>		G1	<2%N	10
<i>Daviesia physodes</i>		M2	<2%T	110
<i>Drosera ?glanduligera</i>		G2	<2%N	2
<i>Drosera ?macrantha</i>		G2	<2%T	50
<i>Drosera erythrorhiza</i> subsp. <i>erythrorhiza</i>		G2	<2%N	2
<i>Drosera porrecta</i>		G2	<2%T	15
<i>Eremaea asterocarpa</i>		M2	10-30%	90
<i>Hakea eneabba</i>		M3	<2%T	90
<i>Hensmania stoniella</i>	P3	G1	<2%T	15
<i>Hibbertia acerosa</i>		M3	<2%T	40
<i>Hibbertia hypericoides</i>		M2	2-10%	70
<i>Hibbertia subvaginata</i>		M2	<2%N	80
<i>Hypocalymma xanthopetalum</i>		M2	<2%T	70
<i>Jacksonia floribunda</i>		M3	<2%T	90
<i>Johnsonia pubescens</i> subsp. <i>pubescens</i>		G1	<2%N	15
<i>Lepidosperma</i> sp.		G1	<2%T	90
<i>Leptospermum spinescens</i>		M3	<2%T	80
<i>Leucopogon polymorphus</i>		M2	<2%T	110
<i>Leucopogon</i> sp.		M3	2-10%	70
<i>Leucopogon</i> sp.		M2	<2%T	110
<i>Lyginia</i> sp.		G1	2-10%	80
<i>Lysinema pentapetalum</i>		M2	<2%T	130
<i>Melaleuca</i> sp.		M3	<2%T	30
<i>Mesomelaena pseudostygia</i>		G1	2-10%	70
<i>Nuytsia floribunda</i>		U1	<2%T	400
<i>Patersonia occidentalis</i>		G1	<2%T	50
<i>Petrophile linearis</i>		M3	<2%T	40
<i>Petrophile macrostachya</i>		M2	<2%T	90
<i>Petrophile seminuda</i>		M3	<2%T	90
<i>Pimelea</i> sp.		M3	<2%T	30
<i>Scaevola</i> sp.		M3	<2%T	30
<i>Schoenus ?brevisetis</i>		G1	<2%N	70
<i>Schoenus ?clandestinus</i>		G1	<2%T	10
<i>Schoenus subflavus</i>		G1	<2%T	20
<i>Scholtzia</i> sp.		M2	<2%T	130
<i>Sphaerolobium macranthum</i>		M3	<2%T	80
<i>Stirlingia latifolia</i>		M2	<2%T	90
<i>Stylidium ?hymenocraspedum</i>	P3	G2	<2%T	10
<i>Stylidium</i> sp.		G2	<2%T	20
<i>Thysanotus ?patersonii</i>		G1	<2%T	C
<i>Xanthorrhoea</i> sp.		G1	<2%T	70

Site:	HR13	Project: Hill River Offset Property	
Type:	Quadrat	Size:	10 x 10 m
Date:	03/08/2016	Described by:	MG/JF
Co-ordinates:	MGA 50J	330740 mE	6655536 mN
Location:	Lot 1, 1395 Banovich Road, Hill River		
Landform and slope:	Mid slope, gentle slope		
Drainage:	Good drainage		
Soil colour & type:	Grey sand		
Vegetation condition:	1		
Fire age & intensity:	Old, minor impact		
Disturbances:	None		
Leaf litter:	Negligible	Wood litter:	Negligible
Humus/Litter (%):	2-10		



Species List

Species	Status	Stratum	% Cover	Height (cm)
? <i>Calytrix</i> sp.		M3	<2%T	40
? <i>Craspedia</i> sp.		G2	<2%T	15
? <i>Sphaerolobium</i> sp.		M3	<2%T	30
<i>Acacia auronitens</i>		M2	<2%T	30
<i>Acacia cochlearis</i>		M2	<2%T	90
<i>Allocasuarina microstachya</i>		M2	2-10%	60
<i>Anigozanthos humilis</i>		G1	<2%N	20
<i>Astroloma ?serratifolium</i>		M3	<2%T	60
<i>Banksia ?dallanneyi</i> subsp. <i>media</i>		M2	<2%N	40
<i>Banksia armata</i>		M2	2-10%	90
<i>Banksia shuttleworthiana</i>		M2	2-10%	90
<i>Boronia cymosa</i>		M2	<2%T	40
<i>Borya nitida</i>		G1	<2%N	15

Species	Status	Stratum	% Cover	Height (cm)
<i>Burchardia</i> sp.		G1	<2%T	20
<i>Calothamnus sanguineus</i>		M1	<2%T	110
<i>Calothamnus torulosus</i>		M2	<2%T	30
<i>Caustis dioica</i>		G1	<2%T	30
<i>Conospermum triplinervium</i>		M2	<2%T	90
<i>Conostylis ?hiemalis</i>		G1	<2%N	15
<i>Conostylis setigera</i>		G1	<2%T	10
<i>Cryptandra pungens</i>		M2	<2%T	70
<i>Daviesia nudiflora</i>		M2	2-10%	80
<i>Drosera ?macrantha</i>		G2	<2%T	30
<i>Drosera ?menziesii</i>		G2	<2%N	20
<i>Drosera erythrorhiza</i> subsp. <i>erythrorhiza</i>		G2	<2%N	5
<i>Drosera porrecta</i>		G2	<2%N	15
<i>Ecdeiocolea monostachya</i>		G1	30-70%	100
<i>Haemodorum ?venosum</i>		G1	<2%T	30
<i>Hakea conchifolia</i>		M2	<2%T	90
<i>Hakea incrassata</i>		M1	<2%T	110
<i>Hakea neospathulata</i>		M3	<2%T	30
<i>Hibbertia hypericoides</i>		M2	2-10%	60
<i>Hypocalymma xanthopetalum</i>		M2	<2%T	40
<i>Leporella fimbriata</i>		G2	<2%T	3
<i>Leptospermum spinescens</i>		M2	<2%T	80
<i>Leucopogon</i> sp.		M2	<2%T	50
<i>Melaleuca</i> sp.		M2	<2%N	30
<i>Mesomelaena pseudostygia</i>		G1	<2%N	30
<i>Opercularia vaginata</i>		G2	2-10%	15
Orchidaceae sp.		G2	<2%T	10
<i>Petrophile chrysantha</i>		M2	<2%T	40
<i>Petrophile macrostachya</i>		M2	<2%T	50
<i>Prasophyllum parvifolium</i>		G2	<2%T	20
<i>Rytidosperma</i> sp.		G1	<2%T	10
<i>Schoenus ?nanus/latitans</i>		G1	2-10%	10
<i>Senecio</i> sp.		G2	<2%T	20
<i>Sphaerolobium drummondii</i>		M2	<2%T	70
<i>Stenanthemum humile</i>		M2	<2%T	20
<i>Stylidium ?hymenocraspedum</i>	P3	G2	<2%T	15
<i>Stylidium</i> sp.		G2	<2%T	15
<i>Tetraria octandra</i>		G1	<2%T	20
<i>Thomasia ?grandiflora</i>		M2	<2%T	80
<i>Verticordia</i> sp.		M2	<2%N	50

Site:	HR14	Project: Hill River Offset Property	
Type:	Quadrat	Size:	10 x 10 m
Date:	03/08/2016	Described by:	MG/JF
Co-ordinates:	MGA 50J	331794 mE	6656778 mN
Location:	Lot 1, 1395 Banovich Road, Hill River		
Landform and slope:	Hill crest, gentle slope		
Drainage:	Good drainage		
Soil colour & type:	Grey sand		
Vegetation condition:	1		
Fire age & intensity:	Old, no damage		
Disturbances:	None		
Leaf litter:	Negligible	Wood litter:	Negligible
Coarse gravel/pebbles 2-6 cm (%):	11-30	Humus/Litter (%):	<2
Fine rocks 2-6 mm (%):	2-10	Stony/stones 20-60 cm (%):	<2



Species List

Species	Status	Stratum	% Cover	Height (cm)
<i>Banksia armata</i>		M1	<2%T	80
<i>Banksia bipinnatifida</i> subsp. <i>multifida</i>		M1	<2%T	20
<i>Calothamnus sanguineus</i>		M1	<2%T	50
<i>Calothamnus torulosus</i>		M1	<2%T	30
<i>Cassylia</i> sp.		G2	<2%T	C
<i>Caustis dioica</i>		G1	<2%T	50
<i>Conostylis androstemma</i>		G1	10-30%	15
<i>Cryptandra myriantha</i>		M1	<2%T	20
<i>Cryptandra pungens</i>		M1	<2%T	50
<i>Daviesia nudiflora</i>		M1	<2%T	50

Species	Status	Stratum	% Cover	Height (cm)
<i>Drosera ?macrantha</i>		G2	<2%T	30
<i>Drosera erythrorhiza</i> subsp. <i>erythrorhiza</i>		G2	<2%N	2
<i>Gastrolobium polystachyum</i>		M1	<2%T	60
<i>Haemodorum</i> sp.		G1	<2%T	30
<i>Hakea conchifolia</i>		M1	<2%T	50
<i>Hakea neospathulata</i>		M1	<2%T	50
<i>Hibbertia acerosa</i>		M1	2-10%	30
<i>Hibbertia hypericoides</i>		M1	10-30%	70
<i>Hypocalymma xanthopetalum</i>		M1	<2%N	30
<i>Hypochoeris glabra</i>	*	G2	<2%T	2
<i>Isopogon asper</i>		M1	<2%T	30
<i>Isopogon drummondii</i>		M1	<2%T	30
<i>Lambertia multiflora</i>		M1	<2%T	20
<i>Lepidosperma</i> sp.		G1	10-30%	50
<i>Melaleuca</i> sp.		M1	<2%N	30
<i>Mesomelaena pseudostygia</i>		G1	<2%T	60
<i>Neurachne alopecuroidea</i>		G1	2-10%	15
<i>Petrophile chrysantha</i>		M1	<2%T	20
<i>Schoenus ?nanus/latitans</i>		G1	2-10%	5
<i>Stackhousia</i> sp.		G2	<2%N	40
<i>Stylidium</i> sp.		G2	2-10%	5
<i>Tetraria octandra</i>		G1	<2%N	30
<i>Trachymene pilosa</i>		G2	<2%T	5
<i>Xanthorrhoea</i> sp.		G1	2-10%	100

Site:	HR15	Project: Hill River Offset Property	
Type:	Quadrat	Size:	10 x 10 m
Date:	03/08/2016	Described by:	MG/JF
Co-ordinates:	MGA 50J	331363 mE	6659059 mN
Location:	Lot 1, 1395 Banovich Road, Hill River		
Landform and slope:	Drainage depression, negligible slope		
Drainage:	Seasonal wet		
Soil colour & type:	Brown clayey loam		
Vegetation condition:	2		
Fire age & intensity:	Moderate, few trees killed		
Disturbances:	Recent fire and weeds		
Leaf litter:	Moderate	Wood litter:	Sparse
Humus/Litter (%):	2-10		



Species List

Species	Status	Stratum	% Cover	Height (cm)
<i>Acacia saligna</i>		M2	<2%T	130
Anarthriaceae sp.		G1	2-10%	30
<i>Caladenia longicauda</i> subsp. <i>borealis</i>		G2	<2%N	30
<i>Calothamnus quadrifidus</i>		M3	2-10%	90
<i>Cassutha</i> sp.		G2	2-10%	C
<i>Daucus glochidiatus</i>		G2	<2%T	5
<i>Dianella revoluta</i>		G1	<2%T	90
<i>Drosera erythrorhiza</i> subsp. <i>erythrorhiza</i>		G2	<2%N	2
<i>Drosera</i> sp.		G2	<2%T	15
<i>Eucalyptus rudis</i>		U1	<2%T	900
<i>Hakea lissocarpha</i>		M3	<2%T	80
<i>Hypocalymma angustifolium</i>		M3	10-30%	90
<i>Hypochaeris glabra</i>	*	G2	<2%T	2

Species	Status	Stratum	% Cover	Height (cm)
<i>Jacksonia sternbergiana</i>		M3	<2%T	90
<i>Lagenophora huegelii</i>		G2	<2%N	5
<i>Lepidosperma</i> sp.		G1	<2%T	40
<i>Melaleuca platycalyx</i>		M2	<2%T	110
<i>Melaleuca platycalyx</i>		M3	2-10%	80
<i>Melaleuca raphiophylla</i>		M1	<2%N	300
<i>Melaleuca viminea</i>		M1	<2%T	210
<i>Melaleuca viminea</i>		M2	2-10%	180
<i>Melaleuca viminea</i>		M3	<2%N	80
<i>Pimelea argentea</i>		M3	<2%T	50
Poaceae sp.		G1	<2%N	10
<i>Quinetia urvillei</i>		G2	<2%N	10
<i>Romulea rosea</i>	*	G1	<2%N	20
<i>Senecio</i> sp.		G2	<2%T	10
<i>Stylidium ?tortricarpum</i>	P3	G2	<2%N	15
<i>Tribonanthes ?australis</i>		G1	<2%N	20

Site:	HR16	Project: Hill River Offset Property	
Type:	Quadrat	Size:	10 x 10 m
Date:	03/08/2016	Described by:	MG/JF
Co-ordinates:	MGA 50J	331982 mE	6659850 mN
Location:	Lot 1, 1395 Banovich Road, Hill River		
Landform and slope:	Mid slope, gentle slope		
Drainage:	Good drainage		
Soil colour & type:	White loamy sand		
Vegetation condition:	1		
Fire age & intensity:	Old, no damage		
Disturbances:	None		
Leaf litter:	Negligible	Wood litter:	Negligible
Humus/Litter (%):	2-10	Coarse gravel/pebbles 2-6 cm (%):	11-30



Species List

Species	Status	Stratum	% Cover	Height (cm)
? <i>Craspedia</i> sp.		G2	<2%N	50
<i>Allocasuarina microstachya</i>		M2	<2%T	30
<i>Anigozanthos</i> sp.		G1	<2%T	10
<i>Banksia armata</i>		M2	2-10%	50
<i>Banksia dallanneyi</i> subsp. <i>media</i>		M2	<2%N	20
<i>Bossiaea eriocarpa</i>		M2	<2%T	70
<i>Calothamnus quadrifidus</i>		M2	<2%T	100
<i>Calothamnus sanguineus</i>		M2	2-10%	40
<i>Calothamnus torulosus</i>		M2	<2%T	30
<i>Cassytha</i> sp.		G2	<2%T	20
<i>Caustis dioica</i>		G1	<2%T	20
<i>Conostylis androstemma</i>		G1	<2%N	10

Species	Status	Stratum	% Cover	Height (cm)
<i>Conostylis setigera</i>		G1	<2%T	10
<i>Conothamnus trinervis</i>		M2	<2%T	50
<i>Cryptandra pungens</i>		M2	<2%N	50
<i>Drosera ?macrantha</i>		G2	<2%N	10
<i>Gastrolobium capitatum</i>		M2	<2%T	60
<i>Gastrolobium polystachyum</i>		M2	2-10%	70
<i>Haemodorum ?venosum</i>		G1	<2%T	10
<i>Hakea conchifolia</i>		M2	<2%T	60
<i>Hakea flabellifolia</i>		M2	<2%T	20
<i>Hakea incrassata</i>		M2	2-10%	100
<i>Hakea neospathulata</i>		M2	<2%T	40
<i>Hibbertia acerosa</i>		M2	<2%N	20
<i>Hibbertia hypericoides</i>		M2	2-10%	40
<i>Hibbertia</i> sp.		M2	<2%T	30
<i>Hypocalymma xanthopetalum</i>		M2	<2%N	40
<i>Isopogon dubius</i>		M2	<2%T	50
<i>Isopogon inconspicuus</i>		M2	2-10%	40
<i>Isopogon</i> sp.		M2	<2%T	15
<i>Lepidobolus</i> sp.		G1	<2%T	15
<i>Leucopogon</i> sp.		M2	<2%T	20
<i>Lomandra sericea</i>		G1	<2%T	40
<i>Mesomelaena pseudostygia</i>		G1	<2%N	30
<i>Neurachne alopecuroidea</i>		G1	<2%N	5
<i>Rytidosperma</i> sp.		G1	<2%T	20
<i>Schoenus ?nanus/latitans</i>		G1	<2%N	5
<i>Schoenus</i> sp.		G1	<2%N	15
<i>Scholtzia</i> sp.		M2	<2%T	30
<i>Stylidium</i> sp.		M2	<2%T	5
<i>Synaphea aephyntsa</i>		G2	<2%T	30
<i>Tetralix octandra</i>		G1	<2%T	20
<i>Verticordia</i> sp.		M2	<2%T	80
<i>Xanthorrhoea drummondii</i>		G1	2-10%	80

Site:	HR17	Project: Hill River Offset Property	
Type:	Quadrat	Size:	10 x 10 m
Date:	04/08/2016	Described by:	MG/JF
Co-ordinates:	MGA 50J	327925 mE	6659958 mN
Location:	Lot 1, 1395 Banovich Road, Hill River		
Landform and slope:	Upper slope, gentle slope		
Drainage:	Poor drainage		
Soil colour & type:	Brown sandy loam		
Vegetation condition:	1		
Fire age & intensity:	Old, no damage		
Disturbances:	None		
Leaf litter:	Sparse	Wood litter:	Negligible
Humus/Litter (%):	2-10	Cobbly/cobbles 6-20 cm (%):	2-10
Stony/stones 20-60 cm (%):	<2		

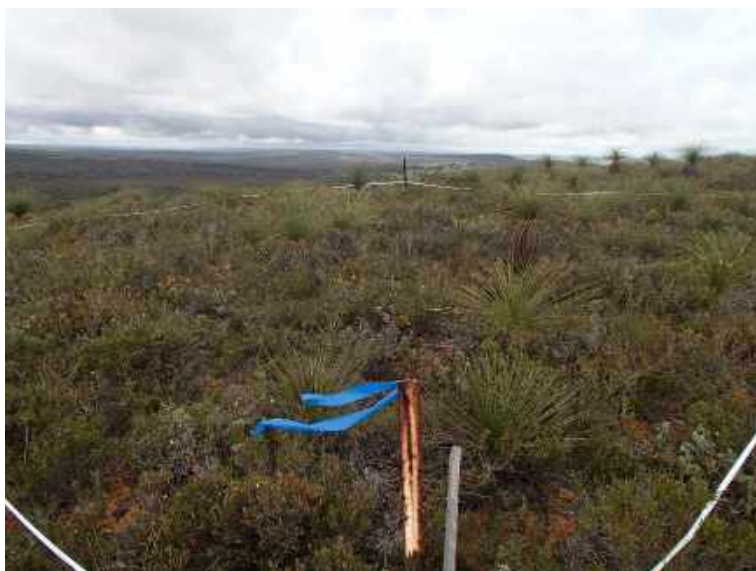


Species List

Species	Status	Stratum	% Cover	Height (cm)
<i>?Craspedia</i> sp.		G2	<2%N	5
<i>Acacia ?ericifolia</i>		M2	<2%T	80
<i>Acacia lasiocarpa</i> var. <i>lasiocarpa</i>		M2	<2%T	30
<i>Baeckea</i> sp.		M2	<2%T	50
<i>Borya nitida</i>		G1	<2%N	5
<i>Calothamnus quadrifidus</i>		M1	10-30%	150
<i>Cassytha</i> sp.		G2	<2%T	C
<i>Chamaescilla corymbosa</i>		G2	<2%T	5
<i>Cryptandra pungens</i>		M2	<2%T	70
<i>Drosera ?macrantha</i>		G2	<2%N	10
<i>Drosera erythrorhiza</i> subsp. <i>erythrorhiza</i>		G2	<2%N	1

Species	Status	Stratum	% Cover	Height (cm)
<i>Ficinia nodosa</i>		G1	<2%N	20
<i>Hakea lissocarpa</i>		M2	2-10%	100
<i>Hibbertia hypericoides</i>		M2	<2%N	50
<i>Hibbertia</i> sp.		M2	<2%T	30
<i>Lagenophora huegelii</i>		G2	<2%T	2
<i>Melaleuca ?concreta</i>		M1	2-10%	170
<i>Melaleuca platycalyx</i>		M1	10-30%	150
<i>Mesomelaena pseudostygia</i>		G1	<2%N	30
<i>Neurachne alopecuroidea</i>		G1	<2%N	2
Orchidaceae sp.		G2	<2%N	1
<i>Petrophile chrysantha</i>		M2	<2%N	80
<i>Senecio</i> sp.		G2	<2%N	5
<i>Stylidium</i> sp.		G2	<2%N	5
<i>Verticordia</i> sp.		M1	10-30%	120

Site:	HR18	Project: Hill River Offset Property	
Type:	Quadrat	Size:	10 x 10 m
Date:	04/08/2016	Described by:	MG/JF
Co-ordinates:	MGA 50J	330115 mE	6660685 mN
Location:	Lot 1, 1395 Banovich Road, Hill River		
Landform and slope:	Ridge, gentle slope		
Drainage:	Good drainage		
Soil colour & type:	Grey sand		
Vegetation condition:	1		
Fire age & intensity:	Old, no damage		
Disturbances:	None		
Leaf litter:	Sparse	Wood litter:	Negligible
Humus/Litter (%):	2-10	Cobbly/cobbles 6-20 cm (%):	2-10
Coarse gravel/pebbles 2-6 cm (%):	2-10	Surface plates/Boulders >60 cm (%):	<2



Species List

Species	Status	Stratum	% Cover	Height (cm)
<i>Acacia moirii</i> subsp. <i>recurvistipula</i>		M3	<2%N	20
<i>Allocasuarina humilis</i>		M2	<2%T	60
<i>Allocasuarina microstachya</i>		M2	<2%T	40
<i>Banksia ?sclerophylla</i>		M3	2-10%	60
<i>Banksia armata</i>		M2	<2%T	40
<i>Banksia dallanneyi</i> subsp. <i>media</i>		G2	<2%N	30
<i>Banksia micrantha</i>		M2	2-10%	50
<i>Calectasia narragara</i>		M3	<2%T	30
<i>Callitris ?acuminata</i>		M3	<2%T	20
<i>Calothamnus sanguineus</i>		M2	2-10%	50

Species	Status	Stratum	% Cover	Height (cm)
<i>Cassytha</i> sp.		G2	<2%T	C
<i>Caustis dioica</i>		G1	<2%N	15
<i>Conostylis ?teretiuscula</i>		G2	<2%N	15
<i>Conostylis aurea</i>		G2	<2%T	20
<i>Conothamnus trinervis</i>		M2	2-10%	50
<i>Dampiera</i> sp.		G2	<2%T	15
<i>Daviesia nudiflora</i>		M3	<2%T	30
<i>Desmocladius ?lateriticus</i>		G1	<2%N	5
<i>Drosera ?macrantha</i>		G2	<2%N	10
<i>Gastrolobium capitatum</i>		M2	<2%T	30
<i>Gastrolobium plicatum</i>		M3	<2%N	20
<i>Gastrolobium polystachyum</i>		M2	<2%T	50
<i>Gastrolobium</i> sp.		M3	<2%T	20
<i>Grevillea synapheae</i> subsp. <i>pachyphylla</i>		M3	<2%T	30
<i>Haemodorum</i> sp.		G2	<2%T	5
<i>Hakea conchifolia</i>		M2	2-10%	50
<i>Hibbertia acerosa</i>		M3	<2%N	30
<i>Hibbertia hypericoides</i>		M2	2-10%	40
<i>Hibbertia hypericoides</i> subsp. <i>septentrionalis</i>		M2	2-10%	30
<i>Hovea stricta</i>		M3	<2%T	20
<i>Hypocalymma xanthopetalum</i>		M2	<2%N	40
<i>Isopogon</i> sp.		G2	<2%T	20
<i>Lambertia multiflora</i>		M2	2-10%	40
<i>Lepidobolus</i> sp.		G1	<2%N	15
<i>Lepidosperma ?squamatum</i>		G1	<2%N	40
<i>Lepidosperma</i> sp.		G1	<2%N	30
<i>Leucopogon</i> sp.		M2	<2%T	30
<i>Melaleuca</i> sp.		M2	2-10%	40
<i>Mesomelaena pseudostygia</i>		G1	<2%N	40
<i>Mesomelaena tetragona</i>		G1	<2%T	40
<i>Neurachne alopecuroidea</i>		G1	<2%T	5
Orchidaceae sp.		G2	<2%T	2
<i>Petrophile ?brevifolia</i>		M3	<2%N	50
<i>Petrophile ?brevifolia</i>		G2	<2%T	50
<i>Petrophile chrysantha</i>		M3	<2%T	40
<i>Petrophile macrostachya</i>		M2	<2%T	70
<i>Philothea spicata</i>		M3	<2%T	40
<i>Pimelea</i> sp.		M3	<2%T	30
<i>Schoenus ?brevisetis</i>		G1	<2%N	10
<i>Stylidium</i> sp.		G2	<2%N	5
<i>Synaphea spinulosa</i>		M3	<2%T	40
<i>Tetragonia octandra</i>		G1	<2%N	20
<i>Xanthorrhoea drummondii</i>		G1	2-10%	100

Site:	HR19	Project: Hill River Offset Property	
Type:	Quadrat	Size:	10 x 10 m
Date:	04/08/2016	Described by:	MG/JF
Co-ordinates:	MGA 50J	330946 mE	6660721 mN
Location:	Lot 1, 1395 Banovich Road, Hill River		
Landform and slope:	Mid slope, gentle slope		
Drainage:	Good drainage		
Soil colour & type:	Grey loamy sand		
Vegetation condition:	1		
Fire age & intensity:	Old, minor impact		
Disturbances:	None		
Leaf litter:	Sparse	Wood litter:	Negligible
Humus/Litter (%):	2-10	Coarse gravel/pebbles 2-6 cm (%):	11-30
Surface plates/Boulders >60 cm (%):	<2		



Species List

Species	Status	Stratum	% Cover	Height (cm)
? <i>Craspedia</i> sp.		G2	<2%N	5
<i>Allocasuarina humilis</i>		M2	<2%T	90
<i>Allocasuarina microstachya</i>		M2	<2%N	40
<i>Andersonia lehmanniana</i> subsp. <i>lehmanniana</i>		M3	<2%T	40
<i>Banksia armata</i>		M2	2-10%	100
<i>Banksia dallanneyi</i> subsp. <i>media</i>		M3	<2%T	15
<i>Calectasia narragara</i>		M3	<2%T	15
<i>Calothamnus quadrifidus</i>		M2	2-10%	70
<i>Calothamnus torulosus</i>		M3	<2%N	15
<i>Cassytha</i> sp.		G2	<2%N	C

Species	Status	Stratum	% Cover	Height (cm)
<i>Conostylis ?teretiusscula</i>		G2	<2%T	10
<i>Conostylis androstemma</i>		G2	<2%N	20
<i>Conostylis setigera</i>		G2	<2%N	15
<i>Conothamnus trinervis</i>		M2	<2%T	60
<i>Cryptandra pungens</i>		M2	<2%T	60
<i>Drosera ?macrantha</i>		G2	<2%N	30
<i>Drosera erythrorhiza</i> subsp. <i>erythrorhiza</i>		G2	<2%N	2
<i>Gastrolobium polystachyum</i>		M2	<2%T	30
<i>Haemodorum</i> sp.		G2	<2%T	10
<i>Hakea conchifolia</i>		M2	<2%T	50
<i>Hakea incrassata</i>		M2	<2%T	70
<i>Hakea neospathulata</i>		M3	<2%T	30
<i>Hibbertia acerosa</i>		M3	<2%N	30
<i>Hibbertia hypericoides</i>		M2	2-10%	40
<i>Hypocalymma xanthopetalum</i>		M2	<2%N	30
<i>Isotropis</i> sp.		G2	<2%T	10
<i>Lagenophora huegelii</i>		G2	<2%T	3
<i>Lambertia multiflora</i>		M2	2-10%	100
<i>Lepidosperma</i> sp.		G1	<2%T	30
<i>Leucopogon</i> sp.		M3	<2%T	20
<i>Melaleuca ?trichophylla</i>		M2	2-10%	50
<i>Mesomelaena pseudostygia</i>		G1	<2%N	30
<i>Neurachne alopecuroidea</i>		G1	<2%N	5
<i>Petrophile chrysantha</i>		M2	<2%T	40
<i>Schoenus ?clandestinus</i>		G1	<2%N	5
<i>Scholtzia</i> sp.		M2	<2%T	80
<i>Sphaerolobium medium</i>		M3	<2%T	40
<i>Stylidium</i> sp.		G2	<2%T	3
<i>Synaphea spinulosa</i>		M3	<2%N	40
<i>Tetragia octandra</i>		G1	<2%T	20
<i>Tetragia paucifolia</i>		M3	<2%T	20
<i>Xanthorrhoea preissii</i>		G1	2-10%	130

Site:	HR20	Project: Hill River Offset Property	
Type:	Quadrat	Size:	10 x 10 m
Date:	05/08/2016	Described by:	MG/JF
Co-ordinates:	MGA 50J	328444 mE	6659245 mN
Location:	Lot 1, 1395 Banovich Road, Hill River		
Landform and slope:	Upper slope, gentle slope		
Drainage:	Good		
Soil colour & type:	White sand		
Vegetation condition:	1		
Fire age & intensity:	Old, no damage		
Disturbances:	None		
Leaf litter:	Moderate	Wood litter:	Negligible
Humus/Litter (%):	11-30		



Species List

Species	Status	Stratum	% Cover	Height (cm)
<i>Anigozanthos humilis</i>		G2	<2%T	15
<i>Banksia attenuata</i>		M1	10-30%	180
<i>Callitris ?acuminata</i>		M2	<2%T	80
<i>Calothamnus quadrifidus</i>		M2	<2%T	80
<i>Cassytha</i> sp.		M3	<2%T	C
<i>Conospermum triplinervium</i>		M3	<2%T	15
<i>Conostylis ?teretiuscula</i>		G2	<2%N	15
<i>Conostylis</i> sp.		G2	<2%T	15
<i>Daviesia podophylla</i>		M2	<2%T	60
<i>Drosera ?macrantha</i>		G2	<2%T	10
<i>Drosera erythrorhiza</i> subsp. <i>erythrorhiza</i>		G2	<2%N	1
<i>Eremaea asterocarpa</i>		M2	2-10%	60
<i>Haemodorum</i> sp.		G2	<2%T	10

Species	Status	Stratum	% Cover	Height (cm)
<i>Hakea erinacea</i>		M3	<2%T	30
<i>Hakea ruscifolia</i>		M2	<2%T	100
<i>Hibbertia acerosa</i>		M3	<2%T	20
<i>Hibbertia hypericoides</i>		M2	2-10%	40
<i>Hypocalymma xanthopetalum</i>		M2	2-10%	60
<i>Isotropis ?cuneifolia</i>		G2	<2%N	10
<i>Jacksonia floribunda</i>		M2	<2%T	70
<i>Lepidobolus</i> sp.		G1	<2%T	30
<i>Lepidosperma</i> sp.		G1	<2%N	30
<i>Leptospermum spinescens</i>		M2	<2%T	80
<i>Melaleuca ?tinkeri</i>		M2	10-30%	100
<i>Melaleuca</i> sp.		M2	<2%T	100
<i>Mesomelaena pseudostygia</i>		G1	2-10%	60
<i>Mesomelaena tetragona</i>		G1	<2%T	70
<i>Neurachne alopecuroidea</i>		G1	<2%N	5
<i>Patersonia occidentalis</i>		G2	<2%T	40
<i>Petrophile macrostachya</i>		M3	<2%N	40
<i>Pimelea</i> sp.		M3	<2%T	20
<i>Schoenus ?brevisetis</i>		G1	<2%N	20
<i>Schoenus ?clandestinus</i>		G1	<2%N	5
<i>Scholtzia</i> sp.		M2	<2%T	60
<i>Stirlingia latifolia</i>		M2	2-10%	100
<i>Strangea cynanchicarpa</i>		M2	2-10%	80
<i>Stylidium</i> sp.		G2	<2%N	2
<i>Thysanotus ?patersonii</i>		G2	<2%T	40



Threatened and Priority Flora Report Form

Please complete as much of the form as possible.

For information on how to complete the form please refer to the Threatened & Priority Flora Report Form (TPRF) manual on the DPaW website at <http://www.dpaw.wa.gov.au/>

TAXON: <u>Lepidobolus quadratus</u>		TPFL Pop. No.: _____	
OBSERVATION DATE: <u>01/08/2016</u>		CONSERVATION STATUS: <u>P3</u> New population <input checked="" type="checkbox"/>	
OBSERVER/S: <u>Mathew Gannaway</u>		PHONE: <u>(08) 6222 8058</u>	
ROLE: <u>Consultant - Ecologist</u>		ORGANISATION: <u>GHD</u>	

DESCRIPTION OF LOCATION (Provide at least nearest town/named locality, and the distance and direction to that place):

Located west of Banovich Road and north of Jurien Road, approximately 20 km north east of Jurien town site.

Reserve No.: _____

DISTRICT: Midwest **LGA:** Shire of Dandaragan Land manager present:

DATUM: GDA94 / MGA94 <input checked="" type="checkbox"/> AGD84 / AMG84 <input type="checkbox"/> WGS84 <input type="checkbox"/> Unknown <input type="checkbox"/>	COORDINATES: (If UTM coords provided, Zone is also required)			METHOD USED:	
	DecDegrees <input type="checkbox"/>	DegMinSec <input type="checkbox"/>	UTMs <input checked="" type="checkbox"/>	GPS <input checked="" type="checkbox"/>	Differential GPS <input type="checkbox"/> Map <input type="checkbox"/>
	Lat / Northing: <u>331527</u>		No. satellites: _____		Map used: _____
	Long / Easting: <u>6659221</u>		Boundary polygon captured: <input type="checkbox"/>		Map scale: _____
	Zone: <u>50J</u>				

LAND TENURE:

- | | | | | |
|--|---|--|--|--|
| Nature reserve <input type="checkbox"/> | Timber reserve <input type="checkbox"/> | Private property <input checked="" type="checkbox"/> | Rail reserve <input type="checkbox"/> | Shire road reserve <input type="checkbox"/> |
| National park <input type="checkbox"/> | State forest <input type="checkbox"/> | Pastoral lease <input type="checkbox"/> | MRWA road reserve <input type="checkbox"/> | Other Crown reserve <input type="checkbox"/> |
| Conservation park <input type="checkbox"/> | Water reserve <input type="checkbox"/> | UCL <input type="checkbox"/> | SLK/Pole _____ to _____ | Specify other: _____ |

AREA ASSESSMENT: Edge survey Partial survey Full survey Area observed (m²): _____

EFFORT: Time spent surveying (minutes): _____ No. of minutes spent / 100 m²: _____

POP'N COUNT ACCURACY: Actual Extrapolation Estimate

Count method: (Refer to field manual for list) _____

WHAT COUNTED: Plants Clumps Clonal stems

TOTAL POP'N STRUCTURE:	Mature:	Juveniles:	Seedlings:	Totals:
Alive	3			3
Dead				

Area of pop (m²): _____

Note: Pls record count as numbers (not percentages) for database.

QUADRATS PRESENT: No. _____ Size _____ Data attached Total area of quadrats (m²): _____

Summary Quad. Totals: Alive

--	--	--	--

REPRODUCTIVE STATE: Clonal Vegetative Flowerbud Flower
Immature fruit Fruit Dehisced fruit Percentage in flower: _____%

CONDITION OF PLANTS: Healthy Moderate Poor Senescent

COMMENT:

THREATS - type, agent and supporting information:

E.g. clearing, too frequent fire, weed, disease. Refer to field manual for list of threats & agents. **Specify agent** where relevant.

Rate current and potential threat impact: N=Nil, L=Low, M=Medium, H=High, E=Extreme

Estimate time to potential impact: S=Short (<12mths), M=Medium (<5yrs), L=Long (5yrs+)

	Current impact (N-E)	Potential Impact (L-E)	Potential Threat Onset (S-L)
J Weeds	<u>N</u>	<u>M</u>	<u>L</u>
J	_____	_____	_____
J	_____	_____	_____

Please return completed form to **Species And Communities Branch DPaW,**

Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer,** Species and Communities Branch.

Record entered by: _____ Sheet No.: _____ Record Accepted in Database



Threatened and Priority Flora Report Form

Version 1.2 August 2013

HABITAT INFORMATION: (Check more than one box for combinations or where necessary)

LANDFORM:	ROCK TYPE:	LOOSE ROCK:	SOIL TYPE:	SOIL COLOUR:	DRAINAGE:
Crest <input type="checkbox"/> Hill <input type="checkbox"/> Ridge <input type="checkbox"/> Outcrop <input type="checkbox"/> Slope <input checked="" type="checkbox"/> Flat <input type="checkbox"/> Open depression <input type="checkbox"/> Drainage line <input type="checkbox"/> Closed depression <input type="checkbox"/> Wetland <input type="checkbox"/>	Granite <input type="checkbox"/> Dolerite <input type="checkbox"/> Laterite <input checked="" type="checkbox"/> Ironstone <input type="checkbox"/> Limestone <input type="checkbox"/> Quartz <input type="checkbox"/> Specify other:	(on soil surface; e.g. gravel, quartz fields) 0-10% <input checked="" type="checkbox"/> 10-30% <input type="checkbox"/> 30-50% <input type="checkbox"/> 50-100% <input type="checkbox"/>	Sand <input type="checkbox"/> Sandy loam <input type="checkbox"/> Loam <input type="checkbox"/> Clay loam <input checked="" type="checkbox"/> Light clay <input type="checkbox"/> Peat <input type="checkbox"/> Specify other:	Red <input type="checkbox"/> Brown <input checked="" type="checkbox"/> Yellow <input type="checkbox"/> White <input type="checkbox"/> Grey <input type="checkbox"/> Black <input type="checkbox"/> Specify other:	Well drained <input checked="" type="checkbox"/> Seasonally inundated <input type="checkbox"/> Permanently inundated <input type="checkbox"/> Tidal <input type="checkbox"/> Specify other:

Specific Landform Element: (Refer to field manual for additional values)

CONDITION OF SOIL:

Dry Moist Waterlogged Inundated Cracked Saline Other:

VEGETATION CLASSIFICATION:*

E.g. 1. Banksia woodland (B. attenuata, B. ilicifolia);
 2. Open shrubland (Hibbertia sp., Acacia spp.)
 3. Isolated clumps of sedges (Mesomelaena tetragona)

1. Heathland (*Allocasuarina microstachya*, *A. humilis*, *Banksia armata*, *Hibbertia hypericoides*)
2. Sparse rushland (*Schoenus ?nanus*, *Schoenus subflavus*)
3. Isolated grasses (*Neurachne alopecuroidea*)
- 4.

ASSOCIATED SPECIES:

Other (non-dominant) spp

Hypocalymma xanthopetalum
Hakea incrassata
Xanthorrhoea drummondii
Melaleuca ?trichophylla

* Please record up to four of the most representative vegetation layers (with up to three dominant species in each layer). Structural Formations should follow 2009 *Australian Soil and Land Survey Field Handbook* guidelines – refer to field manual for further information and structural formation table.

CONDITION OF HABITAT: Pristine Excellent Very good Good Degraded Completely degraded

COMMENT:

FIRE HISTORY: Last Fire: Season/Month: _____ Year: _____ Fire Intensity: High Medium Low No signs of fire

FENCING: Not required Present Replace / repair Required Length req'd: _____

ROADSIDE MARKERS: Not required Present Replace / reposition Required Quantity req'd: _____

OTHER COMMENTS: (Please include recommended management actions and/or implemented actions - include date. Also include details of additional data available, and how to locate it.)

Please return completed form to **Species And Communities Branch** DPaW,
 Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.

Record entered by: _____ Sheet No.: _____ Record Accepted in Database



Threatened and Priority Flora Report Form

DRF PERMIT/ LICENCE No: SL011729

Note if only observing plants (i.e. no specimens or plant material is taken) then no permit/licence is required. For further information on permit and licencing requirements see the Threatened Flora and Wildlife Licensing pages on DPaW's website. Any actions carried out under licence/permit should be recorded above in the OTHER COMMENTS section.

SPECIMEN: Collectors No: MG03 WA Herb. Regional Herb. District Herb. Other:

ATTACHED: Map Mudmap Photo GIS data Field notes Other:

COPY SENT TO: Regional Office District Office Other:

Submitter of record: Mathew Gannaway

Role: Ecologist

Signature:



Date submitted: 12/09/2016

Please return completed form to **Species And Communities Branch** DPaW,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.



Threatened and Priority Flora Report Form

Please complete as much of the form as possible.

For information on how to complete the form please refer to the Threatened & Priority Flora Report Form (TPRF) manual on the DPaW website at <http://www.dpaw.wa.gov.au/>

TAXON: <u>Stylidium ?hymenocraspedum</u>		TPFL Pop. No.: _____
OBSERVATION DATE: <u>03/08/2016</u>	CONSERVATION STATUS: <u>P3</u>	New population <input checked="" type="checkbox"/>
OBSERVER/S: <u>Mathew Gannaway</u>		PHONE : <u>(08) 6222 8058</u>
ROLE: <u>Consultant - Ecologist</u>		ORGANISATION: <u>GHD</u>

DESCRIPTION OF LOCATION (Provide at least nearest town/named locality, and the distance and direction to that place):

Located west of Banovich Road and north of Jurien Road, approximately 20 km north east of Jurien town site.

Reserve No.: _____

DISTRICT: Midwest **LGA:** Shire of Dandaragan Land manager present:

DATUM:	COORDINATES: (If UTM coords provided, Zone is also required)	METHOD USED:
GDA94 / MGA94 <input checked="" type="checkbox"/>	DecDegrees <input type="checkbox"/> DegMinSec <input type="checkbox"/> UTM's <input checked="" type="checkbox"/>	GPS <input checked="" type="checkbox"/> Differential GPS <input type="checkbox"/> Map <input type="checkbox"/>
AGD84 / AMG84 <input type="checkbox"/>	Lat / Northing: <u>330847</u>	No. satellites: _____ Map used: _____
WGS84 <input type="checkbox"/>	Long / Easting: <u>6656140</u>	Boundary polygon captured: <input type="checkbox"/> Map scale: _____
Unknown <input type="checkbox"/>	Zone: <u>50J</u>	

LAND TENURE:

- | | | | | |
|--|---|--|--|--|
| Nature reserve <input type="checkbox"/> | Timber reserve <input type="checkbox"/> | Private property <input checked="" type="checkbox"/> | Rail reserve <input type="checkbox"/> | Shire road reserve <input type="checkbox"/> |
| National park <input type="checkbox"/> | State forest <input type="checkbox"/> | Pastoral lease <input type="checkbox"/> | MRWA road reserve <input type="checkbox"/> | Other Crown reserve <input type="checkbox"/> |
| Conservation park <input type="checkbox"/> | Water reserve <input type="checkbox"/> | UCL <input type="checkbox"/> | SLK/Pole _____ to _____ | Specify other: _____ |

AREA ASSESSMENT: Edge survey Partial survey Full survey Area observed (m²): _____

EFFORT: Time spent surveying (minutes): _____ No. of minutes spent / 100 m²: _____

POP'N COUNT ACCURACY: Actual Extrapolation Estimate

Count method: (Refer to field manual for list) _____

WHAT COUNTED: Plants Clumps Clonal stems

TOTAL POP'N STRUCTURE:	Mature:	Juveniles:	Seedlings:	Totals:	Area of pop (m ²): _____ Note: Pls record count as numbers (not percentages) for database.
Alive	4			4	
Dead					

QUADRATS PRESENT: No. _____ Size _____ Data attached Total area of quadrats (m²): _____

Summary Quad. Totals: Alive

--	--	--	--

REPRODUCTIVE STATE: Clonal Vegetative Flowerbud Flower
Immature fruit Fruit Dehisced fruit Percentage in flower: _____%

CONDITION OF PLANTS: Healthy Moderate Poor Senescent

COMMENT:

THREATS - type, agent and supporting information:

E.g. clearing, too frequent fire, weed, disease. Refer to field manual for list of threats & agents. **Specify agent** where relevant.

Rate current and potential threat impact: N=Nil, L=Low, M=Medium, H=High, E=Extreme

Estimate time to potential impact: S=Short (<12mths), M=Medium (<5yrs), L=Long (5yrs+)

	Current impact (N-E)	Potential Impact (L-E)	Potential Threat Onset (S-L)
J Weeds	N	M	L
J	---	---	---
J	---	---	---

Please return completed form to **Species And Communities Branch** DPaW,

Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.

Record entered by: _____ Sheet No.: _____ Record Accepted in Database



Threatened and Priority Flora Report Form

Version 1.2 August 2013

HABITAT INFORMATION: (Check more than one box for combinations or where necessary)

LANDFORM:	ROCK TYPE:	LOOSE ROCK:	SOIL TYPE:	SOIL COLOUR:	DRAINAGE:
Crest <input type="checkbox"/> Hill <input type="checkbox"/> Ridge <input type="checkbox"/> Outcrop <input type="checkbox"/> Slope <input checked="" type="checkbox"/> Flat <input type="checkbox"/> Open depression <input type="checkbox"/> Drainage line <input type="checkbox"/> Closed depression <input type="checkbox"/> Wetland <input type="checkbox"/>	Granite <input type="checkbox"/> Dolerite <input type="checkbox"/> Laterite <input type="checkbox"/> Ironstone <input type="checkbox"/> Limestone <input type="checkbox"/> Quartz <input type="checkbox"/> Specify other:	(on soil surface; e.g. gravel, quartz fields) 0-10% <input type="checkbox"/> 10-30% <input type="checkbox"/> 30-50% <input type="checkbox"/> 50-100% <input type="checkbox"/>	Sand <input checked="" type="checkbox"/> Sandy loam <input type="checkbox"/> Loam <input type="checkbox"/> Clay loam <input type="checkbox"/> Light clay <input type="checkbox"/> Peat <input type="checkbox"/> Specify other:	Red <input type="checkbox"/> Brown <input type="checkbox"/> Yellow <input type="checkbox"/> White <input checked="" type="checkbox"/> Grey <input type="checkbox"/> Black <input type="checkbox"/> Specify other:	Well drained <input checked="" type="checkbox"/> Seasonally inundated <input type="checkbox"/> Permanently inundated <input type="checkbox"/> Tidal <input type="checkbox"/> Specify other:

Specific Landform Element: (Refer to field manual for additional values)

CONDITION OF SOIL:

Dry Moist Waterlogged Inundated Cracked Saline Other:

VEGETATION CLASSIFICATION:*

E.g. 1. Banksia woodland (B. attenuata, B. ilicifolia);
 2. Open shrubland (Hibbertia sp., Acacia spp.)
 3. Isolated clumps of sedges (Mesomelaena tetragona)

1. Woodland (Eucalyptus todtiana, Banksia attenuata, B. menziesii)
2. Heathland (Adenanthos cygnorum subsp. cygnorum, Eremaea spp., Hibbertia spp.)
3. Sparse herbland (Stylidium spp., Conostylis spp., Drosera spp.)
- 4.

ASSOCIATED SPECIES:

Other (non-dominant) spp

Banksia candolleana
 Jacksonia floribunda
 Blancoa canescens
 Johnsonia pubescens subsp. pubescens

* Please record up to four of the most representative vegetation layers (with up to three dominant species in each layer). Structural Formations should follow 2009 *Australian Soil and Land Survey Field Handbook* guidelines – refer to field manual for further information and structural formation table.

CONDITION OF HABITAT: Pristine Excellent Very good Good Degraded Completely degraded

COMMENT:

FIRE HISTORY: Last Fire: Season/Month: _____ Year: _____ Fire Intensity: High Medium Low No signs of fire

FENCING: Not required Present Replace / repair Required Length req'd: _____

ROADSIDE MARKERS: Not required Present Replace / reposition Required Quantity req'd: _____

OTHER COMMENTS: (Please include recommended management actions and/or implemented actions - include date. Also include details of additional data available, and how to locate it.)

Please return completed form to **Species And Communities Branch** DPaW,
 Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.

Record entered by: _____ Sheet No.: _____ Record Accepted in Database



Threatened and Priority Flora Report Form

DRF PERMIT/ LICENCE No: SL011729

Note if only observing plants (i.e. no specimens or plant material is taken) then no permit/licence is required. For further information on permit and licencing requirements see the Threatened Flora and Wildlife Licensing pages on DPaW's website. Any actions carried out under licence/permit should be recorded above in the OTHER COMMENTS section.

SPECIMEN: Collectors No: WA Herb. Regional Herb. District Herb. Other:

ATTACHED: Map Mudmap Photo GIS data Field notes Other:

COPY SENT TO: Regional Office District Office Other:

Submitter of record: Mathew Gannaway

Role: Ecologist

Signature:



Date submitted: 12/09/2016

Please return completed form to **Species And Communities Branch** DPaW,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.

Record entered by: _____ Sheet No.: _____ Record Accepted in Database



Threatened and Priority Flora Report Form

Please complete as much of the form as possible.

For information on how to complete the form please refer to the Threatened & Priority Flora Report Form (TPRF) manual on the DPaW website at <http://www.dpaw.wa.gov.au/>

TAXON: <u>Stylidium ?tortincarpum</u>		TPFL Pop. No.: _____	
OBSERVATION DATE: <u>03/08/2016</u>		CONSERVATION STATUS: <u>P3</u> New population <input checked="" type="checkbox"/>	
OBSERVER/S: <u>Mathew Gannaway</u>		PHONE: <u>(08) 6222 8058</u>	
ROLE: <u>Consultant - Ecologist</u>		ORGANISATION: <u>GHD</u>	

DESCRIPTION OF LOCATION (Provide at least nearest town/named locality, and the distance and direction to that place):

Located west of Banovich Road and north of Jurien Road, approximately 20 km north east of Jurien town site.

Reserve No.: _____

DISTRICT: Midwest **LGA:** Shire of Dandaragan Land manager present:

DATUM: GDA94 / MGA94 <input checked="" type="checkbox"/> AGD84 / AMG84 <input type="checkbox"/> WGS84 <input type="checkbox"/> Unknown <input type="checkbox"/>	COORDINATES: (If UTM coords provided, Zone is also required)			METHOD USED:	
	DecDegrees <input type="checkbox"/>	DegMinSec <input type="checkbox"/>	UTMs <input checked="" type="checkbox"/>	GPS <input checked="" type="checkbox"/>	Differential GPS <input type="checkbox"/> Map <input type="checkbox"/>
	Lat / Northing: <u>331363</u>		No. satellites: _____		Map used: _____
	Long / Easting: <u>6659059</u>		Boundary polygon captured: <input type="checkbox"/>		Map scale: _____
	Zone: <u>50J</u>				

LAND TENURE:

- | | | | | |
|--|---|--|--|--|
| Nature reserve <input type="checkbox"/> | Timber reserve <input type="checkbox"/> | Private property <input checked="" type="checkbox"/> | Rail reserve <input type="checkbox"/> | Shire road reserve <input type="checkbox"/> |
| National park <input type="checkbox"/> | State forest <input type="checkbox"/> | Pastoral lease <input type="checkbox"/> | MRWA road reserve <input type="checkbox"/> | Other Crown reserve <input type="checkbox"/> |
| Conservation park <input type="checkbox"/> | Water reserve <input type="checkbox"/> | UCL <input type="checkbox"/> | SLK/Pole _____ to _____ | Specify other: _____ |

AREA ASSESSMENT: Edge survey Partial survey Full survey Area observed (m²): _____

EFFORT: Time spent surveying (minutes): _____ No. of minutes spent / 100 m²: _____

POP'N COUNT ACCURACY: Actual Extrapolation Estimate

Count method: (Refer to field manual for list) _____

WHAT COUNTED: Plants Clumps Clonal stems

TOTAL POP'N STRUCTURE:	Mature:	Juveniles:	Seedlings:	Totals:
Alive	2			2
Dead				

Area of pop (m²): _____

Note: Pls record count as numbers (not percentages) for database.

QUADRATS PRESENT: No. _____ Size _____ Data attached Total area of quadrats (m²): _____

Summary Quad. Totals: Alive

--	--	--	--

REPRODUCTIVE STATE: Clonal Vegetative Flowerbud Flower
Immature fruit Fruit Dehisced fruit Percentage in flower: _____%

CONDITION OF PLANTS: Healthy Moderate Poor Senescent

COMMENT:

THREATS - type, agent and supporting information:

E.g. clearing, too frequent fire, weed, disease. Refer to field manual for list of threats & agents. **Specify agent** where relevant.

Rate current and potential threat impact: N=Nil, L=Low, M=Medium, H=High, E=Extreme

Estimate time to potential impact: S=Short (<12mths), M=Medium (<5yrs), L=Long (5yrs+)

	Current impact (N-E)	Potential Impact (L-E)	Potential Threat Onset (S-L)
J Weeds	N	M	L
J	---	---	---
J	---	---	---

Please return completed form to **Species And Communities Branch DPaW,**

Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer,** Species and Communities Branch.

Record entered by: _____ Sheet No.: _____ Record Accepted in Database



Threatened and Priority Flora Report Form

Version 1.2 August 2013

HABITAT INFORMATION: (Check more than one box for combinations or where necessary)

LANDFORM:	ROCK TYPE:	LOOSE ROCK:	SOIL TYPE:	SOIL COLOUR:	DRAINAGE:
Crest <input type="checkbox"/> Hill <input type="checkbox"/> Ridge <input type="checkbox"/> Outcrop <input type="checkbox"/> Slope <input type="checkbox"/> Flat <input type="checkbox"/> Open depression <input type="checkbox"/> Drainage line <input checked="" type="checkbox"/> Closed depression <input type="checkbox"/> Wetland <input type="checkbox"/>	Granite <input type="checkbox"/> Dolerite <input type="checkbox"/> Laterite <input type="checkbox"/> Ironstone <input type="checkbox"/> Limestone <input type="checkbox"/> Quartz <input type="checkbox"/> Specify other:	(on soil surface; e.g. gravel, quartz fields) 0-10% <input type="checkbox"/> 10-30% <input type="checkbox"/> 30-50% <input type="checkbox"/> 50-100% <input type="checkbox"/>	Sand <input type="checkbox"/> Sandy loam <input type="checkbox"/> Loam <input type="checkbox"/> Clay loam <input checked="" type="checkbox"/> Light clay <input type="checkbox"/> Peat <input type="checkbox"/> Specify other:	Red <input type="checkbox"/> Brown <input checked="" type="checkbox"/> Yellow <input type="checkbox"/> White <input type="checkbox"/> Grey <input type="checkbox"/> Black <input type="checkbox"/> Specify other:	Well drained <input type="checkbox"/> Seasonally inundated <input checked="" type="checkbox"/> Permanently inundated <input type="checkbox"/> Tidal <input type="checkbox"/> Specify other:

Specific Landform Element: (Refer to field manual for additional values)

CONDITION OF SOIL:

Dry Moist Waterlogged Inundated Cracked Saline Other:

VEGETATION CLASSIFICATION:*

E.g. 1. Banksia woodland (B. attenuata, B. ilicifolia);
 2. Open shrubland (Hibbertia sp., Acacia spp.)
 3. Isolated clumps of sedges (Mesomelaena tetragona)

1. Woodland (Melaleuca raphiophylla, Eucalyptus rudis, Corymbia calophylla)
2. Open shrubland (Pimelea argentea, Melaleuca viminea, Calothamnus quadrifidus)
3. Open heathland (Hypocalymma angustifolium, Melaleuca platycalyx, Acacia spp.)
- 4.

ASSOCIATED SPECIES:

Other (non-dominant) spp

Trymalium odoratissimum
 *Romulea rosea
 *Hypochaeris glabra

* Please record up to four of the most representative vegetation layers (with up to three dominant species in each layer). Structural Formations should follow 2009 *Australian Soil and Land Survey Field Handbook* guidelines – refer to field manual for further information and structural formation table.

CONDITION OF HABITAT: Pristine Excellent Very good Good Degraded Completely degraded

COMMENT:

FIRE HISTORY: Last Fire: Season/Month: _____ Year: _____ Fire Intensity: High Medium Low No signs of fire

FENCING: Not required Present Replace / repair Required Length req'd: _____

ROADSIDE MARKERS: Not required Present Replace / reposition Required Quantity req'd: _____

OTHER COMMENTS: (Please include recommended management actions and/or implemented actions - include date. Also include details of additional data available, and how to locate it.)

Please return completed form to **Species And Communities Branch** DPaW,
 Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.

Record entered by: _____ Sheet No.: _____ Record Accepted in Database



Threatened and Priority Flora Report Form

DRF PERMIT/ LICENCE No: SL011729

Note if only observing plants (i.e. no specimens or plant material is taken) then no permit/licence is required. For further information on permit and licencing requirements see the Threatened Flora and Wildlife Licensing pages on DPaW's website. Any actions carried out under licence/permit should be recorded above in the OTHER COMMENTS section.

SPECIMEN: Collectors No: WA Herb. Regional Herb. District Herb. Other:

ATTACHED: Map Mudmap Photo GIS data Field notes Other:

COPY SENT TO: Regional Office District Office Other:

Submitter of record: Mathew Gannaway **Role:** Ecologist

Signature:  **Date submitted:** 12/09/2016

Please return completed form to **Species And Communities Branch** DPaW,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.



Threatened and Priority Flora Report Form

Please complete as much of the form as possible.

For information on how to complete the form please refer to the Threatened & Priority Flora Report Form (TPRF) manual on the DPaW website at <http://www.dpaw.wa.gov.au/>

TAXON: <u>Lepidobolus quadratus</u>		TPFL Pop. No.: _____	
OBSERVATION DATE: <u>01/08/2016</u>		CONSERVATION STATUS: <u>P3</u> New population <input checked="" type="checkbox"/>	
OBSERVER/S: <u>Mathew Gannaway</u>		PHONE: <u>(08) 6222 8058</u>	
ROLE: <u>Consultant - Ecologist</u>		ORGANISATION: <u>GHD</u>	

DESCRIPTION OF LOCATION (Provide at least nearest town/named locality, and the distance and direction to that place):

Located west of Banovich Road and north of Jurien Road, approximately 20 km north east of Jurien town site.

Reserve No.: _____

DISTRICT: Midwest **LGA:** Shire of Dandaragan Land manager present:

DATUM: GDA94 / MGA94 <input checked="" type="checkbox"/> AGD84 / AMG84 <input type="checkbox"/> WGS84 <input type="checkbox"/> Unknown <input type="checkbox"/>	COORDINATES: (If UTM coords provided, Zone is also required)			METHOD USED:		
	DecDegrees <input type="checkbox"/>	DegMinSec <input type="checkbox"/>	UTMs <input checked="" type="checkbox"/>	GPS <input checked="" type="checkbox"/>	Differential GPS <input type="checkbox"/>	Map <input type="checkbox"/>
	Lat / Northing: <u>329935</u>			No. satellites: _____		Map used: _____
	Long / Easting: <u>6658244</u>			Boundary polygon captured: <input type="checkbox"/>		Map scale: _____
	Zone: <u>50J</u>					

LAND TENURE:

- | | | | | |
|--|---|--|--|--|
| Nature reserve <input type="checkbox"/> | Timber reserve <input type="checkbox"/> | Private property <input checked="" type="checkbox"/> | Rail reserve <input type="checkbox"/> | Shire road reserve <input type="checkbox"/> |
| National park <input type="checkbox"/> | State forest <input type="checkbox"/> | Pastoral lease <input type="checkbox"/> | MRWA road reserve <input type="checkbox"/> | Other Crown reserve <input type="checkbox"/> |
| Conservation park <input type="checkbox"/> | Water reserve <input type="checkbox"/> | UCL <input type="checkbox"/> | SLK/Pole _____ to _____ | Specify other: _____ |

AREA ASSESSMENT: Edge survey Partial survey Full survey Area observed (m²): _____

EFFORT: Time spent surveying (minutes): _____ No. of minutes spent / 100 m²: _____

POP'N COUNT ACCURACY: Actual Extrapolation Estimate

Count method: (Refer to field manual for list) _____

WHAT COUNTED: Plants Clumps Clonal stems

TOTAL POP'N STRUCTURE:	Mature:	Juveniles:	Seedlings:	Totals:
Alive	6			6
Dead				

Area of pop (m²): _____

Note: Pls record count as numbers (not percentages) for database.

QUADRATS PRESENT: No. _____ Size _____ Data attached Total area of quadrats (m²): _____

Summary Quad. Totals: Alive

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REPRODUCTIVE STATE: Clonal Vegetative Flowerbud Flower
Immature fruit Fruit Dehisced fruit Percentage in flower: _____%

CONDITION OF PLANTS: Healthy Moderate Poor Senescent

COMMENT:

THREATS - type, agent and supporting information:

E.g. clearing, too frequent fire, weed, disease. Refer to field manual for list of threats & agents. **Specify agent** where relevant.

Rate current and potential threat impact: N=Nil, L=Low, M=Medium, H=High, E=Extreme

Estimate time to potential impact: S=Short (<12mths), M=Medium (<5yrs), L=Long (5yrs+)

	Current impact (N-E)	Potential Impact (L-E)	Potential Threat Onset (S-L)
J Weeds	N	M	L
J	---	---	---
J	---	---	---

Please return completed form to **Species And Communities Branch** DPaW,

Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.

Record entered by: _____ Sheet No.: _____ Record Accepted in Database



Threatened and Priority Flora Report Form

Version 1.2 August 2013

HABITAT INFORMATION: (Check more than one box for combinations or where necessary)

LANDFORM:	ROCK TYPE:	LOOSE ROCK:	SOIL TYPE:	SOIL COLOUR:	DRAINAGE:
Crest <input type="checkbox"/> Hill <input type="checkbox"/> Ridge <input type="checkbox"/> Outcrop <input type="checkbox"/> Slope <input checked="" type="checkbox"/> Flat <input type="checkbox"/> Open depression <input type="checkbox"/> Drainage line <input type="checkbox"/> Closed depression <input type="checkbox"/> Wetland <input type="checkbox"/>	Granite <input type="checkbox"/> Dolerite <input type="checkbox"/> Laterite <input checked="" type="checkbox"/> Ironstone <input type="checkbox"/> Limestone <input type="checkbox"/> Quartz <input type="checkbox"/> Specify other:	(on soil surface; e.g. gravel, quartz fields) 0-10% <input type="checkbox"/> 10-30% <input checked="" type="checkbox"/> 30-50% <input type="checkbox"/> 50-100% <input type="checkbox"/>	Sand <input checked="" type="checkbox"/> Sandy loam <input type="checkbox"/> Loam <input type="checkbox"/> Clay loam <input checked="" type="checkbox"/> Light clay <input type="checkbox"/> Peat <input type="checkbox"/> Specify other:	Red <input type="checkbox"/> Brown <input type="checkbox"/> Yellow <input type="checkbox"/> White <input type="checkbox"/> Grey <input checked="" type="checkbox"/> Black <input type="checkbox"/> Specify other:	Well drained <input checked="" type="checkbox"/> Seasonally inundated <input type="checkbox"/> Permanently inundated <input type="checkbox"/> Tidal <input type="checkbox"/> Specify other:

Specific Landform Element: (Refer to field manual for additional values)

CONDITION OF SOIL:

Dry Moist Waterlogged Inundated Cracked Saline Other:

VEGETATION CLASSIFICATION:*

E.g. 1. Banksia woodland (B. attenuata, B. ilicifolia);
 2. Open shrubland (Hibbertia sp., Acacia spp.)
 3. Isolated clumps of sedges (Mesomelaena tetragona)

1. Heathland (Petrophile chrysantha, Banksia armata, Calothamnus sanguineus, Daviesia nudiflora)
2. Sparse rushland (Schoenus ?nanus)
3. Isolated sedge (Lepidosperma squamatum)
4. Isolated herbs (Burchardia sp., Tetratheca paucifolia, Anigozanthos humilis)

ASSOCIATED SPECIES:

Other (non-dominant) spp

Hakea anadenia
 Hakea erinacea
 Hibbertia hypericoides

* Please record up to four of the most representative vegetation layers (with up to three dominant species in each layer). Structural Formations should follow 2009 *Australian Soil and Land Survey Field Handbook* guidelines – refer to field manual for further information and structural formation table.

CONDITION OF HABITAT: Pristine Excellent Very good Good Degraded Completely degraded

COMMENT:

FIRE HISTORY: Last Fire: Season/Month: _____ Year: _____ Fire Intensity: High Medium Low No signs of fire

FENCING: Not required Present Replace / repair Required Length req'd: _____

ROADSIDE MARKERS: Not required Present Replace / reposition Required Quantity req'd: _____

OTHER COMMENTS: (Please include recommended management actions and/or implemented actions - include date. Also include details of additional data available, and how to locate it.)

Please return completed form to **Species And Communities Branch** DPaW,
 Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.

Record entered by: _____ Sheet No.: _____ Record Accepted in Database



Threatened and Priority Flora Report Form

DRF PERMIT/ LICENCE No: SL011729

Note if only observing plants (i.e. no specimens or plant material is taken) then no permit/licence is required. For further information on permit and licencing requirements see the Threatened Flora and Wildlife Licensing pages on DPaW's website. Any actions carried out under licence/permit should be recorded above in the OTHER COMMENTS section.

SPECIMEN: Collectors No: MG03 WA Herb. Regional Herb. District Herb. Other:

ATTACHED: Map Mudmap Photo GIS data Field notes Other:

COPY SENT TO: Regional Office District Office Other:

Submitter of record: Mathew Gannaway

Role: Ecologist

Signature:



Date submitted: 12/09/2016

Please return completed form to **Species And Communities Branch** DPaW,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.



Threatened and Priority Flora Report Form

Please complete as much of the form as possible.

For information on how to complete the form please refer to the Threatened & Priority Flora Report Form (TPRF) manual on the DPaw website at <http://www.dpaw.wa.gov.au/>

TAXON: <u>Acacia retrorsa</u>		TPFL Pop. No.: _____	
OBSERVATION DATE: <u>02/08/2016</u>		CONSERVATION STATUS: <u>P2</u> New population <input checked="" type="checkbox"/>	
OBSERVER/S: <u>Mathew Gannaway</u>		PHONE: <u>(08) 6222 8058</u>	
ROLE: <u>Consultant - Ecologist</u>		ORGANISATION: <u>GHD</u>	

DESCRIPTION OF LOCATION (Provide at least nearest town/named locality, and the distance and direction to that place):

Located west of Banovich Road and north of Jurien Road, approximately 20 km north east of Jurien town site.

Reserve No.: _____

DISTRICT: Midwest **LGA:** Shire of Dandaragan Land manager present:

DATUM:	COORDINATES: (If UTM coords provided, Zone is also required)	METHOD USED:
GDA94 / MGA94 <input checked="" type="checkbox"/>	DecDegrees <input type="checkbox"/> DegMinSec <input type="checkbox"/> UTM's <input checked="" type="checkbox"/>	GPS <input checked="" type="checkbox"/> Differential GPS <input type="checkbox"/> Map <input type="checkbox"/>
AGD84 / AMG84 <input type="checkbox"/>	Lat / Northing: <u>328792</u>	No. satellites: _____ Map used: _____
WGS84 <input type="checkbox"/>	Long / Easting: <u>6659297</u>	Boundary polygon captured: <input type="checkbox"/> Map scale: _____
Unknown <input type="checkbox"/>	Zone: <u>50J</u>	

LAND TENURE:

- | | | | | |
|--|---|--|--|--|
| Nature reserve <input type="checkbox"/> | Timber reserve <input type="checkbox"/> | Private property <input checked="" type="checkbox"/> | Rail reserve <input type="checkbox"/> | Shire road reserve <input type="checkbox"/> |
| National park <input type="checkbox"/> | State forest <input type="checkbox"/> | Pastoral lease <input type="checkbox"/> | MRWA road reserve <input type="checkbox"/> | Other Crown reserve <input type="checkbox"/> |
| Conservation park <input type="checkbox"/> | Water reserve <input type="checkbox"/> | UCL <input type="checkbox"/> | SLK/Pole _____ to _____ | Specify other: _____ |

AREA ASSESSMENT: Edge survey Partial survey Full survey Area observed (m²): _____

EFFORT: Time spent surveying (minutes): _____ No. of minutes spent / 100 m²: _____

POP'N COUNT ACCURACY: Actual Extrapolation Estimate

Count method: (Refer to field manual for list) _____

WHAT COUNTED: Plants Clumps Clonal stems

TOTAL POP'N STRUCTURE:	Mature:	Juveniles:	Seedlings:	Totals:
Alive	1			1
Dead				

Area of pop (m²): _____

Note: Pls record count as numbers (not percentages) for database.

QUADRATS PRESENT: No. _____ Size _____ Data attached Total area of quadrats (m²): _____

Summary Quad. Totals: Alive

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REPRODUCTIVE STATE: Clonal Vegetative Flowerbud Flower
Immature fruit Fruit Dehisced fruit Percentage in flower: _____%

CONDITION OF PLANTS: Healthy Moderate Poor Senescent

COMMENT:

THREATS - type, agent and supporting information:

E.g. clearing, too frequent fire, weed, disease. Refer to field manual for list of threats & agents. **Specify agent** where relevant.

Rate current and potential threat impact: N=Nil, L=Low, M=Medium, H=High, E=Extreme

Estimate time to potential impact: S=Short (<12mths), M=Medium (<5yrs), L=Long (5yrs+)

THREATS - type, agent and supporting information:	Current impact (N-E)	Potential Impact (L-E)	Potential Threat Onset (S-L)
J Weeds	<u>N</u>	<u>M</u>	<u>L</u>
J	_____	_____	_____
J	_____	_____	_____

Please return completed form to **Species And Communities Branch** DPaw,

Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.

Record entered by: _____ Sheet No.: _____ Record Accepted in Database



Threatened and Priority Flora Report Form

Version 1.2 August 2013

HABITAT INFORMATION: (Check more than one box for combinations or where necessary)

LANDFORM:	ROCK TYPE:	LOOSE ROCK:	SOIL TYPE:	SOIL COLOUR:	DRAINAGE:
Crest <input type="checkbox"/> Hill <input type="checkbox"/> Ridge <input type="checkbox"/> Outcrop <input type="checkbox"/> Slope <input checked="" type="checkbox"/> Flat <input type="checkbox"/> Open depression <input type="checkbox"/> Drainage line <input type="checkbox"/> Closed depression <input type="checkbox"/> Wetland <input type="checkbox"/>	Granite <input type="checkbox"/> Dolerite <input type="checkbox"/> Laterite <input checked="" type="checkbox"/> Ironstone <input type="checkbox"/> Limestone <input type="checkbox"/> Quartz <input type="checkbox"/> Specify other:	(on soil surface; e.g. gravel, quartz fields) 0-10% <input checked="" type="checkbox"/> 10-30% <input type="checkbox"/> 30-50% <input type="checkbox"/> 50-100% <input type="checkbox"/>	Sand <input type="checkbox"/> Sandy loam <input checked="" type="checkbox"/> Loam <input type="checkbox"/> Clay loam <input type="checkbox"/> Light clay <input type="checkbox"/> Peat <input type="checkbox"/> Specify other:	Red <input type="checkbox"/> Brown <input type="checkbox"/> Yellow <input type="checkbox"/> White <input type="checkbox"/> Grey <input type="checkbox"/> Black <input type="checkbox"/> Orange Specify other:	Well drained <input checked="" type="checkbox"/> Seasonally inundated <input type="checkbox"/> Permanently inundated <input type="checkbox"/> Tidal <input type="checkbox"/> Specify other:

Specific Landform Element: (Refer to field manual for additional values)

CONDITION OF SOIL:

Dry Moist Waterlogged Inundated Cracked Saline Other:

VEGETATION CLASSIFICATION:*

E.g. 1. Banksia woodland (B. attenuata, B. ilicifolia);
 2. Open shrubland (Hibbertia sp., Acacia spp.)
 3. Isolated clumps of sedges (Mesomelaena tetragona)

1. Heathland (*Allocasuarina humilis*, *Cryptandra pungens*, *Hakea anadenia*, *Hypocalymma xanthopetalum*)
2. Isolated clumps of mallee (*Eucalyptus drummondii*, *Eucalyptus wandoo*)
3. Sparse rushland (*Lepidosperma* sp., *Schoenus* sp._
4. Isolated herbs (*Conostylis* spp., *Drosera* spp., *Stylidium* spp.)

ASSOCIATED SPECIES:

Other (non-dominant) spp

Hibbertia hypericoides
Conostephium preissii
Neurachne alopecuroidea
Xanthorrhoea drummondii

* Please record up to four of the most representative vegetation layers (with up to three dominant species in each layer). Structural Formations should follow 2009 *Australian Soil and Land Survey Field Handbook* guidelines – refer to field manual for further information and structural formation table.

CONDITION OF HABITAT: Pristine Excellent Very good Good Degraded Completely degraded

COMMENT:

FIRE HISTORY: Last Fire: Season/Month: _____ Year: _____ Fire Intensity: High Medium Low No signs of fire

FENCING: Not required Present Replace / repair Required Length req'd: _____

ROADSIDE MARKERS: Not required Present Replace / reposition Required Quantity req'd: _____

OTHER COMMENTS: (Please include recommended management actions and/or implemented actions - include date. Also include details of additional data available, and how to locate it.)

Please return completed form to **Species And Communities Branch** DPaW,
 Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.

Record entered by: _____ Sheet No.: _____ Record Accepted in Database



Threatened and Priority Flora Report Form

DRF PERMIT/ LICENCE No: SL011729

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SPECIMEN: Collectors No: MG37 WA Herb. Regional Herb. District Herb. Other:

ATTACHED: Map Mudmap Photo GIS data Field notes Other:

COPY SENT TO: Regional Office District Office Other:

Submitter of record: Mathew Gannaway

Role: Ecologist

Signature:



Date submitted: 12/09/2016

Please return completed form to **Species And Communities Branch** DPaW,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.



Threatened and Priority Flora Report Form

Please complete as much of the form as possible.

For information on how to complete the form please refer to the Threatened & Priority Flora Report Form (TPRF) manual on the DPaW website at <http://www.dpaw.wa.gov.au/>

TAXON: <u>Acacia retrorsa</u>		TPFL Pop. No.: _____	
OBSERVATION DATE: <u>02/08/2016</u>		CONSERVATION STATUS: <u>P2</u> New population <input checked="" type="checkbox"/>	
OBSERVER/S: <u>Mathew Gannaway</u>		PHONE: <u>(08) 6222 8058</u>	
ROLE: <u>Consultant - Ecologist</u>		ORGANISATION: <u>GHD</u>	

DESCRIPTION OF LOCATION (Provide at least nearest town/named locality, and the distance and direction to that place):

Located west of Banovich Road and north of Jurien Road, approximately 20 km north east of Jurien town site.

Reserve No.: _____

DISTRICT: Midwest **LGA:** Shire of Dandaragan Land manager present:

DATUM: GDA94 / MGA94 <input checked="" type="checkbox"/> AGD84 / AMG84 <input type="checkbox"/> WGS84 <input type="checkbox"/> Unknown <input type="checkbox"/>	COORDINATES: (If UTM coords provided, Zone is also required)			METHOD USED:	
	DecDegrees <input type="checkbox"/>	DegMinSec <input type="checkbox"/>	UTMs <input checked="" type="checkbox"/>	GPS <input checked="" type="checkbox"/>	Differential GPS <input type="checkbox"/> Map <input type="checkbox"/>
	Lat / Northing: <u>328113</u>		No. satellites: _____		Map used: _____
	Long / Easting: <u>6659659</u>		Boundary polygon captured: <input type="checkbox"/>		Map scale: _____
	Zone: <u>50J</u>				

LAND TENURE:

Nature reserve Timber reserve Private property Rail reserve Shire road reserve
 National park State forest Pastoral lease MRWA road reserve Other Crown reserve
 Conservation park Water reserve UCL SLK/Pole _____ to _____ Specify other: _____

AREA ASSESSMENT: Edge survey Partial survey Full survey Area observed (m²): _____

EFFORT: Time spent surveying (minutes): _____ No. of minutes spent / 100 m²: _____

POP'N COUNT ACCURACY: Actual Extrapolation Estimate

Count method: (Refer to field manual for list) _____

WHAT COUNTED: Plants Clumps Clonal stems

TOTAL POP'N STRUCTURE:	Mature:	Juveniles:	Seedlings:	Totals:	Area of pop (m ²): _____ Note: Pls record count as numbers (not percentages) for database.
	Alive	1			
Dead					

QUADRATS PRESENT: No. _____ Size _____ Data attached Total area of quadrats (m²): _____

Summary Quad. Totals: Alive

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REPRODUCTIVE STATE: Clonal Vegetative Flowerbud Flower
 Immature fruit Fruit Dehisced fruit Percentage in flower: _____%

CONDITION OF PLANTS: Healthy Moderate Poor Senescent

COMMENT:

THREATS - type, agent and supporting information: <small>E.g. clearing, too frequent fire, weed, disease. Refer to field manual for list of threats & agents. Specify agent where relevant. Rate current and potential threat impact: N=Nil, L=Low, M=Medium, H=High, E=Extreme Estimate time to potential impact: S=Short (<12mths), M=Medium (<5yrs), L=Long (5yrs+)</small>	Current impact (N-E)	Potential Impact (L-E)	Potential Threat Onset (S-L)
J Weeds	L	M	M
J	---	---	---
J	---	---	---

Please return completed form to **Species And Communities Branch DPaW,**

Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer,** Species and Communities Branch.

Record entered by: _____ Sheet No.: _____ Record Accepted in Database



Threatened and Priority Flora Report Form

Version 1.2 August 2013

HABITAT INFORMATION: (Check more than one box for combinations or where necessary)

LANDFORM:	ROCK TYPE:	LOOSE ROCK:	SOIL TYPE:	SOIL COLOUR:	DRAINAGE:
Crest <input type="checkbox"/> Hill <input type="checkbox"/> Ridge <input type="checkbox"/> Outcrop <input type="checkbox"/> Slope <input type="checkbox"/> Flat <input type="checkbox"/> Open depression <input type="checkbox"/> Drainage line <input checked="" type="checkbox"/> Closed depression <input type="checkbox"/> Wetland <input type="checkbox"/>	Granite <input type="checkbox"/> Dolerite <input type="checkbox"/> Laterite <input type="checkbox"/> Ironstone <input type="checkbox"/> Limestone <input type="checkbox"/> Quartz <input type="checkbox"/> Specify other:	(on soil surface; e.g. gravel, quartz fields) 0-10% <input type="checkbox"/> 10-30% <input type="checkbox"/> 30-50% <input type="checkbox"/> 50-100% <input type="checkbox"/>	Sand <input type="checkbox"/> Sandy loam <input type="checkbox"/> Loam <input type="checkbox"/> Clay loam <input checked="" type="checkbox"/> Light clay <input type="checkbox"/> Peat <input type="checkbox"/> Specify other:	Red <input type="checkbox"/> Brown <input checked="" type="checkbox"/> Yellow <input type="checkbox"/> White <input type="checkbox"/> Grey <input type="checkbox"/> Black <input type="checkbox"/> Specify other:	Well drained <input type="checkbox"/> Seasonally inundated <input checked="" type="checkbox"/> Permanently inundated <input type="checkbox"/> Tidal <input type="checkbox"/> Specify other:

Specific Landform Element: (Refer to field manual for additional values)

CONDITION OF SOIL:

Dry Moist Waterlogged Inundated Cracked Saline Other:

VEGETATION CLASSIFICATION:*

E.g. 1. Banksia woodland (B. attenuata, B. ilicifolia);
 2. Open shrubland (Hibbertia sp., Acacia spp.)
 3. Isolated clumps of sedges (Mesomelaena tetragona)

- Woodland (Melaleuca raphiophylla, Eucalyptus rudis)
- Open shrubland (Pimelea argentea, Melaleuca viminea, Calothamnus quadrifidus)
- Open heathland (Hypocalymma angustifolium, Melaleuca platycalyx, Acacia spp.)
- Open herbland (*Lysimachia arvensis, *Romulea rosea)

ASSOCIATED SPECIES:

Other (non-dominant) spp

Trymalium odoratissimum

* Please record up to four of the most representative vegetation layers (with up to three dominant species in each layer). Structural Formations should follow 2009 *Australian Soil and Land Survey Field Handbook* guidelines – refer to field manual for further information and structural formation table.

CONDITION OF HABITAT: Pristine Excellent Very good Good Degraded Completely degraded

COMMENT:

FIRE HISTORY: Last Fire: Season/Month: _____ Year: _____ Fire Intensity: High Medium Low No signs of fire

FENCING: Not required Present Replace / repair Required Length req'd: _____

ROADSIDE MARKERS: Not required Present Replace / reposition Required Quantity req'd: _____

OTHER COMMENTS: (Please include recommended management actions and/or implemented actions - include date. Also include details of additional data available, and how to locate it.)

Please return completed form to **Species And Communities Branch** DPaW,
 Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.

Record entered by: _____ Sheet No.: _____ Record Accepted in Database



Threatened and Priority Flora Report Form

DRF PERMIT/ LICENCE No: SL011729

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SPECIMEN: Collectors No: MG37 WA Herb. Regional Herb. District Herb. Other:

ATTACHED: Map Mudmap Photo GIS data Field notes Other:

COPY SENT TO: Regional Office District Office Other:

Submitter of record: Mathew Gannaway

Role: Ecologist

Signature:



Date submitted: 12/09/2016

Please return completed form to **Species And Communities Branch** DPaW,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.



Threatened and Priority Flora Report Form

Please complete as much of the form as possible.

For information on how to complete the form please refer to the Threatened & Priority Flora Report Form (TPRF) manual on the DPaW website at <http://www.dpaw.wa.gov.au/>

TAXON: <u>Grevillea delta</u>		TPFL Pop. No.: _____	
OBSERVATION DATE: <u>02/08/2016</u>		CONSERVATION STATUS: <u>P2</u> New population <input checked="" type="checkbox"/>	
OBSERVER/S: <u>Mathew Gannaway</u>		PHONE: <u>(08) 6222 8058</u>	
ROLE: <u>Consultant - Ecologist</u>		ORGANISATION: <u>GHD</u>	

DESCRIPTION OF LOCATION (Provide at least nearest town/named locality, and the distance and direction to that place):

Located west of Banovich Road and north of Jurien Road, approximately 20 km north east of Jurien town site.

Reserve No.: _____

DISTRICT: Midwest **LGA:** Shire of Dandaragan Land manager present:

DATUM: GDA94 / MGA94 <input checked="" type="checkbox"/> AGD84 / AMG84 <input type="checkbox"/> WGS84 <input type="checkbox"/> Unknown <input type="checkbox"/>	COORDINATES: (If UTM coords provided, Zone is also required)			METHOD USED:		
	DecDegrees <input type="checkbox"/>	DegMinSec <input type="checkbox"/>	UTMs <input checked="" type="checkbox"/>	GPS <input checked="" type="checkbox"/>	Differential GPS <input type="checkbox"/>	Map <input type="checkbox"/>
	Lat / Northing: <u>328371</u>			No. satellites: _____		
	Long / Easting: <u>6659895</u>			Boundary polygon captured: <input type="checkbox"/>		
Zone: <u>50J</u>			Map used: _____			
			Map scale: _____			

LAND TENURE:

- | | | | | |
|--|---|--|--|--|
| Nature reserve <input type="checkbox"/> | Timber reserve <input type="checkbox"/> | Private property <input checked="" type="checkbox"/> | Rail reserve <input type="checkbox"/> | Shire road reserve <input type="checkbox"/> |
| National park <input type="checkbox"/> | State forest <input type="checkbox"/> | Pastoral lease <input type="checkbox"/> | MRWA road reserve <input type="checkbox"/> | Other Crown reserve <input type="checkbox"/> |
| Conservation park <input type="checkbox"/> | Water reserve <input type="checkbox"/> | UCL <input type="checkbox"/> | SLK/Pole _____ to _____ | Specify other: _____ |

AREA ASSESSMENT: Edge survey Partial survey Full survey Area observed (m²): _____

EFFORT: Time spent surveying (minutes): _____ No. of minutes spent / 100 m²: _____

POP'N COUNT ACCURACY: Actual Extrapolation Estimate

Count method: (Refer to field manual for list) _____

WHAT COUNTED: Plants Clumps Clonal stems

TOTAL POP'N STRUCTURE:	Mature:	Juveniles:	Seedlings:	Totals:
Alive	1			1
Dead				

Area of pop (m²): _____

Note: Pls record count as numbers (not percentages) for database.

QUADRATS PRESENT: No. _____ Size _____ Data attached Total area of quadrats (m²): _____

Summary Quad. Totals: Alive

--	--	--	--

REPRODUCTIVE STATE: Clonal Vegetative Flowerbud Flower
Immature fruit Fruit Dehisced fruit Percentage in flower: _____%

CONDITION OF PLANTS: Healthy Moderate Poor Senescent

COMMENT:

THREATS - type, agent and supporting information:

E.g. clearing, too frequent fire, weed, disease. Refer to field manual for list of threats & agents. **Specify agent** where relevant.

Rate current and potential threat impact: N=Nil, L=Low, M=Medium, H=High, E=Extreme

Estimate time to potential impact: S=Short (<12mths), M=Medium (<5yrs), L=Long (5yrs+)

THREATS - type, agent and supporting information:	Current impact (N-E)	Potential Impact (L-E)	Potential Threat Onset (S-L)
J Weeds	N	M	L
J	---	---	---
J	---	---	---

Please return completed form to **Species And Communities Branch** DPaW,

Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.

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Threatened and Priority Flora Report Form

Version 1.2 August 2013

HABITAT INFORMATION: (Check more than one box for combinations or where necessary)

LANDFORM:	ROCK TYPE:	LOOSE ROCK:	SOIL TYPE:	SOIL COLOUR:	DRAINAGE:
Crest <input type="checkbox"/> Hill <input type="checkbox"/> Ridge <input type="checkbox"/> Outcrop <input type="checkbox"/> Slope <input checked="" type="checkbox"/> Flat <input type="checkbox"/> Open depression <input type="checkbox"/> Drainage line <input type="checkbox"/> Closed depression <input type="checkbox"/> Wetland <input type="checkbox"/>	Granite <input type="checkbox"/> Dolerite <input type="checkbox"/> Laterite <input type="checkbox"/> Ironstone <input type="checkbox"/> Limestone <input type="checkbox"/> Quartz <input type="checkbox"/> Specify other:	(on soil surface; e.g. gravel, quartz fields) 0-10% <input type="checkbox"/> 10-30% <input type="checkbox"/> 30-50% <input type="checkbox"/> 50-100% <input type="checkbox"/>	Sand <input type="checkbox"/> Sandy loam <input type="checkbox"/> Loam <input type="checkbox"/> Clay loam <input checked="" type="checkbox"/> Light clay <input type="checkbox"/> Peat <input type="checkbox"/> Specify other:	Red <input type="checkbox"/> Brown <input checked="" type="checkbox"/> Yellow <input type="checkbox"/> White <input type="checkbox"/> Grey <input type="checkbox"/> Black <input type="checkbox"/> Specify other:	Well drained <input checked="" type="checkbox"/> Seasonally inundated <input type="checkbox"/> Permanently inundated <input type="checkbox"/> Tidal <input type="checkbox"/> Specify other:

Specific Landform Element: (Refer to field manual for additional values)

CONDITION OF SOIL:

Dry Moist Waterlogged Inundated Cracked Saline Other:

VEGETATION CLASSIFICATION:*

E.g. 1. Banksia woodland (B. attenuata, B. ilicifolia);
 2. Open shrubland (Hibbertia sp., Acacia spp.)
 3. Isolated clumps of sedges (Mesomelaena tetragona)

1. Woodland (Eucalyptus wandoo subsp. pulverea, Eucalyptus rudis)
2. Open shrubland (Pimelea argentea, Melaleuca viminea, Calothamnus quadrifidus)
3. Open heathland (Hypocalymma angustifolium, Melaleuca platycalyx, Acacia spp.)
- 4.

ASSOCIATED SPECIES:

Other (non-dominant) spp

Trymalium odoratissimum
 Xanthorrhoea drummondii

* Please record up to four of the most representative vegetation layers (with up to three dominant species in each layer). Structural Formations should follow 2009 *Australian Soil and Land Survey Field Handbook* guidelines – refer to field manual for further information and structural formation table.

CONDITION OF HABITAT: Pristine Excellent Very good Good Degraded Completely degraded

COMMENT:

FIRE HISTORY: Last Fire: Season/Month: _____ Year: _____ Fire Intensity: High Medium Low No signs of fire

FENCING: Not required Present Replace / repair Required Length req'd: _____

ROADSIDE MARKERS: Not required Present Replace / reposition Required Quantity req'd: _____

OTHER COMMENTS: (Please include recommended management actions and/or implemented actions - include date. Also include details of additional data available, and how to locate it.)

Please return completed form to **Species And Communities Branch** DPaW,
 Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.

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Threatened and Priority Flora Report Form

DRF PERMIT/ LICENCE No: SL011729

Note if only observing plants (i.e. no specimens or plant material is taken) then no permit/licence is required. For further information on permit and licencing requirements see the Threatened Flora and Wildlife Licensing pages on DPaW's website. Any actions carried out under licence/permit should be recorded above in the OTHER COMMENTS section.

SPECIMEN: Collectors No: MG40 WA Herb. Regional Herb. District Herb. Other:

ATTACHED: Map Mudmap Photo GIS data Field notes Other:

COPY SENT TO: Regional Office District Office Other:

Submitter of record: Mathew Gannaway

Role: Ecologist

Signature:



Date submitted: 12/09/2016

Please return completed form to **Species And Communities Branch** DPaW,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.



Threatened and Priority Flora Report Form

Please complete as much of the form as possible.

For information on how to complete the form please refer to the Threatened & Priority Flora Report Form (TPRF) manual on the DPaW website at <http://www.dpaw.wa.gov.au/>

TAXON: <u>Hakea neurophylla</u>		TPFL Pop. No.: _____	
OBSERVATION DATE: <u>02/08/2016</u>		CONSERVATION STATUS: <u>P4</u> <input checked="" type="checkbox"/> New population	
OBSERVER/S: <u>Mathew Gannaway</u>		PHONE: <u>(08) 6222 8058</u>	
ROLE: <u>Consultant - Ecologist</u>		ORGANISATION: <u>GHD</u>	

DESCRIPTION OF LOCATION (Provide at least nearest town/named locality, and the distance and direction to that place):

Located west of Banovich Road and north of Jurien Road, approximately 20 km north east of Jurien town site.

Reserve No.: _____

DISTRICT: Midwest **LGA:** Shire of Dandaragan **Land manager present:**

DATUM: GDA94 / MGA94 <input checked="" type="checkbox"/> AGD84 / AMG84 <input type="checkbox"/> WGS84 <input type="checkbox"/> Unknown <input type="checkbox"/>	COORDINATES: (If UTM coords provided, Zone is also required)			METHOD USED:		
	DecDegrees <input type="checkbox"/>	DegMinSec <input type="checkbox"/>	UTMs <input checked="" type="checkbox"/>	GPS <input checked="" type="checkbox"/>	Differential GPS <input type="checkbox"/>	Map <input type="checkbox"/>
	Lat / Northing: <u>329224</u>			No. satellites: _____		Map used: _____
	Long / Easting: <u>6660537</u>			Boundary polygon captured: <input type="checkbox"/>		Map scale: _____
	Zone: <u>50J</u>					

LAND TENURE:

Nature reserve Timber reserve Private property Rail reserve Shire road reserve
 National park State forest Pastoral lease MRWA road reserve Other Crown reserve
 Conservation park Water reserve UCL SLK/Pole _____ to _____ Specify other: _____

AREA ASSESSMENT: Edge survey Partial survey Full survey Area observed (m²): _____

EFFORT: Time spent surveying (minutes): _____ No. of minutes spent / 100 m²: _____

POP'N COUNT ACCURACY: Actual Extrapolation Estimate

Count method: (Refer to field manual for list) _____

WHAT COUNTED: Plants Clumps Clonal stems

TOTAL POP'N STRUCTURE:	Mature:	Juveniles:	Seedlings:	Totals:	Area of pop (m ²): _____ Note: Pls record count as numbers (not percentages) for database.
Alive	5			5	
Dead					

QUADRATS PRESENT: No. _____ Size _____ Data attached Total area of quadrats (m²): _____

Summary Quad. Totals: Alive

--	--	--	--

REPRODUCTIVE STATE: Clonal Vegetative Flowerbud Flower
 Immature fruit Fruit Dehisced fruit Percentage in flower: _____%

CONDITION OF PLANTS: Healthy Moderate Poor Senescent

COMMENT:

THREATS - type, agent and supporting information:

E.g. clearing, too frequent fire, weed, disease. Refer to field manual for list of threats & agents. **Specify agent** where relevant.

Rate current and potential threat impact: N=Nil, L=Low, M=Medium, H=High, E=Extreme

Estimate time to potential impact: S=Short (<12mths), M=Medium (<5yrs), L=Long (5yrs+)

THREATS - type, agent and supporting information:	Current impact (N-E)	Potential Impact (L-E)	Potential Threat Onset (S-L)
J Weeds	N	M	L
J	---	---	---
J	---	---	---

Please return completed form to **Species And Communities Branch DPaW,**

Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer,** Species and Communities Branch.

Record entered by: _____ Sheet No.: _____ Record Accepted in Database



Threatened and Priority Flora Report Form

Version 1.2 August 2013

HABITAT INFORMATION: (Check more than one box for combinations or where necessary)

LANDFORM:	ROCK TYPE:	LOOSE ROCK:	SOIL TYPE:	SOIL COLOUR:	DRAINAGE:
Crest <input type="checkbox"/> Hill <input type="checkbox"/> Ridge <input type="checkbox"/> Outcrop <input type="checkbox"/> Slope <input checked="" type="checkbox"/> Flat <input type="checkbox"/> Open depression <input type="checkbox"/> Drainage line <input type="checkbox"/> Closed depression <input type="checkbox"/> Wetland <input type="checkbox"/>	Granite <input type="checkbox"/> Dolerite <input type="checkbox"/> Laterite <input checked="" type="checkbox"/> Ironstone <input type="checkbox"/> Limestone <input type="checkbox"/> Quartz <input type="checkbox"/> Specify other:	(on soil surface; e.g. gravel, quartz fields) 0-10% <input checked="" type="checkbox"/> 10-30% <input type="checkbox"/> 30-50% <input type="checkbox"/> 50-100% <input type="checkbox"/>	Sand <input type="checkbox"/> Sandy loam <input checked="" type="checkbox"/> Loam <input type="checkbox"/> Clay loam <input type="checkbox"/> Light clay <input type="checkbox"/> Peat <input type="checkbox"/> Specify other:	Red <input type="checkbox"/> Brown <input type="checkbox"/> Yellow <input type="checkbox"/> White <input type="checkbox"/> Grey <input checked="" type="checkbox"/> Black <input type="checkbox"/> Specify other:	Well drained <input checked="" type="checkbox"/> Seasonally inundated <input type="checkbox"/> Permanently inundated <input type="checkbox"/> Tidal <input type="checkbox"/> Specify other:

Specific Landform Element: (Refer to field manual for additional values)

CONDITION OF SOIL:

Dry Moist Waterlogged Inundated Cracked Saline Other:

VEGETATION CLASSIFICATION:*

E.g. 1. Banksia woodland (B. attenuata, B. ilicifolia);
 2. Open shrubland (Hibbertia sp., Acacia spp.)
 3. Isolated clumps of sedges (Mesomelaena tetragona)

- Woodland (Eucalyptus todtiana, Banksia attenuata, B. menziesii)
- Heathland (Adenanthos cygnorum subsp. cygnorum, Eremaea spp., Hibbertia spp.)
- Sparse hermland (Blancoa canescens, Conostylis spp., Drosera spp.)
-

ASSOCIATED SPECIES:

Other (non-dominant) spp

Banksia candolleana
 Jacksonia floribunda
 Johnsonia pubescens subsp. pubescens

* Please record up to four of the most representative vegetation layers (with up to three dominant species in each layer). Structural Formations should follow 2009 *Australian Soil and Land Survey Field Handbook* guidelines – refer to field manual for further information and structural formation table.

CONDITION OF HABITAT: Pristine Excellent Very good Good Degraded Completely degraded

COMMENT:

FIRE HISTORY: Last Fire: Season/Month: _____ Year: _____ Fire Intensity: High Medium Low No signs of fire

FENCING: Not required Present Replace / repair Required Length req'd: _____

ROADSIDE MARKERS: Not required Present Replace / reposition Required Quantity req'd: _____

OTHER COMMENTS: (Please include recommended management actions and/or implemented actions - include date. Also include details of additional data available, and how to locate it.)

Please return completed form to **Species And Communities Branch** DPaW,
 Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.

Record entered by: _____ Sheet No.: _____ Record Accepted in Database



Threatened and Priority Flora Report Form

DRF PERMIT/ LICENCE No: SL011729

Note if only observing plants (i.e. no specimens or plant material is taken) then no permit/licence is required. For further information on permit and licencing requirements see the Threatened Flora and Wildlife Licensing pages on DPaW's website. Any actions carried out under licence/permit should be recorded above in the OTHER COMMENTS section.

SPECIMEN: Collectors No: MG42 WA Herb. Regional Herb. District Herb. Other:

ATTACHED: Map Mudmap Photo GIS data Field notes Other:

COPY SENT TO: Regional Office District Office Other:

Submitter of record: Mathew Gannaway

Role: Ecologist

Signature:



Date submitted: 12/09/2016

Please return completed form to **Species And Communities Branch** DPaW,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.



Threatened and Priority Flora Report Form

Please complete as much of the form as possible.

For information on how to complete the form please refer to the Threatened & Priority Flora Report Form (TPRF) manual on the DPaW website at <http://www.dpaw.wa.gov.au/>

TAXON: <u>Hensmania stoniella</u>		TPFL Pop. No.: _____	
OBSERVATION DATE: <u>02/08/2016</u>		CONSERVATION STATUS: <u>P3</u> New population <input checked="" type="checkbox"/>	
OBSERVER/S: <u>Mathew Gannaway</u>		PHONE: <u>(08) 6222 8058</u>	
ROLE: <u>Consultant - Ecologist</u>		ORGANISATION: <u>GHD</u>	

DESCRIPTION OF LOCATION (Provide at least nearest town/named locality, and the distance and direction to that place):

Located west of Banovich Road and north of Jurien Road, approximately 20 km north east of Jurien town site.

Reserve No.: _____

DISTRICT: Midwest **LGA:** Shire of Dandaragan Land manager present:

DATUM: GDA94 / MGA94 <input checked="" type="checkbox"/> AGD84 / AMG84 <input type="checkbox"/> WGS84 <input type="checkbox"/> Unknown <input type="checkbox"/>	COORDINATES: (If UTM coords provided, Zone is also required)			METHOD USED:	
	DecDegrees <input type="checkbox"/>	DegMinSec <input type="checkbox"/>	UTMs <input checked="" type="checkbox"/>	GPS <input checked="" type="checkbox"/>	Differential GPS <input type="checkbox"/> Map <input type="checkbox"/>
	Lat / Northing: <u>330847</u>		No. satellites: _____		Map used: _____
	Long / Easting: <u>6656140</u>		Boundary polygon captured: <input type="checkbox"/>		Map scale: _____
	Zone: <u>50J</u>				

LAND TENURE:

- | | | | | |
|--|---|--|--|--|
| Nature reserve <input type="checkbox"/> | Timber reserve <input type="checkbox"/> | Private property <input checked="" type="checkbox"/> | Rail reserve <input type="checkbox"/> | Shire road reserve <input type="checkbox"/> |
| National park <input type="checkbox"/> | State forest <input type="checkbox"/> | Pastoral lease <input type="checkbox"/> | MRWA road reserve <input type="checkbox"/> | Other Crown reserve <input type="checkbox"/> |
| Conservation park <input type="checkbox"/> | Water reserve <input type="checkbox"/> | UCL <input type="checkbox"/> | SLK/Pole _____ to _____ | Specify other: _____ |

AREA ASSESSMENT: Edge survey Partial survey Full survey Area observed (m²): _____

EFFORT: Time spent surveying (minutes): _____ No. of minutes spent / 100 m²: _____

POP'N COUNT ACCURACY: Actual Extrapolation Estimate

Count method: (Refer to field manual for list) _____

WHAT COUNTED: Plants Clumps Clonal stems

TOTAL POP'N STRUCTURE:	Mature:	Juveniles:	Seedlings:	Totals:
Alive	4			4
Dead				

Area of pop (m²): _____

Note: Pls record count as numbers (not percentages) for database.

QUADRATS PRESENT: No. _____ Size _____ Data attached Total area of quadrats (m²): _____

Summary Quad. Totals: Alive

--	--	--	--

REPRODUCTIVE STATE: Clonal Vegetative Flowerbud Flower
Immature fruit Fruit Dehisced fruit Percentage in flower: _____%

CONDITION OF PLANTS: Healthy Moderate Poor Senescent

COMMENT:

THREATS - type, agent and supporting information:

E.g. clearing, too frequent fire, weed, disease. Refer to field manual for list of threats & agents. **Specify agent** where relevant.

Rate current and potential threat impact: N=Nil, L=Low, M=Medium, H=High, E=Extreme

Estimate time to potential impact: S=Short (<12mths), M=Medium (<5yrs), L=Long (5yrs+)

THREATS - type, agent and supporting information:	Current impact (N-E)	Potential Impact (L-E)	Potential Threat Onset (S-L)
J Weeds	N	M	L
J	---	---	---
J	---	---	---

Please return completed form to **Species And Communities Branch** DPaW,

Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.

Record entered by: _____ Sheet No.: _____ Record Accepted in Database



Threatened and Priority Flora Report Form

Version 1.2 August 2013

HABITAT INFORMATION: (Check more than one box for combinations or where necessary)

LANDFORM:	ROCK TYPE:	LOOSE ROCK:	SOIL TYPE:	SOIL COLOUR:	DRAINAGE:
Crest <input type="checkbox"/> Hill <input type="checkbox"/> Ridge <input type="checkbox"/> Outcrop <input type="checkbox"/> Slope <input checked="" type="checkbox"/> Flat <input type="checkbox"/> Open depression <input type="checkbox"/> Drainage line <input type="checkbox"/> Closed depression <input type="checkbox"/> Wetland <input type="checkbox"/>	Granite <input type="checkbox"/> Dolerite <input type="checkbox"/> Laterite <input type="checkbox"/> Ironstone <input type="checkbox"/> Limestone <input type="checkbox"/> Quartz <input type="checkbox"/> Specify other:	(on soil surface; e.g. gravel, quartz fields) 0-10% <input type="checkbox"/> 10-30% <input type="checkbox"/> 30-50% <input type="checkbox"/> 50-100% <input type="checkbox"/>	Sand <input checked="" type="checkbox"/> Sandy loam <input type="checkbox"/> Loam <input type="checkbox"/> Clay loam <input type="checkbox"/> Light clay <input type="checkbox"/> Peat <input type="checkbox"/> Specify other:	Red <input type="checkbox"/> Brown <input type="checkbox"/> Yellow <input type="checkbox"/> White <input checked="" type="checkbox"/> Grey <input type="checkbox"/> Black <input type="checkbox"/> Specify other:	Well drained <input checked="" type="checkbox"/> Seasonally inundated <input type="checkbox"/> Permanently inundated <input type="checkbox"/> Tidal <input type="checkbox"/> Specify other:

Specific Landform Element: (Refer to field manual for additional values)

CONDITION OF SOIL:

Dry Moist Waterlogged Inundated Cracked Saline Other:

VEGETATION CLASSIFICATION:*

E.g. 1. Banksia woodland (B. attenuata, B. ilicifolia);
 2. Open shrubland (Hibbertia sp., Acacia spp.)
 3. Isolated clumps of sedges (Mesomelaena tetragona)

- Woodland (Eucalyptus tottiana, Banksia attenuata, B. menziesii)
- Heathland (Adenanthos cygnorum subsp. cygnorum, Eremaea spp., Hibbertia spp.)
- Sparse hermland (Blancoa canescens, Conostylis spp., Drosera spp.)
-

ASSOCIATED SPECIES:

Other (non-dominant) spp

Banksia candolleana
 Jacksonia floribunda
 Johnsonia pubescens subsp. pubescens

* Please record up to four of the most representative vegetation layers (with up to three dominant species in each layer). Structural Formations should follow 2009 *Australian Soil and Land Survey Field Handbook* guidelines – refer to field manual for further information and structural formation table.

CONDITION OF HABITAT: Pristine Excellent Very good Good Degraded Completely degraded

COMMENT:

FIRE HISTORY: Last Fire: Season/Month: _____ Year: _____ Fire Intensity: High Medium Low No signs of fire

FENCING: Not required Present Replace / repair Required Length req'd: _____

ROADSIDE MARKERS: Not required Present Replace / reposition Required Quantity req'd: _____

OTHER COMMENTS: (Please include recommended management actions and/or implemented actions - include date. Also include details of additional data available, and how to locate it.)

Please return completed form to **Species And Communities Branch** DPaW,
 Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.

Record entered by: _____ Sheet No.: _____ Record Accepted in Database



Threatened and Priority Flora Report Form

DRF PERMIT/ LICENCE No: SL011729

Note if only observing plants (i.e. no specimens or plant material is taken) then no permit/licence is required. For further information on permit and licencing requirements see the Threatened Flora and Wildlife Licensing pages on DPaW's website. Any actions carried out under licence/permit should be recorded above in the OTHER COMMENTS section.

SPECIMEN: Collectors No: MG54 WA Herb. Regional Herb. District Herb. Other:

ATTACHED: Map Mudmap Photo GIS data Field notes Other:

COPY SENT TO: Regional Office District Office Other:

Submitter of record: Mathew Gannaway

Role: Ecologist

Signature:



Date submitted: 12/09/2016

Please return completed form to **Species And Communities Branch** DPaW,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.



Threatened and Priority Flora Report Form

Please complete as much of the form as possible.

For information on how to complete the form please refer to the Threatened & Priority Flora Report Form (TPRF) manual on the DPaW website at <http://www.dpaw.wa.gov.au/>

TAXON: <u>Thelymitra variegata</u>		TPFL Pop. No.: _____	
OBSERVATION DATE: <u>02/08/2016</u>		CONSERVATION STATUS: <u>P2</u> New population <input checked="" type="checkbox"/>	
OBSERVER/S: <u>Mathew Gannaway</u>		PHONE: <u>(08) 6222 8058</u>	
ROLE: <u>Consultant - Ecologist</u>		ORGANISATION: <u>GHD</u>	

DESCRIPTION OF LOCATION (Provide at least nearest town/named locality, and the distance and direction to that place):

Located west of Banovich Road and north of Jurien Road, approximately 20 km north east of Jurien town site.

Reserve No.: _____

DISTRICT: Midwest **LGA:** Shire of Dandaragan Land manager present:

DATUM: GDA94 / MGA94 <input checked="" type="checkbox"/> AGD84 / AMG84 <input type="checkbox"/> WGS84 <input type="checkbox"/> Unknown <input type="checkbox"/>	COORDINATES: (If UTM coords provided, Zone is also required)			METHOD USED:	
	DecDegrees <input type="checkbox"/>	DegMinSec <input type="checkbox"/>	UTMs <input checked="" type="checkbox"/>	GPS <input checked="" type="checkbox"/>	Differential GPS <input type="checkbox"/> Map <input type="checkbox"/>
	Lat / Northing: <u>329843</u>		No. satellites: _____		Map used: _____
	Long / Easting: <u>6659663</u>		Boundary polygon captured: <input type="checkbox"/>		Map scale: _____
	Zone: <u>50J</u>				

LAND TENURE:

- | | | | | |
|--|---|--|--|--|
| Nature reserve <input type="checkbox"/> | Timber reserve <input type="checkbox"/> | Private property <input checked="" type="checkbox"/> | Rail reserve <input type="checkbox"/> | Shire road reserve <input type="checkbox"/> |
| National park <input type="checkbox"/> | State forest <input type="checkbox"/> | Pastoral lease <input type="checkbox"/> | MRWA road reserve <input type="checkbox"/> | Other Crown reserve <input type="checkbox"/> |
| Conservation park <input type="checkbox"/> | Water reserve <input type="checkbox"/> | UCL <input type="checkbox"/> | SLK/Pole _____ to _____ | Specify other: _____ |

AREA ASSESSMENT: Edge survey Partial survey Full survey Area observed (m²): _____

EFFORT: Time spent surveying (minutes): _____ No. of minutes spent / 100 m²: _____

POP'N COUNT ACCURACY: Actual Extrapolation Estimate

Count method: (Refer to field manual for list) _____

WHAT COUNTED: Plants Clumps Clonal stems

TOTAL POP'N STRUCTURE:	Mature:	Juveniles:	Seedlings:	Totals:	Area of pop (m ²): _____ <small>Note: Pls record count as numbers (not percentages) for database.</small>
	Alive	1			
Dead					

QUADRATS PRESENT: No. _____ Size _____ Data attached Total area of quadrats (m²): _____

Summary Quad. Totals: Alive

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REPRODUCTIVE STATE: Clonal Vegetative Flowerbud Flower
Immature fruit Fruit Dehisced fruit Percentage in flower: _____%

CONDITION OF PLANTS: Healthy Moderate Poor Senescent

COMMENT:

THREATS - type, agent and supporting information:

E.g. clearing, too frequent fire, weed, disease. Refer to field manual for list of threats & agents. **Specify agent** where relevant.

Rate current and potential threat impact: N=Nil, L=Low, M=Medium, H=High, E=Extreme

Estimate time to potential impact: S=Short (<12mths), M=Medium (<5yrs), L=Long (5yrs+)

THREATS - type, agent and supporting information:	Current impact (N-E)	Potential Impact (L-E)	Potential Threat Onset (S-L)
J Weeds	<u>N</u>	<u>M</u>	<u>L</u>
J	_____	_____	_____
J	_____	_____	_____

Please return completed form to **Species And Communities Branch** DPaW,

Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.

Record entered by: _____ Sheet No.: _____ Record Accepted in Database



Threatened and Priority Flora Report Form

Version 1.2 August 2013

HABITAT INFORMATION: (Check more than one box for combinations or where necessary)

LANDFORM:	ROCK TYPE:	LOOSE ROCK:	SOIL TYPE:	SOIL COLOUR:	DRAINAGE:
Crest <input type="checkbox"/> Hill <input type="checkbox"/> Ridge <input type="checkbox"/> Outcrop <input type="checkbox"/> Slope <input checked="" type="checkbox"/> Flat <input type="checkbox"/> Open depression <input type="checkbox"/> Drainage line <input type="checkbox"/> Closed depression <input type="checkbox"/> Wetland <input type="checkbox"/>	Granite <input type="checkbox"/> Dolerite <input type="checkbox"/> Laterite <input checked="" type="checkbox"/> Ironstone <input type="checkbox"/> Limestone <input type="checkbox"/> Quartz <input type="checkbox"/> Specify other:	(on soil surface; e.g. gravel, quartz fields) 0-10% <input type="checkbox"/> 10-30% <input checked="" type="checkbox"/> 30-50% <input type="checkbox"/> 50-100% <input type="checkbox"/>	Sand <input checked="" type="checkbox"/> Sandy loam <input type="checkbox"/> Loam <input type="checkbox"/> Clay loam <input type="checkbox"/> Light clay <input type="checkbox"/> Peat <input type="checkbox"/> Specify other:	Red <input type="checkbox"/> Brown <input type="checkbox"/> Yellow <input type="checkbox"/> White <input type="checkbox"/> Grey <input checked="" type="checkbox"/> Black <input type="checkbox"/> Specify other:	Well drained <input checked="" type="checkbox"/> Seasonally inundated <input type="checkbox"/> Permanently inundated <input type="checkbox"/> Tidal <input type="checkbox"/> Specify other:

Specific Landform Element: (Refer to field manual for additional values)

CONDITION OF SOIL:

Dry Moist Waterlogged Inundated Cracked Saline Other:

VEGETATION CLASSIFICATION:*

E.g. 1. Banksia woodland (B. attenuata, B. ilicifolia);
 2. Open shrubland (Hibbertia sp., Acacia spp.)
 3. Isolated clumps of sedges (Mesomelaena tetragona)

1. Heathland (Xanthorrhoea spp., Kingia australis, Banksia spp., Calothamnus spp.)
2. Isolated rushes (Caustis dioica, Schoenus spp.)
3. Sparse hermland (Stylidium spp., Conostylis spp., Drosera spp.)
- 4.

ASSOCIATED SPECIES:

Other (non-dominant) spp

Cryptandra spp.
 Hakea spp.
 Hibbertia spp.

* Please record up to four of the most representative vegetation layers (with up to three dominant species in each layer). Structural Formations should follow 2009 *Australian Soil and Land Survey Field Handbook* guidelines – refer to field manual for further information and structural formation table.

CONDITION OF HABITAT: Pristine Excellent Very good Good Degraded Completely degraded

COMMENT:

FIRE HISTORY: Last Fire: Season/Month: _____ Year: _____ Fire Intensity: High Medium Low No signs of fire

FENCING: Not required Present Replace / repair Required Length req'd: _____

ROADSIDE MARKERS: Not required Present Replace / reposition Required Quantity req'd: _____

OTHER COMMENTS: (Please include recommended management actions and/or implemented actions - include date. Also include details of additional data available, and how to locate it.)

Please return completed form to **Species And Communities Branch** DPaW,
 Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.

Record entered by: _____ Sheet No.: _____ Record Accepted in Database



Threatened and Priority Flora Report Form

DRF PERMIT/ LICENCE No: SL011729

Note if only observing plants (i.e. no specimens or plant material is taken) then no permit/licence is required. For further information on permit and licencing requirements see the Threatened Flora and Wildlife Licensing pages on DPaW's website. Any actions carried out under licence/permit should be recorded above in the OTHER COMMENTS section.

SPECIMEN: Collectors No: WA Herb. Regional Herb. District Herb. Other:

ATTACHED: Map Mudmap Photo GIS data Field notes Other:

COPY SENT TO: Regional Office District Office Other:

Submitter of record: Mathew Gannaway **Role:** Ecologist

Signature:  **Date submitted:** 12/09/2016

Please return completed form to **Species And Communities Branch** DPaW,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.



Threatened and Priority Flora Report Form

Please complete as much of the form as possible.

For information on how to complete the form please refer to the Threatened & Priority Flora Report Form (TPRF) manual on the DPaW website at <http://www.dpaw.wa.gov.au/>

TAXON: <u>Hakea megalosperma</u>		TPFL Pop. No.: _____	
OBSERVATION DATE: <u>03/08/2016</u>		CONSERVATION STATUS: <u>T</u> New population <input checked="" type="checkbox"/>	
OBSERVER/S: <u>Mathew Gannaway</u>		PHONE: <u>(08) 6222 8058</u>	
ROLE: <u>Consultant - Ecologist</u>		ORGANISATION: <u>GHD</u>	

DESCRIPTION OF LOCATION (Provide at least nearest town/named locality, and the distance and direction to that place):

Located west of Banovich Road and north of Jurien Road, approximately 20 km north east of Jurien town site.

Reserve No.: _____

DISTRICT: Midwest **LGA:** Shire of Dandaragan Land manager present:

DATUM:		COORDINATES: (If UTM coords provided, Zone is also required)		METHOD USED:	
GDA94 / MGA94 <input checked="" type="checkbox"/>	DecDegrees <input type="checkbox"/>	DegMinSec <input type="checkbox"/>	UTMs <input checked="" type="checkbox"/>	GPS <input checked="" type="checkbox"/>	Differential GPS <input type="checkbox"/> Map <input type="checkbox"/>
AGD84 / AMG84 <input type="checkbox"/>	Lat / Northing: <u>329707</u>		No. satellites: _____ Map used: _____		
WGS84 <input type="checkbox"/>	Long / Easting: <u>6660683</u>		Boundary polygon captured: <input type="checkbox"/> Map scale: _____		
Unknown <input type="checkbox"/>	Zone: <u>50J</u>				

LAND TENURE:

Nature reserve Timber reserve Private property Rail reserve Shire road reserve
 National park State forest Pastoral lease MRWA road reserve Other Crown reserve
 Conservation park Water reserve UCL SLK/Pole _____ to _____ Specify other: _____

AREA ASSESSMENT: Edge survey Partial survey Full survey Area observed (m²): _____

EFFORT: Time spent surveying (minutes): _____ No. of minutes spent / 100 m²: _____

POP'N COUNT ACCURACY: Actual Extrapolation Estimate

Count method: (Refer to field manual for list) _____

WHAT COUNTED: Plants Clumps Clonal stems

TOTAL POP'N STRUCTURE:	Mature:	Juveniles:	Seedlings:	Totals:	Area of pop (m ²): _____ Note: Pls record count as numbers (not percentages) for database.
Alive	12	5		17	
Dead					

QUADRATS PRESENT: No. _____ Size _____ Data attached Total area of quadrats (m²): _____

Summary Quad. Totals: Alive

--	--	--	--

REPRODUCTIVE STATE: Clonal Vegetative Flowerbud Flower
 Immature fruit Fruit Dehisced fruit Percentage in flower: _____%

CONDITION OF PLANTS: Healthy Moderate Poor Senescent

COMMENT:

THREATS - type, agent and supporting information:	Current impact (N-E)	Potential Impact (L-E)	Potential Threat Onset (S-L)
E.g. clearing, too frequent fire, weed, disease. Refer to field manual for list of threats & agents. Specify agent where relevant. Rate current and potential threat impact: N=Nil, L=Low, M=Medium, H=High, E=Extreme Estimate time to potential impact: S=Short (<12mths), M=Medium (<5yrs), L=Long (5yrs+)			
J Weeds	<u>N</u>	<u>M</u>	<u>L</u>
J	_____	_____	_____
J	_____	_____	_____

Please return completed form to **Species And Communities Branch DPaW,**

Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer,** Species and Communities Branch.

Record entered by: _____ Sheet No.: _____ Record Accepted in Database



Threatened and Priority Flora Report Form

Version 1.2 August 2013

HABITAT INFORMATION: (Check more than one box for combinations or where necessary)

LANDFORM:	ROCK TYPE:	LOOSE ROCK:	SOIL TYPE:	SOIL COLOUR:	DRAINAGE:
Crest <input type="checkbox"/> Hill <input type="checkbox"/> Ridge <input checked="" type="checkbox"/> Outcrop <input type="checkbox"/> Slope <input type="checkbox"/> Flat <input type="checkbox"/> Open depression <input type="checkbox"/> Drainage line <input type="checkbox"/> Closed depression <input type="checkbox"/> Wetland <input type="checkbox"/>	Granite <input type="checkbox"/> Dolerite <input type="checkbox"/> Laterite <input checked="" type="checkbox"/> Ironstone <input type="checkbox"/> Limestone <input type="checkbox"/> Quartz <input type="checkbox"/> Specify other:	(on soil surface; e.g. gravel, quartz fields) 0-10% <input type="checkbox"/> 10-30% <input checked="" type="checkbox"/> 30-50% <input type="checkbox"/> 50-100% <input type="checkbox"/>	Sand <input checked="" type="checkbox"/> Sandy loam <input type="checkbox"/> Loam <input type="checkbox"/> Clay loam <input type="checkbox"/> Light clay <input type="checkbox"/> Peat <input type="checkbox"/> Specify other:	Red <input type="checkbox"/> Brown <input type="checkbox"/> Yellow <input type="checkbox"/> White <input type="checkbox"/> Grey <input checked="" type="checkbox"/> Black <input type="checkbox"/> Specify other:	Well drained <input checked="" type="checkbox"/> Seasonally inundated <input type="checkbox"/> Permanently inundated <input type="checkbox"/> Tidal <input type="checkbox"/> Specify other:

Specific Landform Element: (Refer to field manual for additional values)

CONDITION OF SOIL:

Dry Moist Waterlogged Inundated Cracked Saline Other:

VEGETATION CLASSIFICATION:*

E.g. 1. Banksia woodland (B. attenuata, B. ilicifolia);
 2. Open shrubland (Hibbertia sp., Acacia spp.)
 3. Isolated clumps of sedges (Mesomelaena tetragona)

1. Heathland (Conothamnus trinervis, Calothmanus sanguineus, Hibbertia hypericoides)
2. Isolated rushes (Caustis dioica, Schoenus spp.)
3. Sparse hermland (Stylidium spp., Conostylis spp., Drosera spp., Dampiera sp.)
- 4.

ASSOCIATED SPECIES:

Other (non-dominant) spp

Hakea conchifolia
 Melaleuca spp.
 Xanthorrhoea drummondii
 Lambertia multiflora

* Please record up to four of the most representative vegetation layers (with up to three dominant species in each layer). Structural Formations should follow 2009 *Australian Soil and Land Survey Field Handbook* guidelines – refer to field manual for further information and structural formation table.

CONDITION OF HABITAT: Pristine Excellent Very good Good Degraded Completely degraded

COMMENT:

FIRE HISTORY: Last Fire: Season/Month: _____ Year: _____ Fire Intensity: High Medium Low No signs of fire

FENCING: Not required Present Replace / repair Required Length req'd: _____

ROADSIDE MARKERS: Not required Present Replace / reposition Required Quantity req'd: _____

OTHER COMMENTS: (Please include recommended management actions and/or implemented actions - include date. Also include details of additional data available, and how to locate it.)

Please return completed form to **Species And Communities Branch** DPaW,
 Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.

Record entered by: _____ Sheet No.: _____ Record Accepted in Database



Threatened and Priority Flora Report Form

DRF PERMIT/ LICENCE No: SL011729

Note if only observing plants (i.e. no specimens or plant material is taken) then no permit/licence is required. For further information on permit and licencing requirements see the Threatened Flora and Wildlife Licensing pages on DPaW's website. Any actions carried out under licence/permit should be recorded above in the OTHER COMMENTS section.

SPECIMEN: Collectors No: WA Herb. Regional Herb. District Herb. Other:

ATTACHED: Map Mudmap Photo GIS data Field notes Other:

COPY SENT TO: Regional Office District Office Other:

Submitter of record: Mathew Gannaway

Role: Ecologist

Signature:



Date submitted: 12/09/2016

Please return completed form to **Species And Communities Branch** DPaW,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.

Appendix E – Fauna Data

Fauna species list

Fauna Likelihood of Occurrence assessment guidelines

Fauna Likelihood of Occurrence assessment

Fauna recorded during GHD survey – August 2016

Family	Scientific name	Common name	Status	August Survey
Birds				
Acanthizidae	<i>Acanthiza apicalis subsp whitlocki</i>	Inland Thornbill		4
Acanthizidae	<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill		8
Acanthizidae	<i>Calamanthus campestris</i>	Rufous Fieldwren		3
Acanthizidae	<i>Gerygone fusca</i>	Western Gerygone		10
Acanthizidae	<i>Smicronis brevirostris</i>	Weebill		14
Acanthizidae	<i>Sericornis frontalis</i>	White-browed Scrubwren		6
Accipitridae	<i>Aquila audax</i>	Wedge tailed Eagle		2
Accipitridae	<i>Accipiter fasciatus</i>	Brown Goshawk		1
Accipitridae	<i>Haliastur sphenurus</i>	Whistling Kite		1
Anatidae	<i>Anas gracilis</i>	Grey Teal		2
Anatidae	<i>Anas superciliosa</i>	Black Duck		2
Anatidae	<i>Chenonetta jubata</i>	Australian Wood Duck		20
Anatidae	<i>Todorna tadornoides</i>	Australian Shellduck		camera
Ardeidae	<i>Ardea pacifica</i>	White-necked Heron		1
Ardeidae	<i>Egretta novaehollandiae</i>	White-faced Heron		1
Artamidae	<i>Artamus cinereus</i>	Black-faced Woodswallow		4
Artamidae	<i>Cracticus nigrogularis</i>	Pied Butcherbird		1
Artamidae	<i>Gymnorhina tibicen</i>	Australian Magpie		1, camera
Artamidae	<i>Strepera versicolor</i>	Grey Currawong		1
Cacatuidae	<i>Cacatua pastinator</i>	Western Long-billed Corella	GIBP	many
Cacatuidae	<i>Calyptorhynchus latirostris</i>	Carnaby's Black Cockatoo	En En, GIBP	many
Cacatuidae	<i>Eolophus roseicapilla</i>	Galah		many
Campephagidae	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike		4
Campephagidae	<i>Lalage tricolor</i>	White-winged Triller		2
Casuariidae	<i>Dromaius novaehollandiae</i>	Emu		8, camera
Climacteridae	<i>Climacteris rufa</i>	Rufous Treecreeper	GIBP	1
Columbidae	<i>Ocyphaps lophotes</i>	Crested Pigeon		2
Columbidae	<i>Phaps chalcoptera</i>	Common Bronzewing		2
Corvidae	<i>Corvus coronoides</i>	Australian Raven		6, camera
Cuculidae	<i>Cacomantis flabelliformis</i>	Fan-tailed Cuckoo		10
Cuculidae	<i>Cacomantis pallidus</i>	Pallid Cuckoo		1
Cuculidae	<i>Chrysococcyx basalis</i>	Horsfield's Bronze Cuckoo		4, camera
Cuculidae	<i>Chrysococcyx lucidus</i>	Shining Bronze Cuckoo		1
Falconidae	<i>Falco berigora</i>	Brown Falcon		2
Falconidae	<i>Falco cenchroides</i>	Nankeen Kestrel		1
Falconidae	<i>Falco longipennis</i>	Australian Hobby		2
Halcyonidae	<i>Dacelo novaeguineae</i>	Laughing Kookaburra	int	6
Hirundinidae	<i>Hirundo neoxena</i>	Welcome Swallow		8
Hirundinidae	<i>Petrochelidon nigricans</i>	Tree Martin		9
Maluridae	<i>Malurus elegans</i>	Red-winged Fairywren		2
Maluridae	<i>Malurus pulcherrimus</i>	Blue-breasted Fairy-wren	GIBP	4
Maluridae	<i>Malurus splendens</i>	Splendid Fairywren		6, camera
Meliphagidae	<i>Acanthagenys rufogularis</i>	Spiny-cheeked Honeyeater		1
Meliphagidae	<i>Acanthorhynchus superciliosus</i>	Western Spinebill	GIBP	1
Meliphagidae	<i>Anthochaera carunculata</i>	Red Wattlebird		2

Meliphagidae	<i>Anthochaera lunulata</i>	Western Wattlebird		2
Meliphagidae	<i>Epthianura albifrons</i>	White-fronted Chat		8
Meliphagidae	<i>Gliciphila melanops</i>	Tawny-crowned Honeyeater		6
Meliphagidae	<i>Lichmera indistincta</i>	Brown Honeyeater		8
Meliphagidae	<i>Melithreptus brevirostris</i>	Brown-headed Honeyeater		2
Meliphagidae	<i>Phylidonyris niger</i>	White-cheeked Honeyeater		many
Monarchidae	<i>Grallina cyanoleuca</i>	Magpie Lark		1
Motacillidae	<i>Anthus australis</i>	Australasian Pipit		2
Neosittidae	<i>Daphoenositta chrysoptera</i>	Varied Sittella		4
Otididae	<i>Ardeotis australis</i>	Australian Bustard		prints
Pachycephalidae	<i>Colluricincla harmonica</i>	Grey Shrike Thrush		4
Pachycephalidae	<i>Oreocica gutturalis subsp pallescens</i>	Crested Bellbird		1
Pachycephalidae	<i>Pachycephala rufiventris</i>	Rufous Whistler		4
Pardalotidae	<i>Pardalotus striatus</i>	Striated Pardalote		many
Petroicidae	<i>Petroica boodang</i>	Scarlet Robin		4
Petroicidae	<i>Petroica goodenovii</i>	Red-capped Robin		4
Petroicidae	<i>Macroeca fascinans</i>	Jacky Winter		1
Podargidae	<i>Podargus strigoides</i>	Tawny Frogmouth		3
Psittacidae	<i>Barnardius zonarius semitorquatus</i>	Australian Ringneck		many
Psittacidae	<i>Glossopsitta porphyrocephala</i>	Purple-crowned Lorikeet		2
Rallidae	<i>Porphyrio porphyrio</i>	Purple Swamphen		1
Rhipiduridae	<i>Rhipidura albiscapa</i>	Grey Fantail		10
Rhipiduridae	<i>Rhipidura leucophrys</i>	Willy Wagtail		1
Strigidae	<i>Ninox novaeseelandiae subsp ocellata</i>	Southern Boobook		many
Threskiornithidae	<i>Threskiornis spinicollis</i>	Straw-necked Ibis		5
Timaliidae	<i>Zosterops lateralis subsp chloronotus</i>	Silvereye		4
Tytonidae	<i>Tyto javanica</i>	Barn Owl		1
Reptiles				
Carphodactylidae	<i>Underwoodisaurus milii</i>	Barking Gecko		2
Diplodactylidae	<i>Crenadactylus ocellatus ocellatus</i>	Clawless Gecko		3
Diplodactylidae	<i>Strophurus spinigerus</i>	Solt Spiny-tailed Gecko		1
Elapidae	<i>Demansia psammophis reticulata</i>	Yellow-faced Whipsnake		1
Elapidae	<i>Parasuta gouldii</i>	Gould's Snake		1
Scincidae	<i>Ctenotus fallens</i>	West Coast Ctenotus		1
Scincidae	<i>Lerista distinguenda sp nov.</i>	South-western Four-toed Slider		1
Scincidae	<i>Menetia greyii</i>	Common Dwarf Skink		1
Scincidae	<i>Morethia obscura</i>	Shrubland Snake-eyed Skink		1
Scincidae	<i>Tiliqua rugosa</i>	Bobtail		3, camera
Varanidae	<i>Varanus gouldii</i>	Goulds Monitor		1
Varanidae	<i>Varanus tristis</i>	Black-headed Monitor		camera
Amphibians				
Hylidae	<i>Litoria adelaidensis</i>	Slender Tree Frog		10
Limnodynastidae	<i>Limnodynastes dorsalis</i>	Pobblebonk		6
Limnodynastidae	<i>Helioporus eyrei</i>	Moaning Frog		3
Limnodynastidae	<i>Neobatrachus pelobatoides</i>	Humming Frog		2
Myobatrachidae	<i>Crinia pseudinsignifera</i>	False Western Froglet		many

Mammals				
Canidae	<i>Vulpes vulpes</i>	Fox	int	prints, camera
Dasyuridae	<i>Sminthopsis crassicaudata/granulipes</i>	Fat-tailed or White-tailed Dunnart (Likely)		camera
Dasyuridae	<i>Sminthopsis griseoventer</i>	Grey-bellied Dunnart (Likely)		camera
Emballonuridae	<i>Austromomus australis</i>	White-striped Freetail Bat		calls
Felidae	<i>Felis catus</i>	Cat	int	prints, camera
Canidae	<i>Canis lupis</i>	Dog	int	prints
Suidae	<i>Sus scrofa</i>	Pigs	int	digs, camera
Leporidae	<i>Oryctolagus cuniculus</i>	Rabbit	int	many
Macropodidae	<i>Macropus fuliginosus</i>	Western Grey Kangaroo		many
Macropodidae	<i>Macropus irma</i>	Western Brush Wallaby	P4	camera
Muridae	<i>Mus musculus</i>	House Mouse	int	camera
Muridae	<i>Pseudomys albocinereus</i>	Ash Grey Mouse (Likely)		camera
Muridae	<i>Rattus fuscipes</i>	Western Bush Rat (Likely)		camera
Tachyglossidae	<i>Tachyglossus aculeatus</i>	Echidna		1, digs, camera
Vespertilionidae	<i>Chalinolobus gouldii</i>	Gould's Wattled Bat		calls
Vespertilionidae	<i>Chalinolobus morio</i>	Chocolate Wattled Bat		calls
Vespertilionidae	<i>Vespadelus regulus</i>	Southern Forest Bat		calls
Vespertilionidae	<i>Nyctophilus sp.</i>	Long-eared Bats		calls

Legend:

many or number = recorded during current survey or numbers recorded (observed or heard)

Shed skin, scats, tracks, prints or digs = Evidence of observation

calls = bat detector (anabat or SM2) record

GIBP = Global Important Bird Population species

Camera= Recorded via remote camera

intro= introduced species

Conservation codes – Appendix B

Parameters of fauna Likelihood of Occurrence assessment

Assessment outcome	Description
Present	Species recorded during the field survey or from recent, reliable records from within the survey area.
Likely	Species are likely to occur in the survey area where there is suitable habitat within the survey area and there are recent records of occurrence of the species in close proximity to the survey area OR Species known distribution overlaps with the survey area and there is suitable habitat within the survey area.
Unlikely	Species assessed as unlikely include: those species previously recorded within the study area however: <ul style="list-style-type: none"> • There is limited (i.e. the type, quality and quantity of the habitat is generally poor or restricted) habitat in the survey area. The suitable habitat within the survey area is isolated from other areas of suitable habitat and the species has no capacity to migrate into the survey area. OR • Those species that have a known distribution overlapping with the survey area however: there is limited (i.e. the type, quality and quantity of the habitat is generally poor or restricted) habitat in the survey area the suitable habitat within the survey area is isolated from other areas of suitable habitat and the species has no capacity to migrate into the survey area.
Highly unlikely	Species that are considered highly unlikely to occur in the survey area include those species: <ul style="list-style-type: none"> • That have no suitable habitat within the survey area • That have become locally extinct, or are not known to have ever been present in the region of the survey area.

Status (see Appendix B for full explanation)

EPBC Act – Species listed as one or more of the following MM = migratory marine species, MW = migratory wetland species, MiT = migratory terrestrial species, Vu = Vulnerable, En = Endangered

WC Act - Species listed as CR = critically endangered, En = endangered, Vu = Vulnerable, CD = conservation dependent, IA = international migratory agreement migratory birds, OS = other specially protected fauna

DPaW – Species listed as Priority (P) 1, 2, 3 or 4

Source information - desktop searches

PMST = DotEE PMST to identify fauna listed under the EPBC Act potentially occurring within the study area accessed July 2016

NM = DPaW NatureMap (2007-2016) records of threatened fauna, database search within the study area (accessed July 2016),

DPaW = WA Government, Department of Parks and Wildlife Threatened and Priority fauna rankings (current as of 20 November 2015) - *Wildlife Conservation Act 1950* for the DPaW Swan region <http://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/threatened-animals>

Definitions

study area = a 20 km buffer around the survey area

locality = the area within an approximate 50 km radius of the survey area

Fauna Likelihood of Occurrence assessment

Common name (species name)	Status (WC Act/DPAW, EPBC Act)		Search			Description & habitat requirements	Habitat with survey areas / Records (NatureMap)	Likelihood of Occurrence
	WC Act	EPBC Act	NM	EPBC PMST	DPaW			
Birds								
Carnaby's Black Cockatoo (<i>Calyptorhynchus latirostris</i>)	EN	EN	X	X		Carnaby's Black Cockatoo mainly occurs in uncleared or remnant native eucalypt woodlands and in shrubland or kwongan heathland dominated by Hakea, Banksia and Grevillea species. The species also occurs in forests containing Marri (<i>Corymbia calophylla</i>), Jarrah (<i>Eucalyptus marginata</i>) or Karri (<i>E. diversicolor</i>). Breeding usually occurs in the Wheatbelt region of WA in large Wandoo (<i>E. wandoo</i>), with flocks moving to the higher rainfall coastal areas to forage after the breeding season. Feeds on the seeds of a variety of native plants, including <i>Allocasuarina</i> , <i>Banksia</i> , <i>Eucalyptus</i> , <i>Grevillea</i> and <i>Hakea</i> , and some introduced plants (DSEWPac 2012).	Both feeding and Breeding habitat is present for this species with both events recorded. Numerous birds were also recorded moving throughout the survey area and roosting recorded.	Present, feeding breeding and roosting was recorded.

Common name (species name)	Status (WC Act/DPAW, EPBC Act)		Search			Description & habitat requirements	Habitat with survey areas / Records (NatureMap)	Likelihood of Occurrence
	WC Act	EPBC Act	NM	EPBC PMST	DPaW			
Western Ground Parrot (<i>Pezoporus flaviventris</i>)	CR	CR	X			There is only one population remaining of the western sub-species of the Ground Parrot, in coastal heath east of Esperance in southeast of Western Australia. There are only two remaining areas of refuge, Cape Arid and Fitzgerald River National Parks, with about 110 individuals still thought to live in the wild. Historically the species also inhabited the mid west coastal heath around Congara and Jurien Bay, however has not been recorded in these areas for some time. The Western Ground Parrot inhabits low, dry or swampy, near-coastal heathlands on sandplains and uplands in areas that receive 400-500 mm of rainfall annually (Gilfillan et al 2007, McNee 1999, 2000). The vegetation in such heathlands consists of moderately dense, low shrubs (usually not more than 0.5-1.0 m tall) and often with an open understorey of low sedges, including Mesomelaena species, that are usually less than 0.5 m tall. The vegetation usually includes scattered clumps of emergent, stunted (DEWHA 2010) low-mallee and sometimes taller shrubs, or occasionally with some scattered tussock-grasses (Gilfillan et al 2007, McNee 1999). The Western Ground Parrot is usually recorded in areas of vegetation that have remained unburnt for five or more years.	Low heathland is present for this species to forage and breed. Numerous records are present in the Mid west from Bow River, Moora Mullewa and Carnamah with the most recent record from 2015. It should be noted that most of these records have a low certainty rating however the most recent (2015) is highly certain.	Likely, this species could not be assessed as unlikely due to the amount of habitat available in the area and lack of survey effort. This species requires additional survey effort to confirm.

Common name (species name)	Status (WC Act/DPAW, EPBC Act)		Search			Description & habitat requirements	Habitat with survey areas / Records (NatureMap)	Likelihood of Occurrence
	WC Act	EPBC Act	NM	EPBC PMST	DPaW			
Malleefowl (<i>Leipoa ocellata</i>)	VU	VU	X	X		The Malleefowl generally occurs in semi-arid areas of Western Australia, from Carnarvon to south east of the Eyre Bird Observatory (south-east WA). It occupies shrublands and low woodlands that are dominated by mallee vegetation, as well as native pine <i>Callitris</i> woodlands, Acacia shrublands, Broombush (<i>Melaleuca uncinata</i>) vegetation or coastal heathlands. The nest is a large mound of sand or soil and organic matter (Jones and Goth 2008; Morcombe 2004).	Some habitat is present for the species in the Wandoo and Marri Woodlands, however there are no records in the Mount Lesueur region and either occur in the coastal Acacia shrublands or further inland in the Mallee. This is probably due to the extremely dense nature of the heaths in this region.	Unlikely
Peregrine Falcon, (<i>Falco peregrinus</i>)	OS	-	X			The Peregrine Falcon is seen occasionally anywhere in the south-west of WA. It is found everywhere from woodlands to open grasslands and coastal cliffs - though less frequently in desert regions. The species is known to have a very large home range and nests primarily on ledges of cliffs, shallow tree hollows, and ledges of building in cities (Morcombe 2004).	Habitat is present for this species throughout the survey area for both hunting (all of the survey area) and some breeding (Wandoo and Marri). Records are present for this species surrounding the survey are with the closest only approximately 10 km east.	Likely

Common name (species name)	Status (WC Act/DPAW, EPBC Act)		Search			Description & habitat requirements	Habitat with survey areas / Records (NatureMap)	Likelihood of Occurrence
	WC Act	EPBC Act	NM	EPBC PMST	DPaW			
Sharp-tailed Sandpiper (<i>Calidris acuminata</i>)	IA	IA	X			In WA, scattered records occur along the Nullarbor Plain and the southern areas of the Great Victoria Desert. They are widespread from Cape Arid to Carnarvon, around coastal and subcoastal plains of Pilbara Region to south-west and east Kimberley Division. Inland records indicate the species is widespread and scattered from Newman, east to Lake Cohen, south to Boulder and west to Meekatharra (Higgins & Davies 1996). The Sharp-tailed Sandpiper prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation including lagoons, swamps, lakes and pools near the coast, and dams, waterholes, soaks, bore drains and bore swamps, salt pans and hypersaline salt lakes inland. They use flooded paddocks, sedgeland and other ephemeral wetlands, but leave when they dry. They tend to occupy coastal mudflats mainly after ephemeral. Sometimes they occur on rocky shores and rarely on exposed reefs (Higgins & Davies 1996). They have also been recorded roosting in mangroves (Minton & Whitelaw 2000).	No wetlands or areas suitable for this species to utilise are present within the survey area. Minor drainage lines are present on site but would unlikely be a resource for this species. Records in the region are mostly coastal or associated with larger inland wetlands and water courses.	Unlikely
Grey Plover (<i>Pluvialis squatarola</i>)	IA	IA	X			In non-breeding grounds in Australia, Grey Plovers occur almost entirely in coastal areas, where they usually inhabit sheltered embayments, estuaries and lagoons with mudflats and sandflats, and occasionally on rocky coasts with wave-cut platforms or reef-flats, or on reefs within muddy lagoons. They also occur around terrestrial wetlands such as near-coastal lakes and swamps, or salt-lakes. The species is also very occasionally recorded further inland, where they occur around wetlands or salt-lakes (Marchant & Higgins 1993).	No wetlands or areas suitable for this species to utilise are present within the survey area. Minor drainage lines are present on site but would unlikely be a resource for this species. Records in the region are mostly coastal on beaches.	Unlikely

Common name (species name)	Status (WC Act/DPAW, EPBC Act)		Search			Description & habitat requirements	Habitat with survey areas / Records (NatureMap)	Likelihood of Occurrence
	WC Act	EPBC Act	NM	EPBC PMST	DPaW			
Grey Wagtail (<i>Motacilla cinerea</i>)	IA	IA		X		A migratory species that regularly visits northern Australia particularly the area from Broome to Darwin (Morcombe 2004). The species prefers coastal habitat near to water where it prefers to forage. However the species has been recorded further inland feeding on plains (Morcombe 2004).	The cleared areas of the survey area maybe utilised by the species however very few records of the species are present outside of the Kimberley and northern regions and would rarely visit the area.	Unlikely
Common Greenshank (<i>Tringa nebularia</i>)	IA	IA		X		The Common Greenshank does not breed in Australia; however, the species occurs in all types of wetland and has the widest distribution of any shorebird in Australia (DSEWPaC 2013).	No wetlands or areas suitable for this species to utilise are present within the survey area. Minor drainage lines are present on site but would unlikely be a resource for this species. Records in the region are mostly coastal on beaches or on inland wetlands and water bodies. The three dams in the survey area maybe used opportunistically.	Unlikely

Common name (species name)	Status (WC Act/DPAW, EPBC Act)		Search			Description & habitat requirements	Habitat with survey areas / Records (NatureMap)	Likelihood of Occurrence
	WC Act	EPBC Act	NM	EPBC PMST	DPaW			
Wood Sandpiper (<i>Tringa glareola</i>)	IA	IA	X			The Wood Sandpiper is a seasonal visitor to Australia and has its largest numbers recorded in north-west Australia (Roebuck Bay near to Broome). Off the Tringa group (like the Common Greenshank) the Wood Sandpiper utilises a broad range of habitat types throughout Western Australia. Typical habitat includes well-vegetated, shallow, freshwater wetlands, such as swamps, billabongs, lakes, pools and waterholes. This species does not breed in Australia (DSEWPaC 2013).	No wetlands or areas suitable for this species to utilise are present within the survey area. Minor drainage lines are present on site but would unlikely be a resource for this species. Records in the region are mostly coastal on beaches or on inland wetlands and water bodies. The three dams in the survey area maybe used opportunistically.	Unlikely
Sanderling (<i>Calidris alba</i>)	IA	IA	X			The Sanderling is a seasonal visitor the Australia. In Western Australia, the Sanderling occurs on most of the coast from Eyre to Derby, and also around Wyndham. They are more often recorded on the south and southwest coasts, north to around southern Shark Bay, with more sparsely scattered records further. The species is recorded mostly on open sandy beaches exposed to open sea-swell, and also on exposed sandbars and spits, and shingle banks, where they forage in the wave-wash zone and amongst rotting seaweed (DSEWPaC 2013).	No wetlands or areas suitable for this species to utilise are present within the survey area. Minor drainage lines are present on site but would unlikely be a resource for this species. Records in the region are mostly coastal on beaches.	Unlikely
Reptiles								

Common name (species name)	Status (WC Act/DPAW, EPBC Act)		Search			Description & habitat requirements	Habitat with survey areas / Records (NatureMap)	Likelihood of Occurrence
	WC Act	EPBC Act	NM	EPBC PMST	DPaW			
Gilled Slender Blue-tongue Skink, (<i>Cyclodomorphus branchialis</i>)	VU	-	X			The Gilled Slender Blue-tongue Skink is endemic to the Midwest of Western Australia. It occupies an area between Murchison River and Irwin River in the coastal region, and extends inland to Yalgoo. This taxon inhabits semi-arid scrubs on heavy soil (Storr <i>et. al.</i> 1999). Little is known about the habitat preferences of this taxon (Shea and Miller 1995), but specimens have been known to burrow under gravelly soils and leaf litter during daylight hours.	Some habitat is present for this species in heathlands on lateritic soils however one dubious record is known from the region. The population is typically known from the region between Irwin and Murchison Rivers.	Unlikely
Western Spiny-tailed Skink (<i>Egernia stokesii</i> subsp. <i>badia</i>)	VU	EN	X	X		Most of the Western Spiny-tailed Skink brown form sites occur in York Gum (<i>Eucalyptus loxophleba</i>) woodland with some sites are in Gimlet (<i>E. salubris</i>) and Salmon Gum (<i>E. salmonophloia</i>) woodland. Populations persist in woodland patches as small as 1 ha and completely surrounded by wheat fields. Sites with the greatest number of individuals had numerous fallen logs and a low intensity of grazing by domestic stock. Hollow logs are required for refuge sites in woodland habitat. Preferred refuges consist of piles of several overlapping hollow logs providing a combination of basking and shelter sites. Populations on farms in the Perenjori shire occupy abandoned farmhouses, sheds and woodpiles.	Some habitat is present for the species in the Wandoo and Marri Woodlands, however there are no records in the Mount Lesueur region. All the records in <i>NatureMap</i> are present further inland in open woodlands.	Unlikely

Common name (species name)	Status (WC Act/DPAW, EPBC Act)		Search			Description & habitat requirements	Habitat with survey areas / Records (NatureMap)	Likelihood of Occurrence
	WC Act	EPBC Act	NM	EPBC PMST	DPaW			
Woma Python (<i>Aspidites ramsayi</i> SW pop.)	P1				X	The Woma inhabits woodlands, heaths and shrublands, often with spinifex. It occurs in the sub-humid and arid areas across Australia's interior with a separate sub-population occurring in the Wheatbelt and Goldfields of Western Australia. The Woma shelters mainly in abandoned monitor and mammal burrows and in soil cracks (Wilson and Swan 2010).	Some habitat is present for this species in heathlands on sandy soils and records are present in the region with one approximately 40 km south east. The species is highly cryptic and rarely observed and the survey area is within the known distribution of the south western population.	Likely
Black-striped Snake (<i>Neelaps calonotos</i>)	P3				X	This Black-striped Snake is restricted to the sandy coastal strip near Perth, between Mandurah and Lancelin. It occurs on dunes and sand-plains vegetated with heaths and eucalypt/banksia woodlands. This species is seriously threatened by increasing development within its restricted distribution (Wilson and Swan 2013).	Some habitat is present for this species in heathlands on sandy soils and records are present in the region with two records approximately 20 km north and 23 km east of the survey area. The species is highly cryptic and rarely observed and the survey area is within the known range of the species.	Likely
Mammals								

Common name (species name)	Status (WC Act/DPAW, EPBC Act)		Search			Description & habitat requirements	Habitat with survey areas / Records (NatureMap)	Likelihood of Occurrence
	WC Act	EPBC Act	NM	EPBC PMST	DPaW			
Dibbler (<i>Parantechinus apicalis</i>)	En	En			X	Historically Dibblers have been recorded over an extensive area from Jurien Bay to Cape Arid National Park and numerous islands of the coast (two populations are present on Boullanger and Whitlock Islands of the coast of Jurien) and it is likely that they can occupy a diverse range of habitats (Friend 2004). However, the species seem to prefer vegetation with a dense canopy greater than 1 m high which has been unburnt for at least 10 years or more (Baczocha & Start 1997). Typically, captures have been on sandy substrates although occasional records are on laterite soils.	Some habitat is present for this species in dense heathlands on sandy and lateritic soils, however few records are available on the mainland (two populations are present on Boullanger and Whitlock Islands of the coast of Jurien) for this species with one record approximately 120 km south east of the survey area in 1999.	Unlikely
Chuditch, Western Quoll (<i>Dasyurus geoffroii</i>)	Vu	V		X		The Chuditch inhabits eucalypt forest (especially Jarrah, <i>Eucalyptus marginata</i>), dry woodland and mallee shrublands. In Jarrah forest, Chuditch populations occur in both moist, densely vegetated, steeply sloping forest and drier, open, gently sloping forest. Most diurnal resting sites in sclerophyll forest consist of hollow logs or earth burrows (Van Dyke and Strahan 2008). The species can travel large distances, has a large home range and is sparsely populated through a large portion of its range.	Habitat is present for this species throughout the survey area with the woodlands providing refugia for denning and breeding and heathlands and shrubland for foraging. Numerous records for the species are present to the south of the survey area with the closest being 75 and 81 km away.	Likely, this species could not be assessed as unlikely due to the amount of habitat available in the area and lack of survey effort. This species requires additional survey effort to confirm.

Common name (species name)	Status (WC Act/DPAW, EPBC Act)		Search			Description & habitat requirements	Habitat with survey areas / Records (NatureMap)	Likelihood of Occurrence
	WC Act	EPBC Act	NM	EPBC PMST	DPaW			
South-western Brush-tailed Phascogale (<i>Phascogale tapoatafa</i>)	Vu				X	Dry sclerophyll forests and open woodlands with a generally sparse ground-storey, which contain suitable nesting resources such as tree hollows, rotted stumps and tree cavities (Van Dyck and Strahan 2008).	Habitat is present for this species throughout the survey area with the woodlands providing refugia for denning and breeding and heathlands and shrubland for foraging, however no records for the species are documented north of Perth.	Unlikely
Ghost Bat, (<i>Macroderma gigas</i>)	Vu	Vu	X			The Ghost Bat occurs in a wide range of habitats, and requires an undisturbed cave, deep fissure or disused mine shaft in which to roost. It is patchily distributed across Australia, and is sensitive to disturbance, with populations now contracting north and present only in the Pilbara and Kimberley (Van Dyck and Strahan 2008).	Habitat is present for the species in the woodlands particularly those trees with large hollows however the species has not been recorded in the region for over 200 years.	Highly Unlikely

Common name (species name)	Status (WC Act/DPAW, EPBC Act)		Search			Description & habitat requirements	Habitat with survey areas / Records (NatureMap)	Likelihood of Occurrence
	WC Act	EPBC Act	NM	EPBC PMST	DPaW			
Southern Brown Bandicoot, (<i>Isoodon obesulus</i>)	P5	-	X			The Quenda prefers dense scrubby, often swampy, vegetation with dense cover up to one metre high. However, it also occurs in woodlands, and may use less ideal habitat where this habitat occurs adjacent to the thicker, more desirable vegetation. The species often feeds in adjacent forest and woodland that is burnt on a regular basis and in areas of pasture and cropland lying close to dense cover (Van Dyck and Strahan 2008).	Some habitat is present for this species in dense heathlands on sandy and lateritic soils, however few records are present for this species in the region, with the survey area being at the most north limit of their distribution. One record is approximately 20 km south west of the survey area.	Likely, this species could not be assessed as unlikely due to the amount of habitat available in the area and lack of survey effort. This species requires additional survey effort to confirm.
Tammar Wallaby (<i>Macropus eugenii derbianus</i>)	P4				X	The Tammar Wallaby inhabits dense, low vegetation for daytime shelter and open grassy areas for feeding. Inhabits coastal scrub, heath, dry sclerophyll (leafy) forest and thickets in mallee and woodland The tammar wallaby is currently known to inhabit three islands in the Houtman Abrolhos group, Garden Island near Perth, Middle and North Twin Peak Islands in the Archipelago of the Recherche, and at least nine sites on the mainland including, Dryandra, Boyagin, Tutanning Batalling (reintroduced) Perup, private property near Pingelly, Jaloran Road timber reserve near Wagin, Hopetown, Stirling Range National Park, and Fitzgerald River National Park (Van Dyck and Strahan 2008).	Habitat is present for this species in the dense heathlands and shrublands however the species is not known to occur in the region, except on some islands within the Abrolhos of Geraldton.	Unlikely

Common name (species name)	Status (WC Act/DPAW, EPBC Act)		Search			Description & habitat requirements	Habitat with survey areas / Records (NatureMap)	Likelihood of Occurrence
	WC Act	EPBC Act	NM	EPBC PMST	DPaW			
Western Brush Wallaby (<i>Macropus Irma</i>)	P4	-	X			The Western Brush Wallaby is a grazer found primarily in open forest or woodland, particularly favouring open, seasonally wet flats with low grasses and open scrubby thickets. It is also found in some areas of mallee and heathland, and is uncommon in karri forest. This species was once very common in the south-west of WA but has undergone a reduction in range and a significant decline in abundance in its current habitat. (Van Dyke and Strahan 2008).	Habitat is present for this species in the dense heathlands and shrublands and woodlands. The species is known to occur in the region, with multiple records surrounding the survey area. A sighting of a wallaby was undertaken during the survey and the species was verified via remote camera	Present

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Ultrasonic detection surveys

Ultrasonic files containing potential bat calls were recorded during the field surveys using Anabat Express detectors (Titley Scientific) and SM2BAT+ SongMeter recorders (Wildlife Acoustics Inc. USA). Bat calls were recorded between sunset and sunrise across consecutive nights at each site.

Call analysis

Craig Grabham from GHD completed the analysis of all data collected during the survey using ultrasonic bat detectors.

Data from SM2 units was downloaded and viewed using Kaleidoscope Viewer (version 3.1.6, Wildlife Acoustics Inc. 2016) as full-spectrum audio files. WAC files were also converted to Anabat sequence files (zero-crossing format) suitable for analysis in AnalookW version 4.1s (Corben 2015).

WAC files were viewed and bat calls were identified using Kaleidoscope Viewer by visually comparing the Kaleidoscope Viewer spectrogram and call characteristics (e.g. characteristic frequency and call shape) with reference calls and/or species call descriptions from available reference material. The spectrogram displayed each call sequence (see below for call definition) with information on the number and timing of calls.

Anabat sequence files were viewed and bat calls were identified using AnalookW by visually comparing the Analook time-frequency graph and call characteristics (e.g. characteristic frequency and call shape) with reference calls and/or species call descriptions from available reference material.

The call identification was also assisted by consulting distribution information for possible species (ALA and DPAW NatureMap records). No reference calls were collected during the survey.

A call (pass) was defined as a sequence of three or more consecutive pulses of similar frequency and shape. Calls with less than three defined consecutive pulses of similar frequency and shape were not unambiguously identified to a species but were used as part of the activity count for the survey area.

Due to variability in the quality of calls, the lack of published information regarding non-search phase calls and the difficulty in distinguishing some species the identification of each call was assigned a confidence rating (see Mills *et al.* 1996 & Duffy *et al.* 2000) as summarised in the table below. Due to the absence of reference calls from the study area and the poor quality of some the recordings and known overlap in call characteristics between some species, a conservative approach was taken when analysing calls.

Species nomenclature follows Armstrong (2011), then van Dyck *et al.* (2013).

Confidence ratings applied to calls

Identification	Description
D - Definite	Species identification not in doubt. Call sequence contains three or more consecutive pulses of similar frequency and shape. Call characteristics match those in referenced material or species reference calls.
PR - Probable	Call most likely to represent a particular species, but there exists a low probability of confusion with species of similar call type or call lacks sufficient detail (e.g. number of pulses).
SG - Species Group	X = Call made by one of two or more species. Call characteristics overlap making it too difficult to distinguish between species

Summary of results and survey effort

Microchiropteran bat detector surveys were completed for 26 nights at three locations during August 2016 within the survey area.

Five species were positively (Definite) identified of the 12 species that are known to occur from this part of the region (Armstrong 2011; NatureMap 2016). As many as three other species may also have been recorded using bat detectors, but poor data quality and/or interspecific call similarities precluded reliable identification of additional species.

The tables below provide site location details and a summary of the results for each site for each night.

Summary of bat call analysis May 2016

Species / Group	Anabat Express	SM2 unit 1	SM2 unit 2
<i>Austronomus australis</i>	D	-	D
<i>Chalinolobus gouldii</i>	D	D	D
<i>Chalinolobus morio</i>	D	D	D
<i>Vespadelus regulus</i>	D	D	D
<i>Nyctophilus sp.</i>	D	D	D
<i>Ozimops kitcheneri</i>	-	PR	D

Notes:

Total number of species recorded for each night/site is based on definite (D) identification only. Total number of D species for each night includes one *Nyctophilus* species where recorded.

See Table 1 for confidence rating e.g. D or Pr, - = not recorded. X = species group present.

CE, E, VU – species listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, P1- 4 (priority species) species under the *Wildlife Conservation Act 1950*

Qualifications

Craig Grabham has completed microchiropteran bat surveys and assessments in WA, New South Wales (NSW), Queensland (QLD), Victoria, Tasmania and the Northern Territory (NT) employing a variety of methods including harp trapping, light tagging, habitat surveys (e.g. cave assessments), roost surveillance (using infrared and thermal video cameras), and echolocation survey (Wildlife Acoustic's SongMeter and Eco Meter devices and Titley Electronic Anabat devices) and analysis (Wildlife Acoustic's SongScope and Chris Corben's Analook). He has completed bat surveys for infrastructure, residential, and mining projects. Craig has also completed bat inventory surveys for National Parks, Nature Reserves, catchment management areas and private land conservation projects. His honours project investigated the use of remnant and revegetated habitats by microchiropteran bats across a fragmented rural landscape in the Eastern Billabong Catchment (south-west slopes) in NSW.

Craig has completed the following training courses with regard to ultrasonic call recording and analysis:

- Anabat system training course – Titley Scientific (December 2012)
- Wildlife Acoustic's Song Meter and SongScope training – Faunatech/Austbat (July 2015).

To date Craig has completed echolocation analysis and reporting for more than 102 projects from WA, NSW, NT, QLD and Victoria since joining GHD in 2006 from calls collected during field surveys from Anabat detectors and/or Song Meter units and identified using Analoop or SongScope software.

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Appendix F – Offsets Calculator

Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*
2 October 2012

This guide relies on Macros being enabled in your browser.

Matter of National Environmental Significance	
Name	Carnaby's Cockatoo
EPBC Act status	Endangered
Annual probability of extinction Based on IUCN category definitions	1.2%

Key to Cell Colours
User input required
Drop-down list
Calculated output
Not applicable to attribute

Impact calculator							
Impact calculator	Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact	Units	Information source	
	<i>Ecological communities</i>						
	Area of community	No		Area			
				Quality			
				Total quantum of impact	0.00		
	<i>Threatened species habitat</i>						
	Area of habitat	Yes		Area	88.7	Hectares	
				Quality	8	Scale 0-10	
				Total quantum of impact	70.96	Adjusted hectares	
	<i>Threatened species</i>						
Number of features e.g. Nest hollows, habitat trees	No						
Condition of habitat Change in habitat condition, but no change in extent	No						
Birth rate e.g. Change in nest success	No						
Mortality rate e.g. Change in number of road kills per year	No						
Number of individuals e.g. Individual plants/animals	No						

Offset calculator																			
Offset calculator	Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)	Start area and quality	Future area and quality without offset	Future area and quality with offset	Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost (\$ total)	Information source		
	<i>Ecological Communities</i>																		
	Area of community	No					Risk-related time horizon (max. 20 years)	Start area (hectares)	Risk of loss (%) without offset		Risk of loss (%) with offset								
							Future area without offset (adjusted hectares)	0.0	Future area with offset (adjusted hectares)	0.0									
							Time until ecological benefit		Start quality (scale of 0-10)		Future quality without offset (scale of 0-10)		Future quality with offset (scale of 0-10)						
	<i>Threatened species habitat</i>																		
	Area of habitat	Yes	70.96	Adjusted hectares	Lot 1, 1395 Banovich Road, Hill River (1993 ha)	Time over which loss is averted (max. 20 years)	20	Start area (hectares)	564	Risk of loss (%) without offset	15%	Risk of loss (%) with offset	2%						
							Future area without offset (adjusted hectares)	479.4	Future area with offset (adjusted hectares)	552.7	73.32	80%	58.66	46.21	75.63	106.57%	Yes		
							Time until ecological benefit	10	Start quality (scale of 0-10)	9	Future quality without offset (scale of 0-10)	8	Future quality with offset (scale of 0-10)	9	1.00	80%	0.80	0.71	
	<i>Threatened species</i>																		
Number of features e.g. Nest hollows, habitat trees	No																		
Condition of habitat Change in habitat condition, but no change in extent	No																		
Birth rate e.g. Change in nest success	No																		
Mortality rate e.g. Change in number of road kills per year	No																		
Number of individuals e.g. Individual plants/animals	No																		

Summary								
Summary	Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost (\$)		
						Direct offset (\$)	Other compensatory measures (\$)	Total (\$)
	Birth rate	0				\$0.00		\$0.00
	Mortality rate	0				\$0.00		\$0.00
	Number of individuals	0				\$0.00		\$0.00
	Number of features	0				\$0.00		\$0.00
	Condition of habitat	0				\$0.00		\$0.00
	Area of habitat	70.96	75.63	106.57%	Yes	\$0.00	N/A	\$0.00
Area of community	0				\$0.00		\$0.00	
					\$0.00	\$0.00	\$0.00	

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		Name	Signature	Name	Signature	Date
0	M Gannaway G Gaikhorst	J Foster C Grabham		D Farrar		12/09/2016

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Appendix B. Carnaby's Black Cockatoo Investigations

Memo

To: Carmelo Gumina, Lisa Boulden

From: Karen Crews

Date: 7 June 2017

Subject: Great Northern Highway Muchea to Wubin Upgrade Stage 2: Carnaby's Black Cockatoo investigations Muchea North and Ippolo Road



Dear Carmelo,

This memo presents the outcomes of the following site inspections conducted for the Muchea North work package:

- identification suitable habitat trees for the erection of artificial nest boxes for Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) Muchea North and Ippolo Road offset site (lot M2091 Ippolo Road)
- searches for evidence of foraging by Carnaby's Black Cockatoo at Lot M2091 Ippolo Rd to determine usage at the site.

BACKGROUND

Muchea North is part of the Great Northern Highway (GNH) Muchea to Wubin Upgrade Stage 2 Project (the Project) and entails proposed upgrade works to the GNH between Old Gingin Road and Chittering Roadhouse, approximately 63 km north of Perth. The Department of Environment and Energy (DoEE) has deemed Muchea North a controlled action under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (EPBC ref: 2016/7656), with a contributing factor being proposed impacts to Carnaby's Black Cockatoo habitat. The species is listed as a matter of national environmental significance (NES) under the EPBC Act, with the conservation status of Endangered. It is also listed as Endangered under the *WA Wildlife Conservation Act 1950*.

Detailed black cockatoo habitat assessments conducted for Muchea North within the Muchea North EPBC Act Approval Boundary are documented in Phoenix (2015¹) and Phoenix (2017²).

Main Roads WA has committed to installing artificial nesting boxes for Carnaby's Black Cockatoo as part of the environmental offset for Muchea North. The Arup Jacobs JV (ASJV) requested Phoenix Environmental Sciences to provide advice in relation to where to place the new artificial nesting boxes. Up to 50 trees were required to be selected to allow for potential access or permission constraints to certain areas. Jacobs requested trees within the road reserve to be considered as a priority for selection followed by Lot M2091 Ippolo Rd.

The searches for evidence of foraging by Carnaby's Black Cockatoo at Lot M2091 Ippolo Rd were required to enable a comparison of the foraging value of the offset area to that of the Muchea North impact area.

¹ Phoenix. 2015. Flora and fauna assessment for Muchea North and Chittering study area. Phoenix Environmental Sciences Pty Ltd, Balcatta, WA. Unpublished report prepared for Muchea to Wubin Integrated Project Team (Main Roads WA, Jacobs and Arup).

² Phoenix. 2017. *Flora and fauna assessment for Muchea North and Chittering study area – Report Addendum*. Phoenix Environmental Sciences Pty Ltd, Balcatta, WA. Unpublished report prepared for Muchea to Wubin Integrated Project Team (Main Roads WA, Jacobs and Arup).

Memo

Subject: Great Northern Highway Muchea to Wubin Upgrade Stage 2: Additional black cockatoo assessment for Muchea North

SCOPE

The scope of work was as follows:

1. Identify criteria for selection of suitable trees for artificial nest box erection.
2. Undertake a site visit to Muchea North and Lot M2091 Ippolo Rd to identify, record the location of and photograph, up to 50 suitable trees
3. Conduct searches for evidence foraging by Carnaby's Black Cockatoo at Lot M2091 Ippolo Rd.
4. Prepare a brief memo report summarising the results.

NEST BOX TREE SELECTION

Criteria for selection of trees

The following criteria were identified as relevant to the selection of suitable trees for the Muchea North project:

- Potential nest box trees should be located in the road reserve if possible, in accordance with Jacob's requirements, but outside the Muchea North disturbance footprint.
- Potential nest box trees should ideally be located in close proximity to the hollows that are being impacted – these were assumed to be the impact hollows that have been recorded with evidence of use (HT06261 HT06278, HT08752, HT08753, HT08754, HT14749).
- Lot M2091 Ippolo Rd was considered less suitable due to distance from the impact hollows; however, may need to be included as part of the mix of sites due to large number of nest boxes to be installed.
- Potential nest box trees should be mature and well shaded.
- Potential nest box trees should be accessible with a cherry picker to allow installation of the nest boxes.

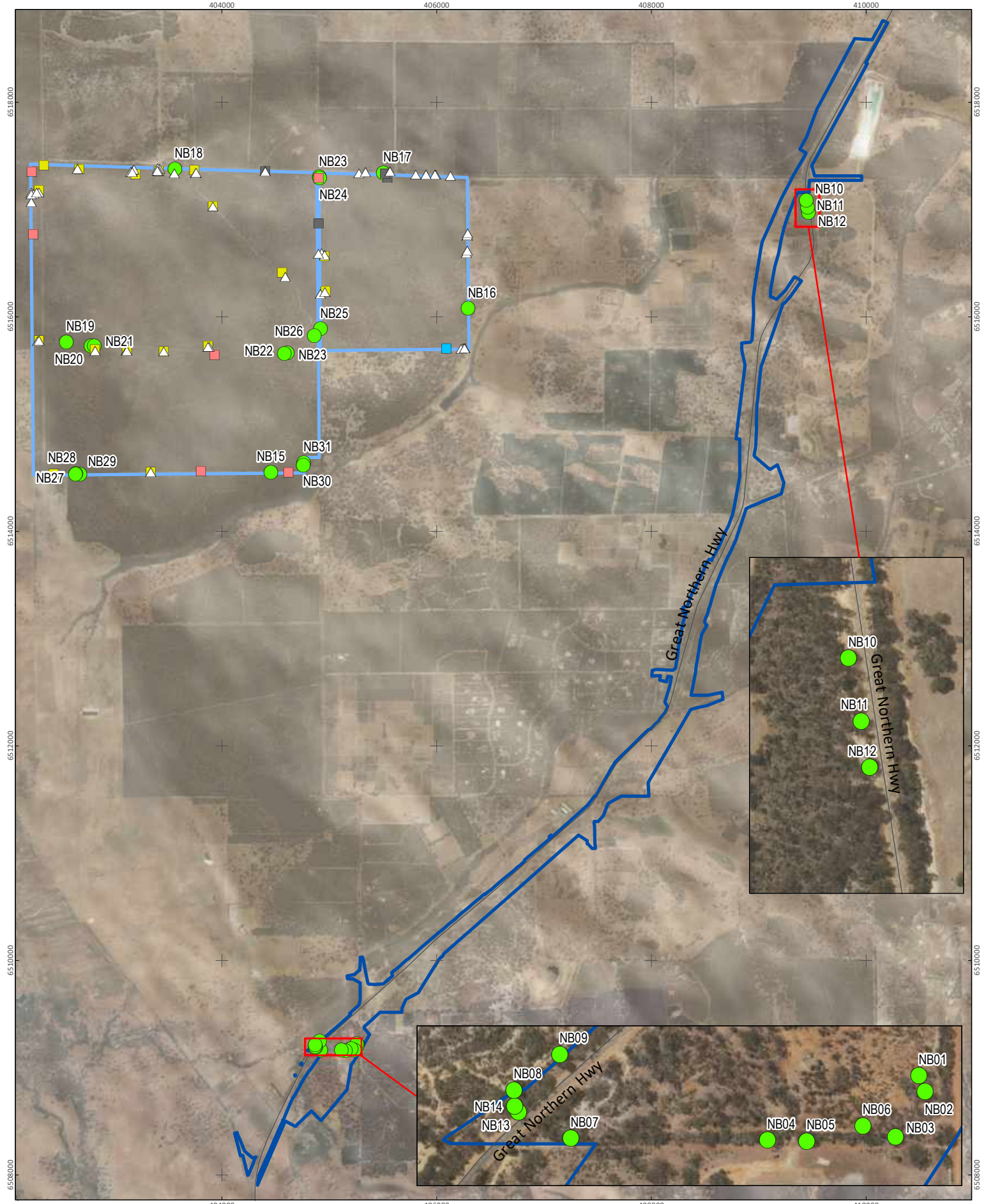
Site assessment

Site visits were undertaken to Muchea North on 9-10 May 2017, and to Ippolo Road on 24 May, by Tony Kirkby and Karen Crews. At Muchea North, trees were inspected in the vicinity of each impact hollow and potential nest box trees selected in accordance with the above criteria, as far as possible. At Ippolo Road, suitable trees were selected along existing access tracks only.

Four of the impact hollows (HT06261, HT06278, HT08752, HT14749) are located in the Main Roads gravel reserve site. The remaining two impact hollows (HT08753, HT08754) are north of this location and isolated from each other.

Thirty potential nest box trees have been recorded to date (Figure 1; Table 1), excluding one tree (NB07) which is been discounted as it will be impacted by the project. Photographs of each tree are provided in Attachment 1. The trees were demarcated with site number using white paint on (side facing away from the road) and location recorded by GPS. A photograph was taken of each tree. DGPS locations of each tree were subsequently recorded by John Hammon (Jacobs) and are shown in Table 1.

Please note that the selected trees are not considered ideal. Reasoning is provided below for each impact hollow and recommendations made for further investigation.



Jacobs
Great Northern Highway,
Muchea to Wubin Upgrades Project

Project No	1130
Date	07 Jun-17
Drawn by	KW
Map author	KC

0 0.25 0.5 1 1.5
Kilometres

1:45,000 (at A4) GDA 1994 MGA Zone 50

- Muchea North EPBC Act approval boundary
- Ippolo Road offset site (Lot M2091)
- Potential nest box trees
- △ Carnaby's Black Cockatoo (CBC) foraging evidence
- CBC habitat site - low evidence
- CBC habitat site - low value
- CBC habitat site - no evidence
- CBC habitat site - water point

Figure 1
Potential nest box trees and foraging habitat



All information within this map is current as of 07-Jun-17. This product is subject to COPYRIGHT and is property of Phoenix Environmental Sciences (Phoenix). While Phoenix has taken care to ensure the accuracy of this product, Phoenix make no representations or warranties about its accuracy, completeness or suitability for any particular purpose.

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Subject: Great Northern Highway Muchea to Wubin Upgrade Stage 2: Additional black cockatoo assessment for Muchea North

Table 1 Potential nest box trees

Tree No	Easting	Northing	Habitat tree being impacted
NB01	405259.52	6509220.99	HT06261, HT06278, HT08752, HT14749
NB02	405265.58	6509205.58	HT06261, HT06278, HT08752, HT14749
NB03	405236.93	6509161.83	HT06261, HT06278, HT08752, HT14749
NB04	405113.14	6509158.76	HT06261, HT06278, HT08752, HT14749
NB05	405151.2	6509157.5	HT06261, HT06278, HT08752, HT14749
NB06	405205.4	6509172.54	HT06261, HT06278, HT08752, HT14749
NB08	404867.41	6509206.98	HT06261, HT06278, HT08752, HT14749
NB09	404911.67	6509241.8	HT06261, HT06278, HT08752, HT14749
NB10	409444.53	6517083.44	HT08753
NB11	409457.81	6517018.3	HT08753
NB12	409466.34	6516970.26	HT08753
NB13	404871.6	6509186.28	HT06261, HT06278, HT08752, HT14749
NB14	404868.02	6509191.67	HT06261, HT06278, HT08752, HT14749
NB15	404458.86	6514549.49	<i>Lot M2091 Ioppolo Rd</i>
NB16	406294.36	6516075.95	<i>Lot M2091 Ioppolo Rd</i>
NB17	405504.9	6517341.37	<i>Lot M2091 Ioppolo Rd</i>
NB18	403562.7	6517374.57	<i>Lot M2091 Ioppolo Rd</i>
NB19	402550.76	6515763.36	<i>Lot M2091 Ioppolo Rd</i>
NB20	402780.99	6515726.72	<i>Lot M2091 Ioppolo Rd</i>
NB21	402810.45	6515724.78	<i>Lot M2091 Ioppolo Rd</i>
NB22	404581.71	6515654.69	<i>Lot M2091 Ioppolo Rd</i>
NB23	404906.72	6517303.79	<i>Lot M2091 Ioppolo Rd</i>
NB23	404608.24	6515660.48	<i>Lot M2091 Ioppolo Rd</i>
NB24	404910.62	6517292.74	<i>Lot M2091 Ioppolo Rd</i>
NB25	404918.72	6515885.02	<i>Lot M2091 Ioppolo Rd</i>
NB26	404861.36	6515820.2	<i>Lot M2091 Ioppolo Rd</i>
NB27	402635	6514534	<i>Lot M2091 Ioppolo Rd</i>
NB28	402640	6514537	<i>Lot M2091 Ioppolo Rd</i>
NB29	402678	6514534	<i>Lot M2091 Ioppolo Rd</i>
NB30	404759	6514617	<i>Lot M2091 Ioppolo Rd</i>
NB31	404763	6514638	<i>Lot M2091 Ioppolo Rd</i>

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Subject: Great Northern Highway Muchea to Wubin Upgrade Stage 2: Additional black cockatoo assessment for Muchea North

HT08753

Three potential nest box trees were demarcated (NB10, NB11, NB 12) but these are located in a cluster ~600 m north of the impact hollow. Within the road reserve, the location of the three trees was considered the only safe area in the vicinity of HT08753 where a cherry picker could be deployed.

An alternative area has been identified that is considered more appropriate and contains several large, suitable trees (hatched in Figure 2) but it is within private tenure. Access would need to be arranged to this area before we can demarcate these trees. It is recommended that Jacobs consider suitability from an access perspective before further site visits are undertaken.

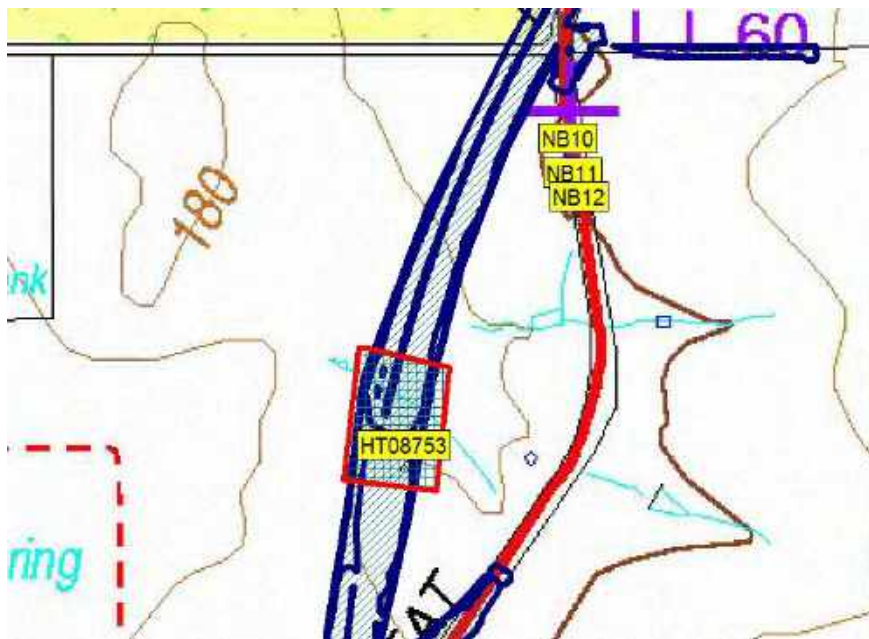


Figure 2 Potential nest box trees and other suitable area (hatched in red border) near HT08753

HT08754

No potential nest box trees were marked near this impact hollow. The only suitably sized trees identified within the road reserve in the vicinity of HT08754 were considered difficult to access with a cherry picker. The area in the vicinity of HT08754 outside the road reserve contains some suitable, large trees (hatched in Figure 3) but it is within private tenure. The best option would be to select trees from within the area hatched in Figure 3.

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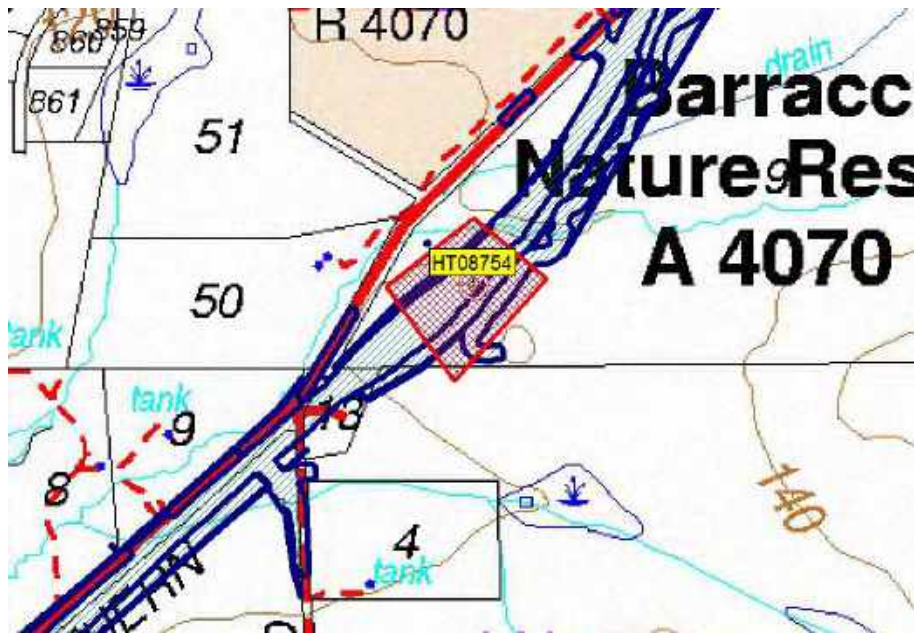


Figure 3 Suitable area (hatched in red) near HT08754

Gravel reserve - HT06261, HT06278, HT08752, HT14749

Eleven potential next box trees were marked in this area; however, Jacobs have since advised that one tree, NB07, will not be suitable as that tree will be impacted by the project. Therefore ten potential nest box trees are currently marked in this area. Some wandoo marked trees are located towards the back and top of the property to the east of the proposed re-alignment. Several Jarrah trees located in the road verge on the western side of GNH have also been marked.

Access to the trees near the GNH is not ideal; however, this may not be an issue if the nest boxes are installed after the current alignment is decommissioned. Many large trees are present nearby on adjacent private properties (see hatched area in Figure 4). It is considered that several of these would be more suitable than some of those selected. Further selection of potential trees in these locations is recommended, subject to consideration of access issues.

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Subject: Great Northern Highway Muchea to Wubin Upgrade Stage 2: Additional black cockatoo assessment for Muchea North

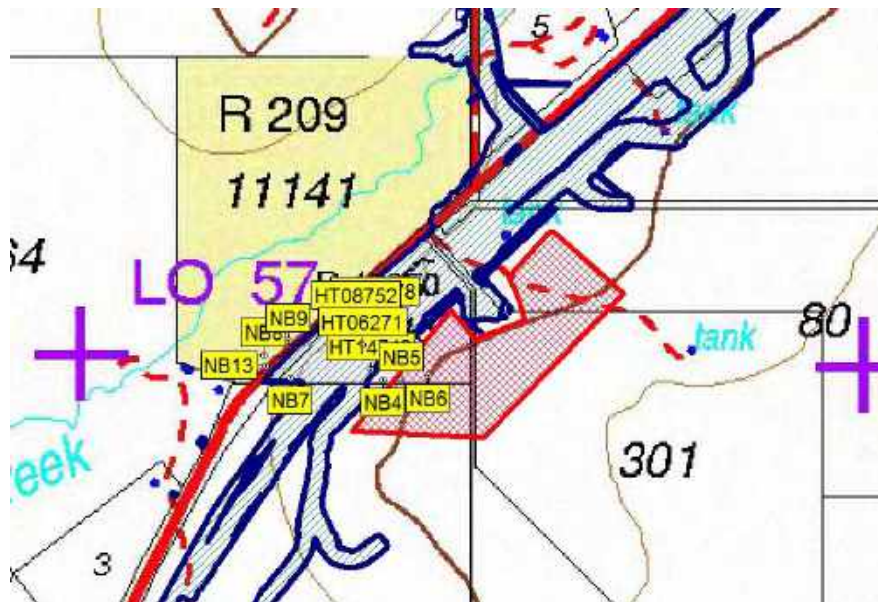


Figure 4 Potential nest box trees and other suitable area (hatched in red) near HT06261, HT06278, HT08752 and HT14749

Lot M2091 Ippolo Rd

Eighteen potential nest box trees have been marked to date in the Lot M2091 Ippolo Rd (Figure 1). All trees are located in close proximity to existing tracks. All marked trees were either Jarrah or Marri

Please note that not all trees marked are considered ideal locations for erection of artificial nest boxes. Further to this, some additional trees are present adjacent to tracks that may be more suitable but were not marked due to time constraints.

Use of Lot M2091 Ippolo Rd for the installation of artificial nest boxes should be considered after all options closer to the impact areas are fully investigated (as discussed above). If Lot M2091 Ippolo Rd is required for the implementation of this mitigation and offset action, further site selection and refinement of priority trees should be undertaken.

CARNABY'S BLACK COCKATOO FORAGING EVIDENCE AT IOPPOLO ROAD

Searches for evidence of foraging by Carnaby's Black Cockatoo at Lot M2091 Ippolo Rd were undertaken on 24 May. Due to the large size of the offset site and limited time available, searches were confined largely to areas along and close to existing access tracks within the site. All accessible tracks were driven and periodic stops made to conduct searches for foraging records. Additional notations were also made regarding level of foraging activity observed and general quality of feeding habitat for Carnaby's Black Cockatoo. Between 5 and 10 minutes was spent at each site.

Evidence of foraging by Carnaby's Black Cockatoo was recorded throughout the site, at several search locations (Figure 1). Most records were evidence of *Banksia attenuata* and *B. menziesii* chewings and grubbing. Both species occur in high abundance in several parts of the site. Apart from two locations, the records in areas identified as containing foraging habitat (in particular banksia woodlands) were noted to be

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Subject: Great Northern Highway Muchea to Wubin Upgrade Stage 2: Additional black cockatoo assessment for Muchea North

in low abundance. In some locations where suitable habitat was identified, no foraging evidence was recorded. The two locations of high foraging evidence were located directly along tracks, one on the southern boundary close to a dam and one on the northern boundary.

Little evidence of marri chewings or foraging on other species other than banksias was observed. One record each of marri and *Xanthorrhoea preissii* chewings were noted. While marri nuts were inspected at several locations along track, little search effort was employed for other foraging species due to time constraints. Therefore this result for other feeding species is likely to be at least partly due to low emphasis placed on searches for other foraging species.

It was evident however that the banksia woodlands provided the highest value foraging habitat for Carnaby's Black Cockatoo within the site. It was also evident that quality of banksia woodland, as foraging habitat value, was variable, with some areas considered low value due to low banksia density and/or poor condition vegetation/high number of dead trees, while other areas were considered good quality foraging habitat. A detailed assessment of foraging habitat quality was not possible within the time available.

Based on the records collected (i.e. along and close to access tracks), the site appears to be subject to a low level of usage as foraging habitat by Carnaby's Black Cockatoo. Additional searches more intensively and systematically through the site may identify higher usage in areas that we not covered in the current survey.

CONCLUSION

In summary, we have selected to date 30 potential next box trees in Muchea North and Ippolo Road. Additional suitable trees exist within adjacent private properties close to the location of impact sites and these should be investigated as a first priority if it is feasible to select trees within these properties. Following this, further refinement of suitable trees in Ippolo Road is required.

Final selection of potential nest box trees may need to consider timing of the installation of artificial nest boxes relative to the construction program for Muchea North in terms of logistical access to trees. The Department of Environment and Energy may also require installation of the artificial nest boxes prior to removal of the impact hollows and before the next breeding season, which may also limit selection of final trees.

Based on the survey of Lot M2091 Ippolo Rd, Carnaby's Black Cockatoo appears to be utilising the site for foraging in very low densities; however, further surveys may identify more intensive utilisation in areas that were not searched.

Yours Sincerely,

Karen Crews

General Manager

karen.crews@phoenixenv.com.au

08 9345 1608

1/511 Wanneroo Rd Balcatta WA 6021

Memo

Subject: Great Northern Highway Muchea to Wubin Upgrade Stage 2: Additional black cockatoo assessment for Muchea North

Attachment 1 Potential next box tree photographs



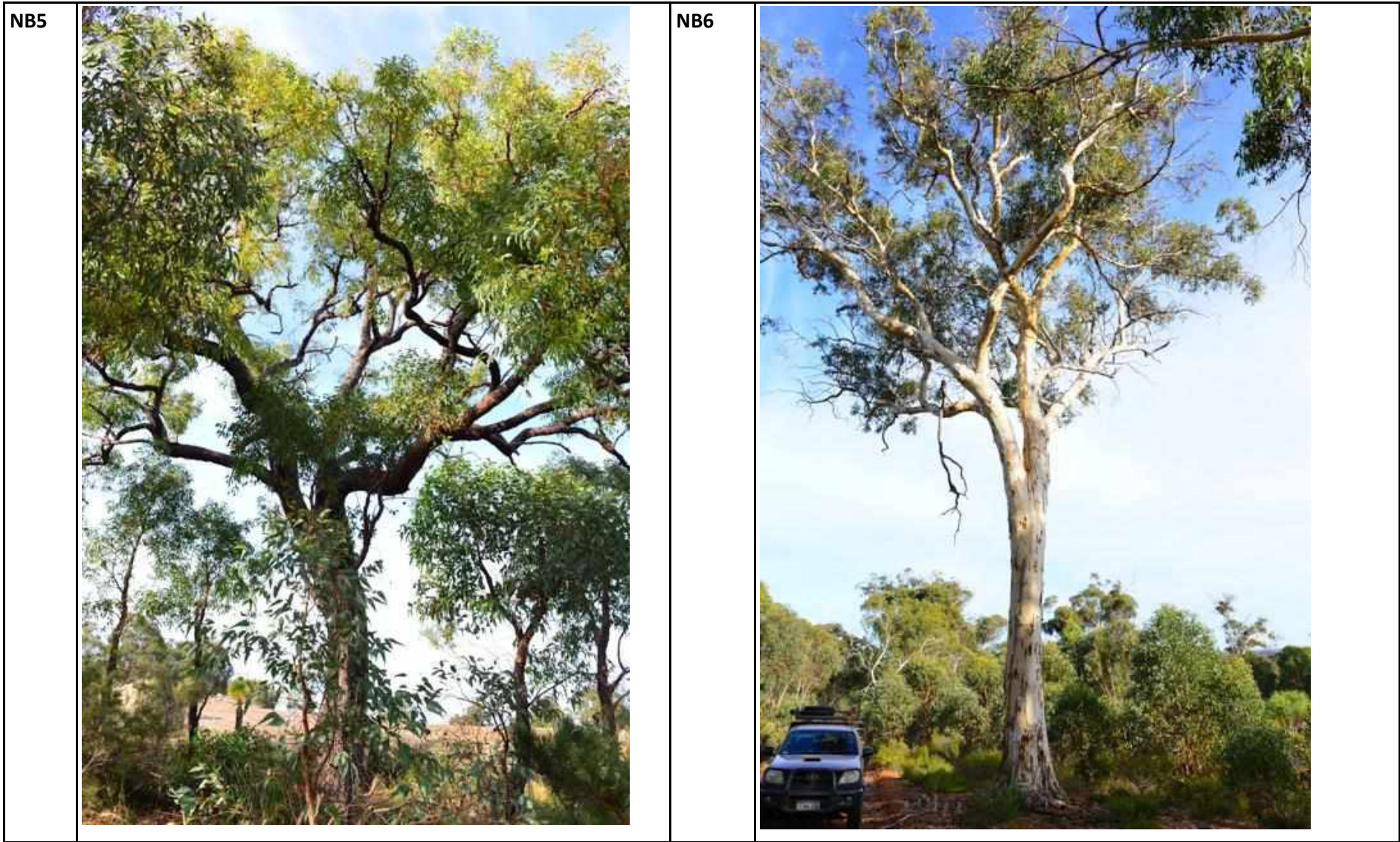
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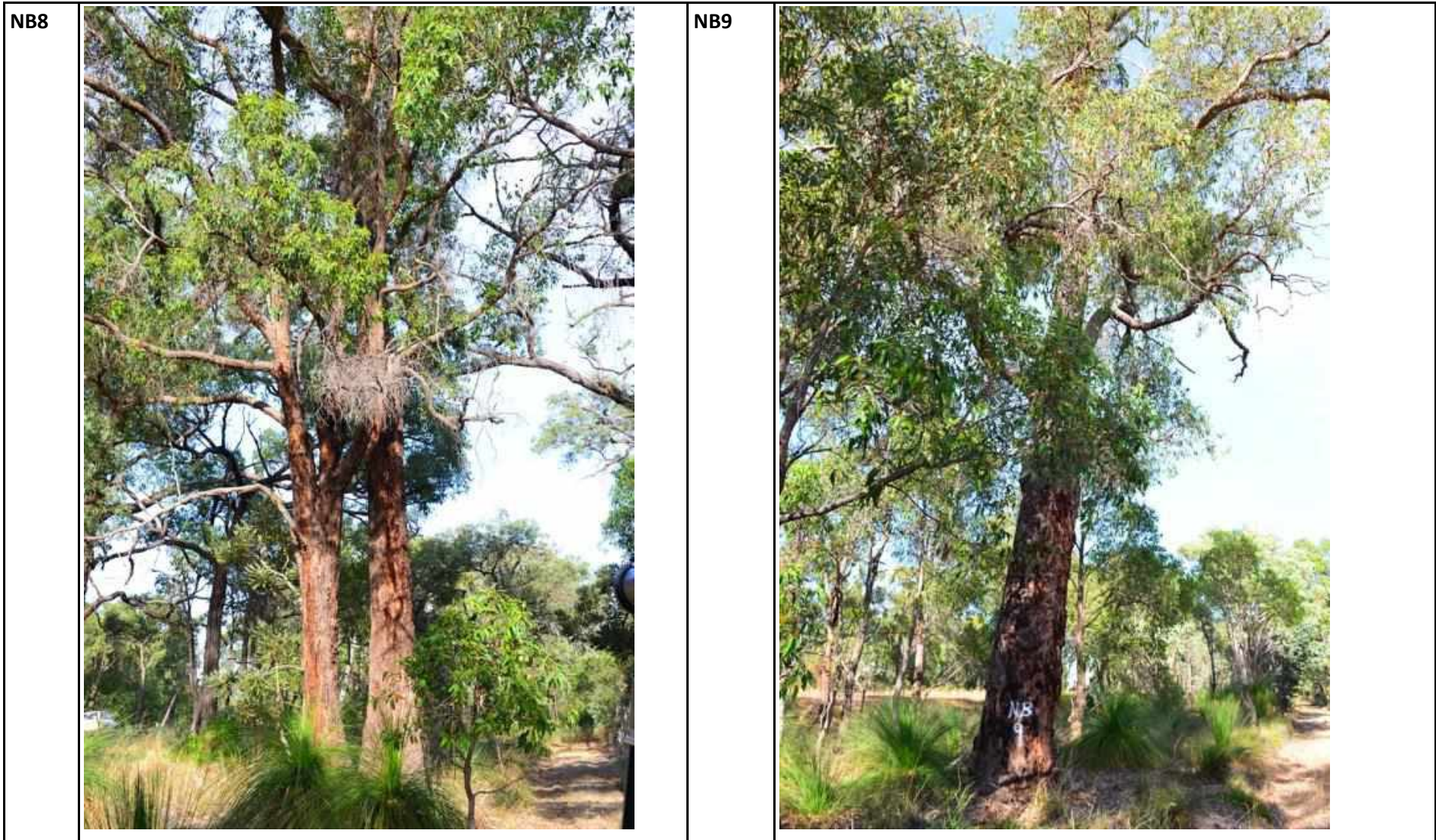
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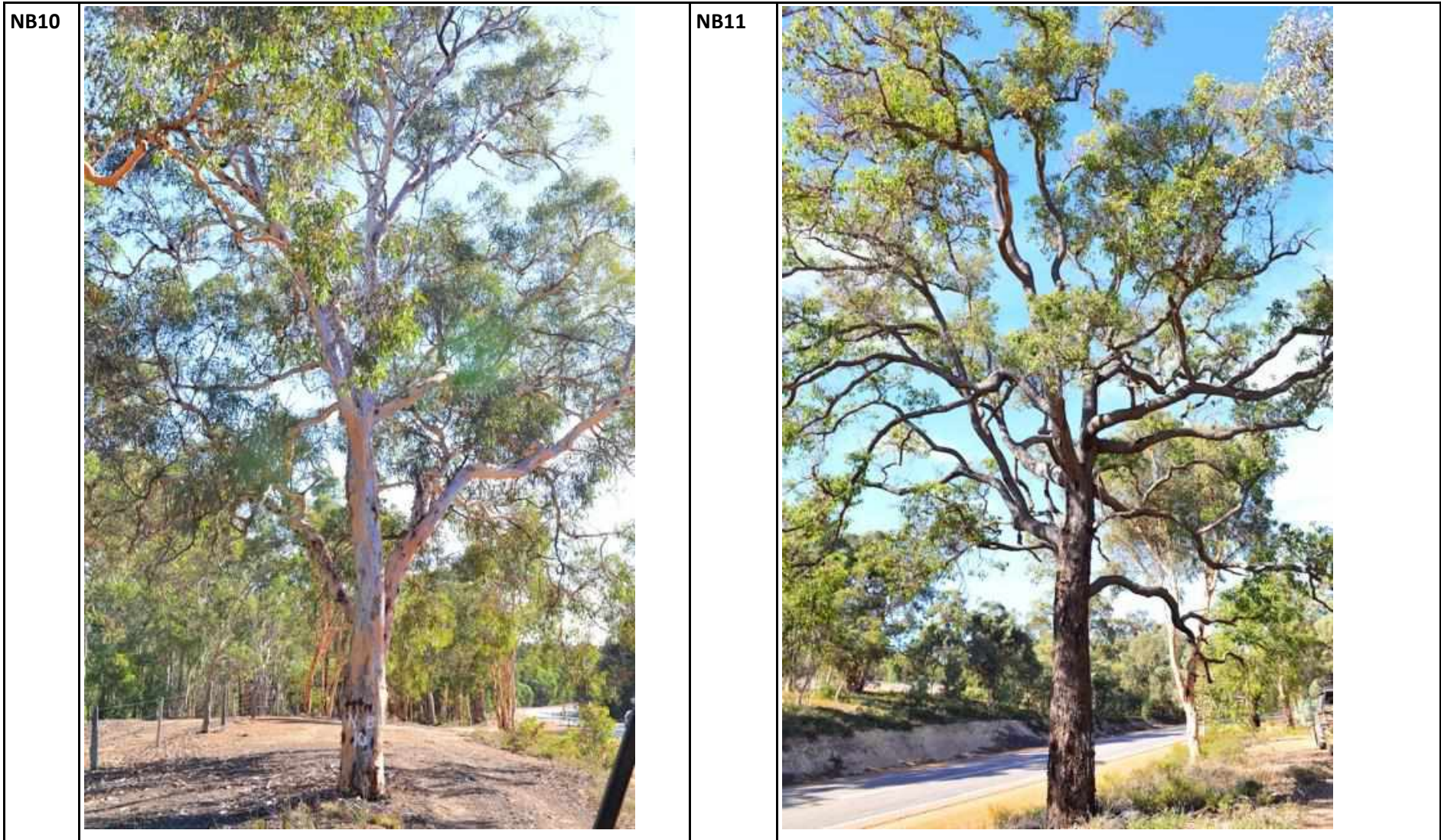
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NB14		NB15	
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NB16		NB17	No photo
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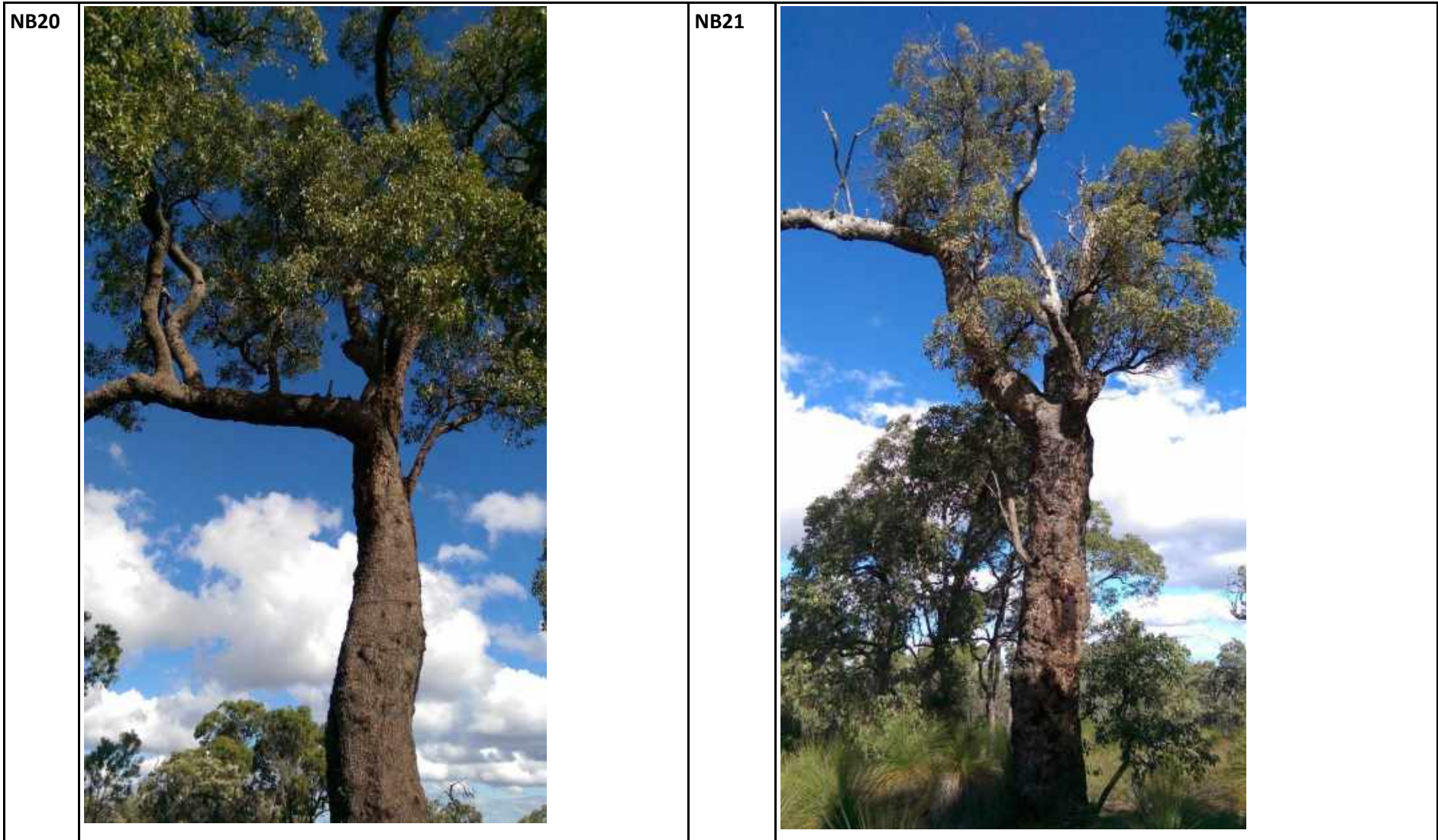
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NB18	No photo	NB19	
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Subject: Great Northern Highway Muchea to Wubin Upgrade Stage 2: Additional black cockatoo assessment for Muchea North



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Subject: Great Northern Highway Muchea to Wubin Upgrade Stage 2: Additional black cockatoo assessment for Muchea North

NB30		NB31	
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Memo

Subject: Great Northern Highway Muchea to Wubin Upgrade Stage 2: Additional black cockatoo assessment for Muchea North

Memo

To: Jonathan Davies

From: Anna Leung

Date: 29 May 2018

Subject: Muchea North – assessment of Carnaby’s Cockatoo breeding trees at Lot M2091, Ippollo Road



Dear Todd,

This memo presents the results of the surveys of potential breeding trees for Carnaby’s black cockatoo (*Calyptorhynchus latirostris*) within Lot M2091 Ippollo Road (Figure 1).

BACKGROUND

Muchea North is part of the Great Northern Highway (GNH) Muchea to Wubin Upgrade Stage 2 Project and entails proposed upgrade works to the GNH between Old Gingin Road and Chittering Roadhouse, approximately 63 km north of Perth. The proponent for Muchea North is Main Roads Western Australia (‘Main Roads’) who, together with industry partners Arup and Jacobs, have formed the Integrated Project Team (IPT).

The Department of Environment and Energy (DoEE) has deemed Muchea North a controlled action under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (EPBC ref: 2016/7656), with a contributing factor being proposed impacts to Carnaby’s Cockatoo habitat. The species is listed as a matter of national environmental significance (NES) under the EPBC Act, with the conservation status of Endangered. It is also listed as Endangered under the *WA Wildlife Conservation Act 1950*.

Lot M2091 Ippollo Rd is a proposed offset site (as part of a more comprehensive offset package for Muchea North). Part of the site is an existing offset for the separate Northlink Project (areas hatched in green and orange in Figure 1; PDNH Offset Site and Tonkin Grade Separation (TDS) Offset Site respectively). The remainder of the site (area hatched in purple in Figure 1) is the proposed offset area for Muchea North.

Phoenix has previously conducted the following at Lot M2091 Ippollo Rd¹:

- identification suitable habitat trees for the erection of artificial nest boxes for Carnaby’s Cockatoo
- searches for evidence of foraging by Carnaby’s Cockatoo.

In addition, Coffey² conducted a breeding tree assessment at the site using a tree density survey. This survey identified areas of high, moderate and low tree densities within the Eucalypt Woodland at the site (Figure 2). Thirty trees with suitable hollows but no evidence of use were opportunistically recorded but this survey did not comprehensively map Carnaby’s Cockatoo potential breeding trees.

¹ Phoenix. 2017. *Memo: Great Northern Highway Muchea to Wubin Upgrade Stage 2: Carnaby's Black Cockatoo investigations Muchea North and Ippollo Road*. Phoenix Environmental Sciences Pty Ltd, Balcatta, WA. Unpublished memo prepared for Muchea to Wubin Integrated Project Team (Mainroads WA, ASJV).

² Coffey. 2015. *Flora, vegetation and fauna assessment. Lot M2091 Ippollo Road, Chittering*. Coffey Environments Australia Pty Ltd, Burswood, WA. Unpublished report prepared for Main Roads Western Australia.

Memo

Muchea North – assessment of Carnaby’s Cockatoo breeding trees at Lot M2091, Ippollo Road

SCOPE

The scope of work was as follows:

- undertake an intensive survey for Carnaby’s Cockatoo potential breeding trees in the proposed Muchea North offset area of Lot M2091 (259 ha; intensive survey area in Figure 1)
- undertake low intensity plot-based sampling in the Northlink offset area of Lot M2091 (726.6 ha; low intensity survey area in Figure 1) and in the vicinity of Lot M2091 to provide additional contextual data.

METHODOLOGY

Site visits were undertaken on 18-20 April 2018 by zoologists with experience conducting black cockatoo habitat assessments.

For the intensive survey in the Muchea North offset area, the location of all potential breeding trees was recorded by differential global positioning system (DGPS) for accuracy. All trees of suitable species and meeting minimum diameter at breast height (DBH) measurements as per DSEWPaC³ were recorded in this survey area.

The low intensity plot based sampling of breeding trees in the Northlink offset area was conducted by selecting 1 ha plots within habitat demarcated by Coffey² (Figure 2) and counting the number of potential breeding trees within these. This number was extrapolated to the boundary of each habitat polygon. The boundaries of the habitat mapping were verified and altered where required to assist in accurate estimation of potential breeding trees.

Calculations of the number of potential breeding trees within the PDNH and TGS offset sites of the low intensity survey area were based on numbers of potential breeding trees within each polygon and extrapolated for that polygon rather than lumped into high, medium and low density categories.

RESULTS

A total of 85 potential breeding trees for Carnaby’s Cockatoo were recorded in the Muchea North offset area (Figure 3). Ten of these had hollows and seven of these were suitable for breeding. None had evidence of breeding. The majority of potential breeding trees (73) were Jarrah and the other 12 were Marri. All trees were located in areas mapped as Banksia Woodland by Coffey (2015); however, in the current survey, 7.17 ha of Banksia Woodland (which the trees were recorded in) was revised to Jarrah Eucalypt Woodland (5.57 ha), and Jarrah and Marri (1.8 ha) Eucalypt Woodland.

The remainder of the Muchea North offset area was confirmed to be Banksia Woodland with occasional eucalypt (*Eucalyptus todtiana*) not large enough to form suitable hollows for Carnaby’s Cockatoo.

Within the low intensity survey area, a total of 326 ha of eucalypt Woodland was mapped. Of this, 61.5 ha was Jarrah Woodland, 220.97 ha was Marri and Jarrah Woodland, and 43.52 ha was Marri Woodland. Minor

³ DSEWPaC. 2012. EPBC Act referral guidelines for three threatened black cockatoo species: Carnaby's Cockatoo (Endangered) *Calyptorhynchus latirostris*, Baudin's Cockatoo (Vulnerable) *Calyptorhynchus baudinii*, Forest Red-tailed Black cockatoo (Vulnerable) *Calyptorhynchus banksii naso*. Australian Government Department of Sustainability, Environment, Water, Populations and Communities, Parkes, ACT.

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Muchea North – assessment of Carnaby’s Cockatoo breeding trees at Lot M2091, Ipollo Road

revisions to Coffey’s 2015 habitat mapping replaced 8.05 ha of Banksia Woodland with Jarrah Woodland. The density of potential breeding trees within the Eucalypt Woodland habitats varied between two and 31 trees per hectare (Table 2; Figure 3). It is estimated that 5,893 potential breeding trees are located within the Northlink offset area. Of these, 5,178 are located in the PDNH offset site and 715 are located in the TGS offset site, which accounts for 36.11 ha of Eucalypt Woodland.

At least one tree with suitable breeding hollow had signs of use as a hollow; however, the presence of a “galah scar” located directly beneath the hollow, indicates of use by galahs rather than black cockatoos.

CONCLUSION

From the data collected during this survey, a total estimated number of 5,178 and 715 potential breeding trees are present in the PDNH and TGS Offset areas respectively.

The area of Eucalypt Woodland was increased by approximately 7.37 ha in the Muchea North offset area and 8.05 ha in the PDNH offset site, replacing Banksia Woodland in both instances.

Carnaby’s Cockatoo favour breeding in Wandoo (*Eucalyptus wandoo*) and Salmon Gum (*E. salmonophloia*) but are known to breed in Jarrah, Marri and other species of eucalypt to a lesser extent (SPRAT⁴). Jarrah and Marri were the dominant *Eucalyptus* tree species; however, most of the Marri present in the survey area did not meet the required DBH. Several suitable hollows and one with possible evidence of breeding were located in the survey area. Visiting the site during breeding season would confirm if any birds were actually using the area for breeding.

Yours Sincerely,

Anna Leung

Zoologist

Anna.leung@phoenixenv.com.au
08 6323 5410

⁴ Department of the Environment and Energy. 2018. *Species Profile and Threats Database*. Department of the Environment and Energy, Canberra, ACT. Available at: <http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl>

Memo

Muchea North – assessment of Carnaby’s Cockatoo breeding trees at Lot M2091, Ipollo Road

Table 1 Potential breeding trees in the Muchea North offset area (intensive survey area)

Tree number	Hollow present	Hollow suitable	Breeding evidence	Hollow height	Species	DBH (mm)	Latitude	Longitude
HT001	No	No	No		<i>C. calophylla</i> (Marri)	500	-31.491548	115.978723
HT002	No	No	No		<i>E. marginata</i> (Jarrah)	550	-31.49185	115.978648
HT003	No	No	No		<i>E. marginata</i> (Jarrah)	600	-31.491978	115.978825
HT004	No	No	No		<i>E. marginata</i> (Jarrah)	500	-31.492103	115.978832
HT005	No	No	No		<i>E. marginata</i> (Jarrah)	900	-31.492167	115.9787
HT006	No	No	No		<i>E. marginata</i> (Jarrah)	750	-31.492284	115.97866
HT007	No	No	No		<i>E. marginata</i> (Jarrah)	650	-31.492203	115.978582
HT008	No	No	No		<i>E. marginata</i> (Jarrah)	600	-31.492539	115.978554
HT009	No	No	No		<i>E. marginata</i> (Jarrah)	750	-31.492638	115.978626
HT010	No	No	No		<i>C. calophylla</i> (Marri)	600	-31.492699	115.978653
HT011	No	No	No		<i>E. marginata</i> (Jarrah)	700	-31.493039	115.978795
HT012	No	No	No		<i>C. calophylla</i> (Marri)	700	-31.493242	115.978534
HT013	No	No	No		<i>E. marginata</i> (Jarrah)	500	-31.493415	115.978526
HT014	No	No	No		<i>E. marginata</i> (Jarrah)	600	-31.49352	115.978385
HT015	No	No	No		<i>E. marginata</i> (Jarrah)	700	-31.493666	115.978404
HT016	No	No	No		<i>E. marginata</i> (Jarrah)	600	-31.493758	115.978452
HT017	No	No	No		<i>E. marginata</i> (Jarrah)	600	-31.493604	115.978655
HT018	No	No	No		<i>E. marginata</i> (Jarrah)	500	-31.493822	115.97887
HT019	No	No	No		<i>E. marginata</i> (Jarrah)	700	-31.49384	115.978949
HT020	No	No	No		<i>E. marginata</i> (Jarrah)	600	-31.494177	115.978932
HT021	No	No	No		<i>E. marginata</i> (Jarrah)	600	-31.494256	115.978922
HT022	Yes	Yes	No	3 m	<i>E. marginata</i> (Jarrah)	500	-31.494392	115.978966
HT023	No	No	No		<i>E. marginata</i> (Jarrah)	700	-31.494485	115.978907
HT024	No	No	No		<i>E. marginata</i> (Jarrah)	750	-31.49448	115.978766
HT025	No	No	No		<i>E. marginata</i> (Jarrah)	500	-31.494706	115.978695
HT026	No	No	No		<i>C. calophylla</i> (Marri)	900	-31.491881	115.979269
HT027	No	No	No		<i>E. marginata</i> (Jarrah)	600	-31.49291	115.979152
HT028	No	No	No		<i>E. marginata</i> (Jarrah)	600	-31.492901	115.979028
HT029	No	No	No		<i>E. marginata</i> (Jarrah)	600	-31.493019	115.979295
HT030	No	No	No		<i>E. marginata</i> (Jarrah)	750	-31.493187	115.979299
HT031	No	No	No		<i>E. marginata</i> (Jarrah)	700	-31.493369	115.979274
HT032	Yes	Yes	No		<i>E. marginata</i> (Jarrah)	700	-31.493984	115.979319
HT033	No	No	No		<i>E. marginata</i> (Jarrah)	500	-31.494201	115.979142
HT034	No	No	No		<i>E. marginata</i> (Jarrah)	1000	-31.494335	115.979162
HT035	No	No	No		<i>E. marginata</i> (Jarrah)	500	-31.494652	115.979337

Memo

Muchea North – assessment of Carnaby’s Cockatoo breeding trees at Lot M2091, Ippollo Road

Tree number	Hollow present	Hollow suitable	Breeding evidence	Hollow height	Species	DBH (mm)	Latitude	Longitude
HT036	No	No	No		<i>E. marginata</i> (Jarrah)	500	-31.494859	115.979293
HT037	No	No	No		<i>E. marginata</i> (Jarrah)	500	-31.494925	115.979386
HT038	No	No	No		<i>E. marginata</i> (Jarrah)	600	-31.495028	115.97929
HT039	Yes	No	No	6 m	<i>E. marginata</i> (Jarrah)	700	-31.495215	115.979306
HT040	Yes	No	No	5 m	<i>E. marginata</i> (Jarrah)	540	-31.495381	115.979219
HT041	Yes	Yes	No	10 m	<i>E. marginata</i> (Jarrah)	700	-31.495476	115.979348
HT042	Yes	Yes	No	7 m	<i>E. marginata</i> (Jarrah)	800	-31.495679	115.97938
HT043	Yes	No	No	7 & 8 m	<i>E. marginata</i> (Jarrah)	600	-31.496389	115.979201
HT044	No	No	No		<i>E. marginata</i> (Jarrah)	700	-31.496413	115.979226
HT045	No	No	No		<i>E. marginata</i> (Jarrah)	600	-31.496492	115.979323
HT046	No	No	No		<i>E. marginata</i> (Jarrah)	650	-31.496492	115.979407
HT047	No	No	No		<i>E. marginata</i> (Jarrah)	600	-31.496572	115.979021
HT048	No	No	No		<i>E. marginata</i> (Jarrah)	1000	-31.496488	115.978988
HT049	No	No	No		<i>E. marginata</i> (Jarrah)	900	-31.495857	115.978824
HT050	No	No	No		<i>E. marginata</i> (Jarrah)	500	-31.495836	115.978878
HT051	No	No	No		<i>E. marginata</i> (Jarrah)	700	-31.495518	115.979007
HT052	No	No	No		<i>E. marginata</i> (Jarrah)	700	-31.495393	115.978493
HT053	No	No	No		<i>E. marginata</i> (Jarrah)	500	-31.49503	115.978501
HT054	No	No	No		<i>E. marginata</i> (Jarrah)	700	-31.494902	115.97843
HT055	No	No	No		<i>E. marginata</i> (Jarrah)	600	-31.494826	115.97872
HT056	No	No	No		<i>E. marginata</i> (Jarrah)	700	-31.494752	115.978926
HT057	No	No	No		<i>E. marginata</i> (Jarrah)	600	-31.494915	115.978836
HT058	No	No	No		<i>E. marginata</i> (Jarrah)	500	-31.494715	115.97913
HT059	No	No	No		<i>E. marginata</i> (Jarrah)	1200	-31.485734	115.972155
HT060	No	No	No		<i>E. marginata</i> (Jarrah)	1090	-31.485826	115.972442
HT061	No	No	No		<i>E. marginata</i> (Jarrah)	1200	-31.485747	115.972686
HT062	No	No	No		<i>E. marginata</i> (Jarrah)	500	-31.485729	115.972623
HT063	No	No	No		<i>E. marginata</i> (Jarrah)	1200	-31.485945	115.972728
HT064	Yes	Yes	No	8 m	<i>E. marginata</i> (Jarrah)	1100	-31.486107	115.972834
HT065	Yes	Yes	No	8 m	<i>E. marginata</i> (Jarrah)	1000	-31.486161	115.972897
HT066	No	No	No		<i>E. marginata</i> (Jarrah)	1200	-31.486161	115.972981
HT067	No	No	No		<i>E. marginata</i> (Jarrah)	600	-31.486161	115.973024
HT068	No	No	No		<i>E. marginata</i> (Jarrah)	500	-31.48461	115.973305
HT069	No	No	No		<i>E. marginata</i> (Jarrah)	640	-31.485354	115.972511
HT070	No	No	No		<i>C. calophylla</i> (Marri)	700	-31.483947	115.973785
HT071	No	No	No		<i>C. calophylla</i> (Marri)	550	-31.484309	115.974397

Memo

Muchea North – assessment of Carnaby’s Cockatoo breeding trees at Lot M2091, Ippollo Road

Tree number	Hollow present	Hollow suitable	Breeding evidence	Hollow height	Species	DBH (mm)	Latitude	Longitude
HT072	No	No	No		<i>C. calophylla</i> (Marri)	650	-31.484442	115.974934
HT073	No	No	No		<i>C. calophylla</i> (Marri)	800	-31.48479	115.975668
HT074	No	No	No		<i>E. marginata</i> (Jarrah)	800	-31.485614	115.972449
HT075	No	No	No		<i>E. marginata</i> (Jarrah)	780	-31.485412	115.97237
HT076	No	No	No		<i>E. marginata</i> (Jarrah)	1000	-31.485382	115.972335
HT077	No	No	No		<i>E. marginata</i> (Jarrah)	880	-31.485382	115.972477
HT078	No	No	No		<i>C. calophylla</i> (Marri)	680	-31.485184	115.972317
HT079	No	No	No		<i>E. marginata</i> (Jarrah)	620	-31.48433	115.97344
HT080	No	No	No		<i>C. calophylla</i> (Marri)	500	-31.484018	115.9733
HT081	No	No	No		<i>C. calophylla</i> (Marri)	600	-31.48395	115.973527
HT082	No	No	No		<i>C. calophylla</i> (Marri)	750	-31.476421	115.973752
HT083	No	No	No		<i>E. marginata</i> (Jarrah)	800	-31.485713	115.972362
HT084	Yes	Yes	No	10 m	<i>E. marginata</i> (Jarrah)	800	-31.495534	115.978841
HT085	No	No	No		<i>E. marginata</i> (Jarrah)	700	-31.495694	115.979015

Memo

Muchea North – assessment of Carnaby’s Cockatoo breeding trees at Lot M2091, Ipollo Road


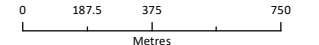
Table 2 Habitat tree density in the Northlink offset area (low intensity survey area)

Site	Habitat	Tree density/ha	Area (ha)	Estimated number of trees within habitat polygon
01	Marri and Jarrah Woodland	22	64.67	1423
02	Jarrah Woodland	14	6.55	92
03 and 11	Jarrah Woodland	22 (24 and 20)	26.33	579
04	Jarrah Woodland	14	12.51	175
05	Marri Woodland	4	3.73	15
06 and 07	Marri Woodland	5 (2 and 8)	35.64	178
08	Marri and Jarrah Woodland	16	16.51	264
09 and 18	Marri and Jarrah Woodland	22 (24 and 20)	31.43	691
10	Marri and Jarrah Woodland	31	22.43	695
12	Marri and Jarrah Woodland	16	14.90	238
13 and 14	Marri and Jarrah Woodland	23 (26 and 20)	19.71	453
15	Marri and Jarrah Woodland	16	22.46	359
16	Marri and Jarrah Woodland	12	9.85	118
17	Marri and Jarrah Woodland	15	4.13	62
19	Jarrah Woodland	30	5.09	153
20	Jarrah Woodland	6	11.01	66
21	Marri and Jarrah Woodland	13	0.77	10
22	Marri and Jarrah Woodland	4	7.34	29
23	Marri Woodland	4	1.09	4
24	Marri Woodland	20	3.57	71
25	Marri and Jarrah Woodland	32	6.73	215
Total			326.45	5,893



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Jacobs - Carnaby's Black Cockatoo breeding tree assesment, Iopollo Rd, GNH, Muchea to Wubin	
Project No	1201
Date	21-May-18
Drawn by	AL
Map author	AL
	
	
1:22,000 (at A4) GDA 1994 MGA Zone 50	






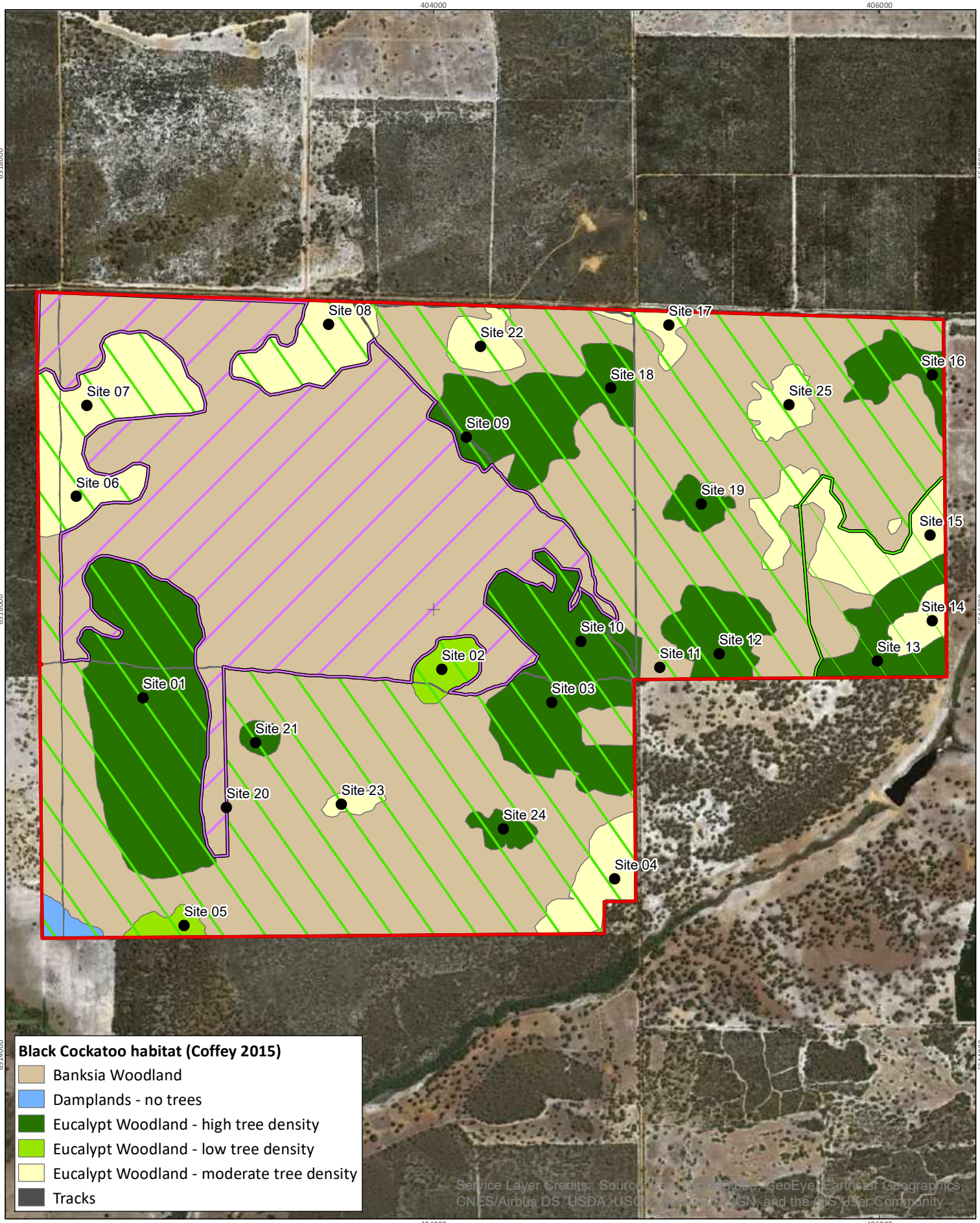
-  Lot M2091 Iopollo Rd, Chittering
- Survey areas**
-  Muchea North Offset Site Boundary - intensive survey area
- Northlink offset area - low intensity survey area**
-  PDNH Offset Site Boundary
-  Tonkin Grade Separation Offset Site Boundary

Figure 1
Survey area



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- Black Cockatoo habitat (Coffey 2015)**
- Banksia Woodland
 - Damplands - no trees
 - Eucalypt Woodland - high tree density
 - Eucalypt Woodland - low tree density
 - Eucalypt Woodland - moderate tree density
 - Tracks

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

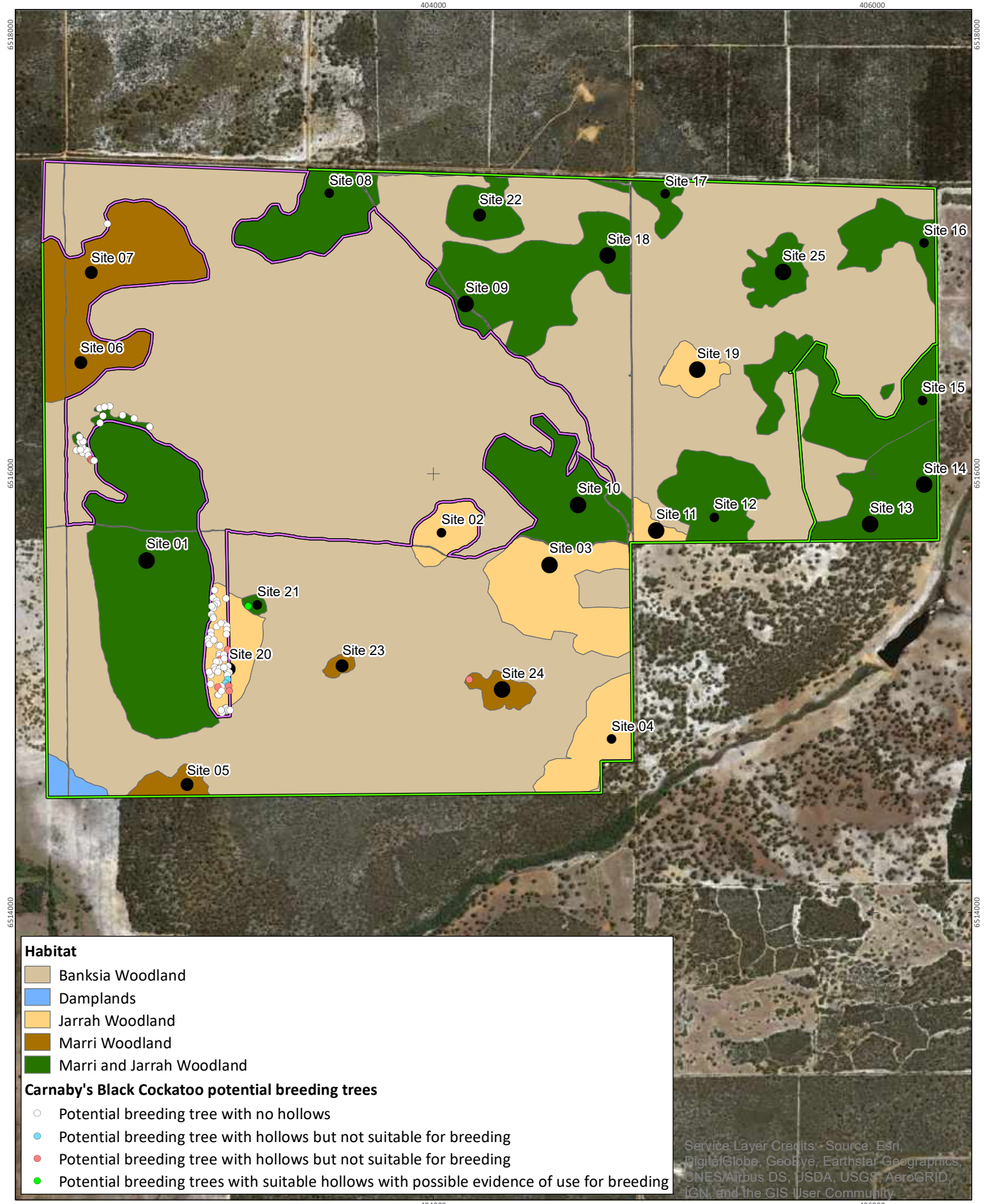


Jacobs - Carnaby's Black Cockatoo breeding tree assesment, Iopollo Rd, GNH, Muchea to Wubin	
Project No	1201
Date	14-May-18
Drawn by	AL
Map author	AL
1:22,000 (at A4) GDA 1994 MGA Zone 50	

- Lot M2091 Iopollo Rd, Chittering
- Survey areas**
- Muchea North Offset Site Boundary - Intensive survey area
- PDNH and TGS Offset Site Boundary - Low intensity survey area
- Low intensity survey site locations

Figure 2

Survey sites



Habitat

- Banksia Woodland
- Damplands
- Jarrah Woodland
- Marri Woodland
- Marri and Jarrah Woodland

Carnaby's Black Cockatoo potential breeding trees

- Potential breeding tree with no hollows
- Potential breeding tree with hollows but not suitable for breeding
- Potential breeding tree with hollows but not suitable for breeding
- Potential breeding trees with suitable hollows with possible evidence of use for breeding

Service Layer Credits: - Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Jacobs - Carnaby's Black Cockatoo breeding tree assesment, Iopollo Rd, GNH, Muchea to Wubin	
Project No	1201
Date	21-May-18
Drawn by	AL
Map author	AL
1:22,000 (at A4) GDA 1994 MGA Zone 50	

- Muchea North Offset Site Boundary
- PDNH and TGS Offset Site Boundary

Low intensity survey sites and potential breeding trees per hectare

- High density
- Low density
- Moderate density

Figure 3

Potential breeding trees and habitat in the survey area

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MEMORANDUM

Date	28 May 2018	Title	Black-cockatoo Nesting Tree Survey Results – Banovich Road Offset Site
Ref.	ASJV18002/01	Distribution	Todd Jess Integrated Project Team
Author	Kellie Bauer-Simpson Principal Ecologist	Review	Mike Bamford Supervising Zoologist

Background

Main Roads Western Australia (Main Roads) is upgrading the 218 km section of Great Northern Highway (GNH) between Muchea and Wubin. Jacobs and Arup together have formed a joint venture, formerly called ASJV, to partner with Main Roads (now together, the Integrated Project Team (IPT)) for the delivery of the upgrade project. The improvements to be made include town bypasses, wider roads, more passing lanes, flattening crests, easing curves, safer roadsides, more rest stops and additional facilities for heavy vehicles. These works will significantly improve safety and amenity and facilitate the future movement of road trains along this section of highway.

Focused Vision Consulting Pty Ltd (FVC) was originally commissioned by ASJV in 2016 to conduct biological assessments of a range of route options for the Bindoon bypass section of the Muchea to Wubin upgrades of the Great Northern Highway. A range of studies have continued to be undertaken throughout the study area since the initial 2016 assessments, alongside FVC's partner consultants, Bamford Consulting Ecologists (BCE).

Following on from studies within the project area, offset sites are being considered and assessed. One such site is situated on Banovich Road, Hill River. In particular, the site is likely to be secured to offset a shortfall of Black-cockatoo potential nesting trees provided by other offset site/s for the Muchea North section of the GNH project. The IPT commissioned FVC (with BCE) to undertake a Black-cockatoo nesting tree survey of a section of the Banovich Road offset site (**Figure 1**).

'Potential nesting trees' are trees of a suitable species which may not yet be nesting/hollow-bearing trees, but based on trunk diameter (diameter at breast height (DBH)), could provide hollows within the next 50 years (Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) 2012).

This correspondence presents the findings of the field assessment for potential nesting trees within the designated section of the site.




0 250 500 750 1000 m

GDA 94 / MGA Zone 50



Figure 1 - Study Area

Legend

 Study Area



Methodology

The field assessment was conducted over three days, between 17 – 19 April 2018, by Senior Zoologists with significant experience in surveys for Black-cockatoos and their habitat; Tim Gamblin and Kath Chuk, assisted by Senior Botanist/Ecologists, Lisa Chappell and Gaby Martinez.

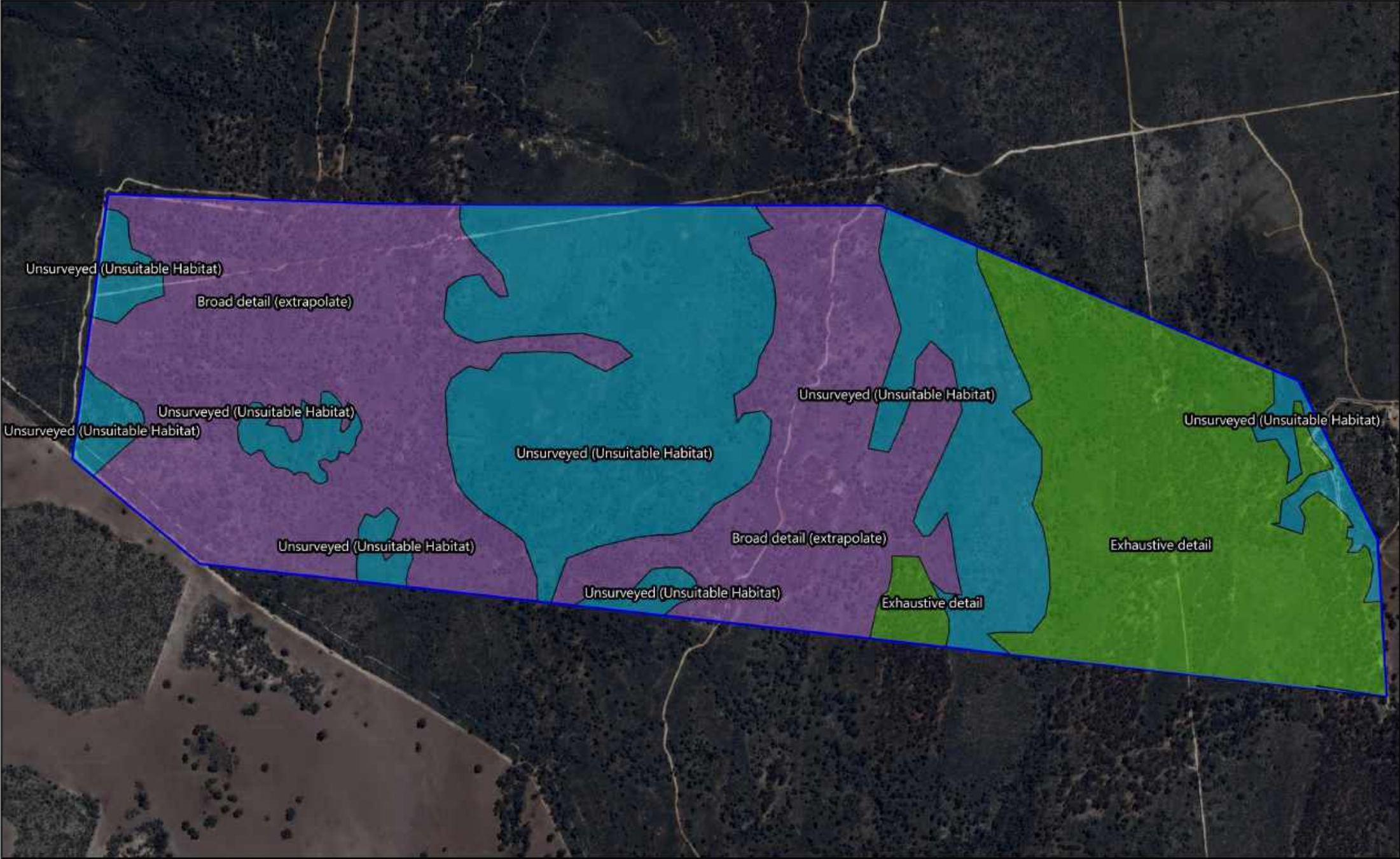
The designated study area, totalling 312 hectares was surveyed in exhaustive detail across 73 hectares within the eastern third of the site, and in broad detail through selected other areas of the remaining 131 hectares of suitable habitat. The broad detail survey was carried out via a series of representative traverses. This approach was utilised to make the best use of available field time. Approximately 108 hectares (35%) of the designated survey area has been inferred as unsuitable habitat for supporting Black-cockatoo nesting or potential nesting trees. The varying levels of survey detail employed and areas of unsuitable habitat are presented in **Figure 2**.

The Commonwealth Department of the Environment and Energy (DEE; formerly the Department of Sustainability, Environment, Water, Population and Communities) provides guidelines for the referral of actions that may result in impact to Black-cockatoos to the DEE (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). In addition, survey methodology followed the recommendations listed on the DEE's Species Profile and Threats Database (DEE 2018).

Within the survey area, the following information was recorded for every suitable tree¹ (predominantly Wandoo, *Eucalyptus wandoo* and Marri, *Corymbia calophylla*) with a diameter at breast height (DBH) equal to or greater than 300 mm for Wandoo or 500 mm for other species:

- tree location
- tree species
- life status
- DBH
- 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 1**.

¹ the draft revised EPBC Act referral guidelines (DEE 2017) stress that any tree species may provide suitable hollows.



0 0.25 0.5 0.75 1 km
 GDA 94 / MGA Zone 50

Figure 2 - Survey Detail



- Legend**
- Study Area
 - Broad detail (Extrapolated)
 - Exhaustive detail
 - Unsurveyed (Unsuitable Habitat)



Table 1 Ranking System for Black-cockatoo Potential Nesting Trees

As per DEE (2017) 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*).

Rank	Description of tree and hollows/activity
1	Active nest observed; adult (or immature) bird seen entering or emerging from hollow.
2	Hollow of suitable size and angle (i.e. near-vertical) visible with chew marks around entrance.
3	Potentially suitable hollow visible but no chew marks present; or potentially suitable hollow present (as suggested by structure of tree, such as large, vertical trunk broken off at a height of >10m).
4	Tree with large hollows or broken branches that might contain large hollows but hollows or potential hollows 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.
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.
x	Where a hollow that is (otherwise) potentially suitable for black-cockatoo nesting has been colonised by feral Honey Bees (<i>Apis mellifera</i>), and therefore rendered unusable, the nest-tree rank is preceded by 'x' (e.g. x2, x3, x4).

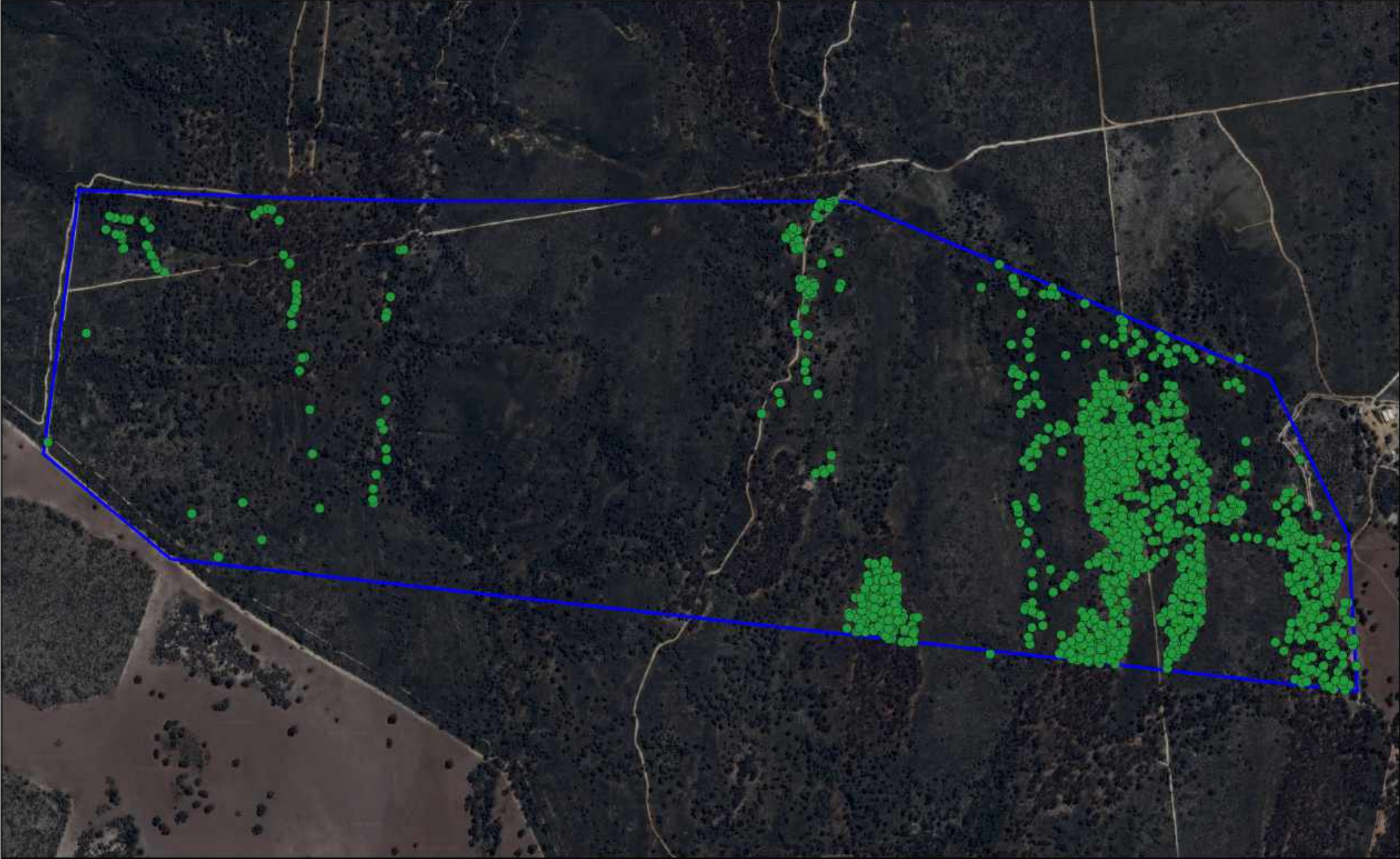
BCE has also developed a tree measurement protocol, based on Commonwealth guidelines which is outlined in **Appendix 1**.

Results

A total of 1,637 trees considered potential current or future nesting trees were recorded within the areas surveyed within the study area (**Table 2, Figure 3**).

Table 2 Summary of Recorded Potential Nesting Trees



Category	Species/Number of Trees				TOTAL	% of Grand Total
	Marri	Wandoo	Coastal Blackbutt	Unknown Species (dead)		
1 – Active nest/s	-	-	-	-	-	-
2 – Potential hollow with chew marks	2	2	-	-	4	0.24
3 – Potential hollow, no chew marks	34	174	2	-	210	12.83
4 – Potential hollow, unsuitable orientation	-	-	-	-	-	-
5 – Sufficient DBH, no observable chew marks	135	1,279	2	7	1,423	86.93
TOTAL	171	1,455	4	7	1,637	
% of Grand Total	10.45	88.88	0.24	0.43		



GDA 94 / MGA Zone 50

Figure 3 - Habitat Trees

Legend

-  Study Area
-  Habitat Tree



The habitat trees present across the site are predominantly *Eucalyptus wandoo* (Wandoo) (approximately 89% of those recorded), with approximately 10% of those recorded *Corymbia calophylla* (Marri) and a small number (four trees) of *Eucalyptus todtiana* (Coastal Blackbutt) recorded that are potentially suitable as nesting trees for Black-cockatoos.

Most of the recorded trees were observed to present a sufficient DBH (500 mm or greater), but with no observable hollows, with only 214 trees (approximately 13%) of those recorded observed to support hollows. No active nests were observed.

Within the areas of exhaustive survey detail, as presented in **Figure 2**, a total of 1,501 potential nesting trees were recorded. This equates to 20.56 potential nesting trees per hectare, which, if applied to the remaining suitable habitat areas (those surveyed in broad detail), equates to 2,694 trees across the 131 hectares. Therefore, the total estimated Black-cockatoo potential nesting trees across the designated survey site is concluded to be approximately 4,195.

There was no direct evidence of any Black-cockatoo activity on site during the field survey, including no evidence of foraging, nor use of tree hollows for nesting. Chew marks observed on four trees, may be attributable to Black-cockatoos, although this result is not definitive. A lack of direct evidence of Black-cockatoo activity on site during the April survey is not necessarily indicative of a lack of suitable habitat, as April is not a suitable time to observe Black-cockatoos in the area, and it is very possible that Black-cockatoos utilise the site at other times of the year (K. Chuk, pers. comm.).

A biological survey undertaken 2016 (GHD), of the entire 1,993 ha Hill River property, recorded Carnaby's Black-cockatoos via observations of birds (89 individuals), actual breeding events (10 birds recorded in hollows) with an additional eight records of hollows considered highly likely as being used (but not confirmed), five records of feeding behaviour and one location of roosting.

Conclusion

The targeted Black-cockatoo habitat tree assessment has surveyed approximately 36% of the suitable habitat within the designated study area in exhaustive detail. The results have determined that the site supports significant numbers of Black-cockatoo habitat trees (potential nesting trees), with more than 4,000 trees likely to be supported by the site, and 1,637 confirmed and recorded. Therefore, the site is considered valuable habitat for the species.

References

DEE (2018). *Calyptorhynchus latirostris* in Species Profile and Threats Database. Department of the Environment. Available from: <http://www.environment.gov.au/sprat>

DEE (2017). Revised draft referral guideline for three threatened black cockatoo species: Carnaby's Cockatoo, Baudin's Cockatoo and the Forest Red-tailed Black-Cockatoo. Department of the Environment and Energy, Commonwealth of Australia, 2017, Canberra, Australian Capital Territory.

DSEWPaC (2012). EPBC Act referral guidelines for three threatened black cockatoo species: Carnaby's cockatoo (endangered) *Calyptorhynchus latirostris*, Baudin's cockatoo (vulnerable) *Calyptorhynchus baudinii*, Forest red-tailed black cockatoo (vulnerable) *Calyptorhynchus banksii naso*. Department of Sustainability, Environment, Water, Population and Communities, Canberra, Australian Capital Territory.

GHD (2016). Main Roads Western Australia Hill River Offset Property Biological Survey. Perth, Western Australia.

Closing

Should you require further information or clarification regarding the information provided in this report, please do not hesitate to contact the undersigned.

Best regards,

Kellie Bauer-Simpson
Director & Principal Ecologist/Environmental Manager
Focused Vision Consulting Pty Ltd

Appendix 1 Bamford Consulting Ecologists Black-cockatoo nesting-tree assessment protocol

Bamford Consulting Ecologists base black-cockatoo nesting-tree assessments on Federal guidelines (DEE 2017; DotE 2018a, b, c) but also refer to the following when undertaking field surveys.

Measuring DBH

While black-cockatoos generally nest towards the crown of a tree, the diameter of a tree at breast-height (DBH) can be indicative of the likelihood of hollow-formation in the upper trunk and can be used in the assessment of the 'value' of a tree to breeding black-cockatoos. A DBH threshold of 500 mm (or 300 mm for Wandoo, *Eucalyptus wandoo*, and Salmon Gum, *E. salmonophloia*) is commonly used to delineate 'potential' nest-trees (DotE 2018a, b, c), however the tree has to be *functionally capable of supporting a nest hollow* and there are several exceptions where trees that meet a strict DBH threshold are excluded (e.g. those with low-forking into narrow-diameter trunks, or those that have been hollowed-out and 'opened' by fire). Thus some discretion needs to be used when assessing trees.

The international standard for 'breast height' is 1.3 m (James and Shugart Jr 1970).

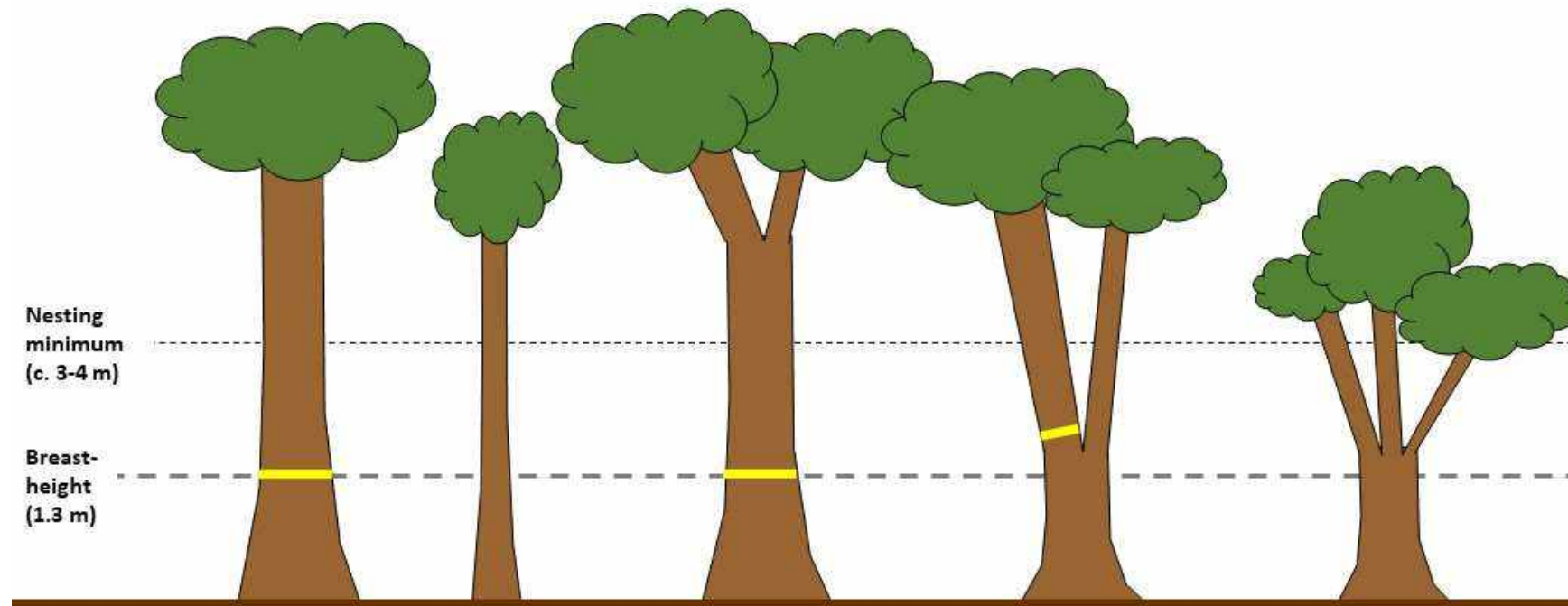
Only occasionally are trees close to perfectly cylindrical. As such, wherever possible, DBH should be 'representative' of the tree. In cases where the tree is approximately oval in cross-section, BCE measures the diameter of the shorter axis. Note that other methods such as circumference, or the quadratic average of the long and short axes are used in some applications, but logistic constraints generally require a more pragmatic approach. DBH should be reflective of the trunk above the nesting threshold (see below). Where a tree spreads at the base along one axis, the axis that best represents the trunk above is chosen for measurement.

Nest height minima

For Carnaby's Black-Cockatoo, the minimum height of known nests is c. 3 m (Saunders 1979). For Forest Red-tailed Black-Cockatoo, the minimum height of a known nest is 6.5 m (Johnstone *et al.* 2013a). Thus, a 3-4 m threshold seems a pragmatic "general" one to use for the purposes of field surveys where both species are likely and multiple tree species are under consideration.

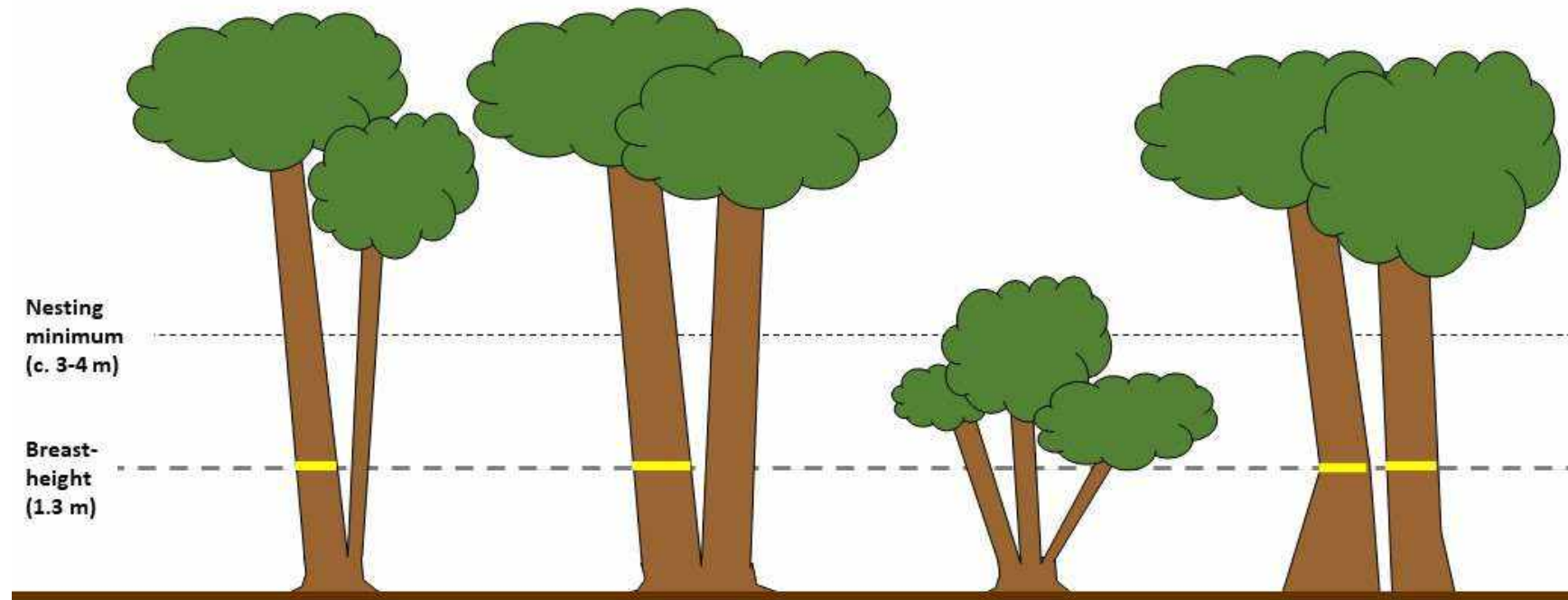
Tree forms

Quite obviously, trees have a range of forms and growth-habits. These can occasionally affect black-cockatoo nesting-tree surveys. As such, the following table has been developed (with reference to the information above) to guide tree assessment.



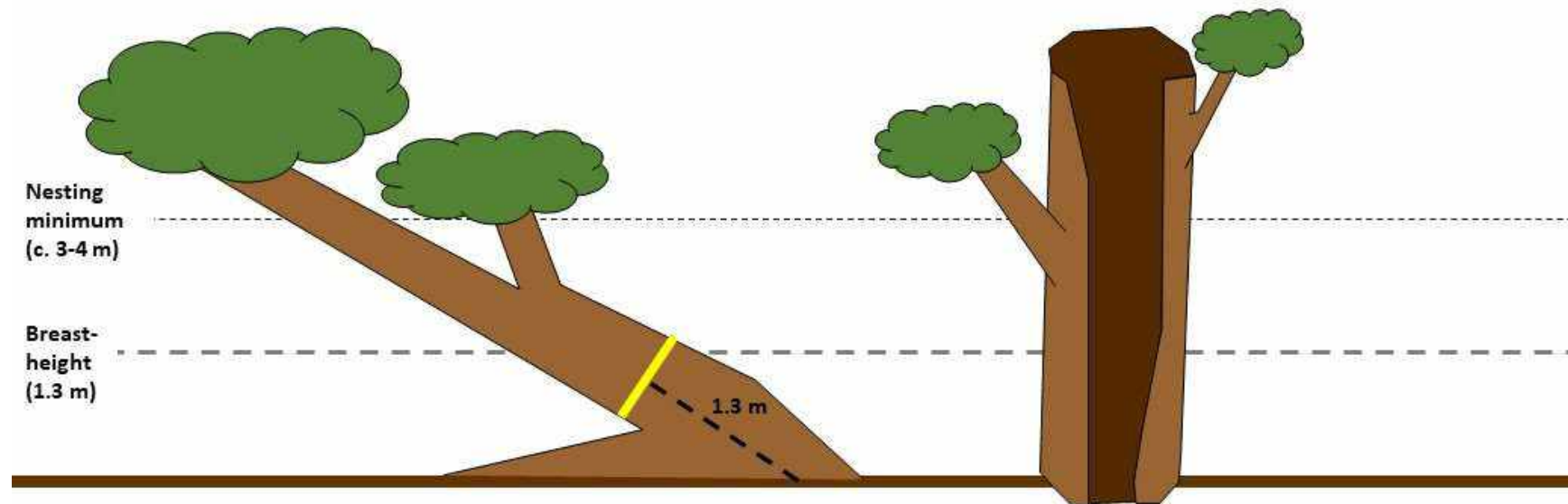
Tree Description:	Straight trunk. DBH > 500 mm*.	Straight trunk. DBH < 500 mm*.	Trunk forks above 3 m. DBH > 500 mm*.	Trunk forks between 1.3 m & 3 m. Diameter of at least one trunk above fork > c. 500 mm*.	Trunk forks between 1.3 m & 3 m. DBH > 500 mm* but <u>no</u> trunks above fork have diameter > c. 500 mm*.
Actions:	Measure DBH. Record species, life status and score for hollows. Waypoint tree.	Do not record.	Measure DBH. Record species, life status and score for hollows. Waypoint tree.	Measure/estimate diameter of <u>widest</u> trunk above fork. Note number of trunks. Record species, life status and score for hollows. Waypoint tree.	Do not record.

* Or 300 mm DBH for Wandoo, Salmon Gum.



Tree Description:	Trunk forks below 1.3 m. Diameter of <u>one</u> trunk above fork > 500 mm*.	Trunk forks below 1.3 m. Diameter of <u>multiple</u> trunks above fork > 500 mm*.	Trunk forks below 1.3 m. DBH of all trunks < 500 mm*.	Two <u>separate</u> trees in very close proximity. Both with DBH > 500 mm.
Actions:	Measure DBH of relevant trunk above fork. Note number of trunks. Record species, life status and score for hollows. Waypoint tree.	Measure DBH of <u>widest</u> trunk above fork. Note number of trunks. Record species, life status and score for hollows. Waypoint tree.	Do not record.	For <u>both</u> trees... Measure DBH. Record species, life status and score for hollows. Waypoint <u>each</u> tree (i.e. 2 separate records).

* Or 300 mm DBH for Wandoo, Salmon Gum.



Tree Description:	Trunk leans dramatically. Diameter > 500 mm* at 1.3m from centre of tree base.	Trunk has been burnt out internally to create an <u>open</u> half-pipe shape (no potential nesting sites). DBH > 500 mm*.
Actions:	Measure diameter at 1.3 m from the central base point, along the midline of the tree. Record species, life status and score for hollows. Waypoint tree.	Do not record.

* Or 300 mm DBH for Wandoo, Salmon Gum.

**Note: The number of boundary coordinates has been simplified. The shape of the offset site is complex with over 900 coordinates. For an accurate boundary of the offset site please refer to the shapefile.*

Offset Site ID	EPBC Act Reference Number	Offset Property Address	Offset Property Size (ha)	Coordinates of boundary property (Decimal Degrees)		EPBC Act Protected Matters compensated for	Legal Mechanism for Conservation	Additional EPBC Act Protected Matters that may benefit
1	2016/7656	Lot M2091 Ioppolo Road, Chittering	259.7504	115.9828	-31.4759	Carnaby's Black Cockatoo foraging and potential breeding habitat	Crown Land Managed by DBCA as Conservation Estate	Banksia Woodlands of the Swan Coastal Plain <i>Chamaelucium</i> sp. Gingin (Gingin Wax) <i>Caladenia huegelii</i> (Grand Spider Orchid) <i>Grevillea curviloba</i> subsp. <i>curviloba</i> <i>Grevillea curviloba</i> subsp. <i>incurva</i> <i>Ptychoseris pusillum</i> (Dwarf Pea) <i>Calyptrorhynchus banksii naso</i> (Forest Red-tailed Black Cockatoo) <i>Dasyurus geoffroyi</i> (Western Quoll)
				115.9822	-31.4761			
				115.9819	-31.4757			
				115.9817	-31.4757			
				115.981	-31.4763			
				115.9802	-31.4763			
				115.9798	-31.4772			
				115.9816	-31.4781			
				115.9816	-31.4781			
				115.9835	-31.4777			
				115.9841	-31.4778			
				115.985	-31.4771			
				115.9864	-31.4767			
				115.9863	-31.4761			
				115.9866	-31.4759			
				115.9895	-31.4784			
				115.9891	-31.479			
				115.9896	-31.4793			
				115.9901	-31.4796			
				115.9906	-31.4807			
				115.9914	-31.481			
				115.9917	-31.4813			
				115.9921	-31.481			
				115.9924	-31.4813			
				115.993	-31.482			
				115.9935	-31.4821			
				115.994	-31.4824			
				115.9945	-31.4829			
				115.9954	-31.4833			
				115.9966	-31.4847			
				115.997	-31.4863			
				115.9976	-31.4866			
				115.9979	-31.4872			
				115.9979	-31.4874			
115.9972	-31.487							
115.9967	-31.4864							
115.9962	-31.486							
115.9962	-31.4863							
115.996	-31.4867							
115.9957	-31.4869							
115.9957	-31.4866							
115.9962	-31.4856							
115.9961	-31.4853							
115.9953	-31.4852							
115.9945	-31.4844							
115.994	-31.4845							
115.994	-31.4848							
115.995	-31.4855							
115.9949	-31.4861							

115.9944	-31.4858
115.9941	-31.4859
115.9927	-31.4853
115.9923	-31.4854
115.9918	-31.4859
115.9917	-31.4866
115.9942	-31.4888
115.994	-31.489
115.9934	-31.4893
115.993	-31.4896
115.9927	-31.4899
115.9913	-31.4903
115.9911	-31.4903
115.991	-31.4903
115.9908	-31.4903
115.99	-31.4902
115.99	-31.4902
115.9903	-31.49
115.9904	-31.49
115.9913	-31.4896
115.9914	-31.4894
115.9915	-31.4888
115.9916	-31.4886
115.9916	-31.4885
115.9913	-31.4882
115.9911	-31.488
115.9907	-31.4879
115.9895	-31.4881
115.9893	-31.4884
115.989	-31.4886
115.9883	-31.4891
115.9882	-31.4895
115.9882	-31.4898
115.9793	-31.4891
115.9793	-31.4891
115.9794	-31.4967
115.9788	-31.4967
115.9784	-31.4963
115.9782	-31.4947
115.9785	-31.4927
115.9787	-31.4911
115.978	-31.4891
115.978	-31.4891
115.978	-31.4884
115.9784	-31.4878
115.9779	-31.4863
115.9767	-31.4856
115.976	-31.4854
115.9755	-31.485
115.9736	-31.4845
115.9727	-31.4854
115.9731	-31.4861
115.9731	-31.4866
115.9732	-31.4868

115.9745	-31.4876
115.9744	-31.4879
115.9736	-31.4877
115.9731	-31.4875
115.9728	-31.4875
115.9725	-31.488
115.9729	-31.4885
115.973	-31.4888
115.973	-31.4888
115.9717	-31.4888
115.9717	-31.4836
115.9724	-31.4834
115.9731	-31.483
115.9736	-31.4825
115.9754	-31.4822
115.9758	-31.481
115.9751	-31.4808
115.9751	-31.4808
115.974	-31.4813
115.973	-31.481
115.9729	-31.4798
115.9744	-31.479
115.9785	-31.4787
115.9783	-31.4777
115.9778	-31.4773
115.9775	-31.4766
115.9765	-31.4758
115.9758	-31.4755
115.9746	-31.4755
115.9739	-31.4757
115.9736	-31.476
115.9738	-31.4765
115.9735	-31.4769
115.9725	-31.4772
115.9726	-31.4776
115.9719	-31.4778
115.9713	-31.477
115.9706	-31.4771
115.9706	-31.4738
115.9834	-31.4743
115.9832	-31.4748
115.9829	-31.4754

Appendix A. Flora, Vegetation and Fauna Assessments

NorthLinkWA

Perth-Darwin National Highway



Flora, Vegetation and Fauna Assessment

Lot M2091 Ippolo Road, Chittering

DOC NO / NLWA-00-EN-RP-0009

REV / 0

DATE / 15 April 2015

coffey 



EXECUTIVE SUMMARY

Main Roads Western Australia (MRWA) commissioned Coffey Environments Australia Pty Ltd (Coffey) to complete a Level 1 flora, vegetation and fauna and Black Cockatoo assessment, at Lot M2019 Ippolo Road, Chittering (the study area), located approximately 50 kilometres (km) north of Perth in the Swan Coastal Plain bioregion of Western Australia.


The purpose of the study was to undertake an assessment of the ecological values of the study area. The outcome of the assessment will be used to determine the suitability of the land as an offset for values to be impacted by the NorthLink WA project. The study area is 986 hectare (ha) and is adjacent to a C Class Nature Reserve to the west, which is 163 ha.

The survey was conducted over four days 8 to 10 June and 17 June 2014. The key findings of the desktop assessment are:

- Twenty Threatened (Declared Rare-extant) flora listed under the *Wildlife Conservation Act 1950* and the *Environment Protection and Biodiversity Conservation Act 1999* were identified as potentially occurring within close proximity to the study area.
- Thirty four Priority listed flora recognised by the Department of Parks and Wildlife were identified as potentially occurring within close proximity to the study area. Ten taxa are considered Likely to occur; 15 as Possible; and 30 as Unlikely to occur in the study area.
- Seven ecological communities listed as conservation significant, including four Threatened Ecological Communities and three Priority Ecological Communities were identified for the study area.
- 221 fauna species have been previously recorded in the vicinity of the study area; these include 12 amphibians, 47 reptiles, 134 birds and 28 mammals.
- 14 conservation significant fauna species were identified as potentially occurring within close proximity to the study area, of these one species is considered Likely to occur, three as Possible and four species as Unlikely to occur in the study area.

The key findings of the field survey are:

- The vegetation condition of the study area was considered to be Good to Pristine as per Bush Forever (Government of Western Australia, 2000 and Keighery, 1994) vegetation condition scale.
- The areas of vegetation considered to be pristine were generally located within the middle of the study area where introduced taxa and human visitation is low or non-existent.
- Dieback in the study was considered uninfested and presents a low risk of spreading the disease into other areas.
- Dieback risk assessment allocated 87.6 ha as Low risk vegetation, with 12.2 ha as moderate and 19.4 ha as high risk.
- Sixteen vegetation units were described, four are considered to be representative of Priority 2 Ecological Community Banksia Yellow-Orange Sands and two Threatened Ecological Communities.
- A total of 154 vascular taxa were recorded from the study area.
- One Threatened taxa *Chamelaucium* sp. Gingin (N.G. Marchant 6) and One Priority taxa *Hypolaena robusta* (P4) were recorded in the study area.

- 
- Six introduced taxa were recorded from the study area. None of them are considered to be Weeds of National Significance.
 - **Zantedeschia aethiopica* is registered as a Declared Pest under the *Biosecurity and Agriculture Management Act 2007* and three species, **Zantedeschia aethiopica*, **Lupinus* sp. and **Brassica tournefortii*, have a High rating under the Environmental Weed Strategy for Western Australia.
 - Three fauna habitats were recorded in the study area: Banksia Woodland, Eucalypt Woodland and a Dampland.
 - The Black Cockatoo Habitat assessed Eucalypt Woodland (315 ha) as high value Black Cockatoo habitat, Banksia Woodland (663 ha) as being moderate and Dampland (3 ha) as low value Black Cockatoo habitat.
 - All habitat types contained multiple foraging resources for Black cockatoos which equates to approximately 981 ha of foraging habitat.
 - Thirty nine fauna species were recorded during the survey including one species of amphibian, three species of reptile, 32 species of bird and three species of mammal.
 - The Western Brush Wallaby (*Macropus irma*) listed as Priority 4 under Department of Parks and Wildlife's Priority listing was the only conservation significant fauna species recorded during the survey.
 - Black-eared Cuckoo (*Chrysococcyx osculans*) was recorded during the survey this record is considered to occur just outside of the southerly distribution of this otherwise common species.

The study area is considered to be of high conservation value comprising habitat for a high number of threatened flora and fauna species. The vegetation is representative of a number of Threatened and Priority Ecological Communities, some of these are likely to be impacted by the NorthLink WA Project. The addition of the study area to the conservation estate will substantially increase the estate with the adjacent Class C Reserve and provide protection of an important ecological linkage.

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ABBREVIATIONS AND UNITS

Term	Definition
°C	decimal degrees
%	percentage
ANZECC	Australian and New Zealand Environment and Conservation Council
BAM Act	<i>Biosecurity and Agriculture Management Act 2007</i>
BOM	Bureau of Meteorology
CALM	Conservation and Land Management
CCW	conservation category wetland
Coffey	Coffey Environments Australia Pty Ltd
Cwlth	Commonwealth
DBH	diameter at breast height
DEC	Department of Environment and Conservation
DOE	Department of the Environment
DOW	Department of Water
DPAW	Department of Parks and Wildlife
DSEWPAC	Department of Sustainability, Environment, Water, Population and Communities
EP Act	<i>Environmental Protection Act 1986</i>
EPA	Environmental Protection Authority
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
EWSWA	Environmental Weed Strategy for Western Australia
FCT	Floristic Community Type
GPS	global positioning system
ha	hectare
IBRA	Interim Biogeographic Regionalisation for Australia
IUCN	International Union for Conservation of Nature
km	kilometres
m	metres
mm	millimetres
MNES	Matters of National Environmental Significance
MRWA	Main Roads Western Australia



Term	Definition
MUW	multiple use wetland
NVIS	National Vegetation Information System
PEC	Priority Ecological Community
REW	resource enhancement wetland
SCP	Swan Coastal Plain
TEC	Threatened Ecological Community
UFI	unique feature identifier
WC Act	<i>Wildlife Conservation Act 1950</i>
WA	Western Australia
WALGA	Western Australian Local Government Association
WAPC	Western Australian Planning Commission



1 INTRODUCTION

MRWA has purchased an area of land (986 ha) in the Chittering area for the purpose of offsetting impacts of the NorthLink WA Project (including this Perth–Darwin National highway and the Tonkin Grade Separations projects). Both projects have been deemed a ‘controlled action’ by the Commonwealth Department of the Environment (DOE) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) given their impacts to Matter of National Environmental Significance (MNES), specifically Black Cockatoos. These projects are also being assessed under the *Environmental Protection Act 1986* (EP Act).

To determine the suitability of this land as an offset site for these projects, MRWA commissioned the NorthLink WA Consultancy Services Team to complete an environmental survey of the study area.

1.1 Location and Tenure

The study area is Lot M2091 Ippolo Road (Certificate of Title 1169-601), Chittering, located approximately 50 kilometres (km) north of Perth within the Swan Coastal Plain bioregion of Western Australia (Figure 1). The study area is approximately 986 ha (Figure 2) in size and is bordered by a C Class Nature Reserve managed by the Department of Parks and Wildlife to the west, private land bordering Ippolo Road to the north, private land to the southwest, south and east.

The study area is currently zoned “Agriculture Resource” under the Shire of Chittering Town Planning Scheme No. 6. MRWA have purchased the study area for the purpose of conservation management by the Department of Parks and Wildlife. The addition of the study area to the existing C Class Nature Reserve to the west will increase the size of the Nature Reserve from 163 ha to 1146 ha.

1.2 Objective

The objectives of the environmental assessment were to identify the existing environmental values of the study area to determine the suitability of the site as an offset for the project. The environmental assessment included a Level 1 flora and vegetation survey and a Level 1 fauna survey and Black Cockatoo habitat assessment.

The objective of the Level 1 flora and vegetation survey was to:

- Compile an inventory of vascular plants.
- Identify and map the extent of vegetation communities.
- Record the occurrence of introduced plant species.
- Identify and record conservation significant species and ecological communities.
- Locate the presences of wetlands, including rivers, creeks and floodways.

The objective of the Level 1 fauna survey and Black Cockatoo habitat assessment was to:

- Identify the fauna values of the habitats present in the study area.
- Determine the significance of the habitats to support Black Cockatoos.
- Identify conservation significant fauna occurring or likely to occur in the study area.
- Assess the regional and local significance of the study area.

1.3 Scope

The scope of works for the Level 1 flora and vegetation survey included:

- A desktop literature review of databases and previous surveys completed in the vicinity of the study area, including:
 - A search of the Commonwealth’s DOTE protected matters search tool for MNES.
 - Department of Parks and Wildlife’s (DPAW’s) Threatened and Priority flora database.
 - DPAW’s Threatened and Priority ecological communities’ database.
 - DPAW’s combined biological database NatureMap.
 - Environmentally Sensitive Area’s listed under the EP Act.
 - Previous flora and vegetation surveys undertaken in close proximity to the study area.
 - A search of DPAW’s *Geomorphic Wetlands of the Swan Coastal Plain* dataset.
- A Level 1 flora and vegetation survey, which included:
 - Mapping and description of the plant communities according to a broad floristic formation level and a vegetation association level, using a combination of recent aerial photography and field surveys to ground-truth.
 - Mapping of vegetation condition using the vegetation condition rating scale developed by Keighery (1994) and published in Government of Western Australia (2000).
 - Compiling a list of native and non-native plant species occurring within the study area as recorded from relevé sampling, opportunistic collections and observations.
 - Identifying, locating (GPS point) and mapping any significant plant species or ecological communities recorded on the DPAW Threatened species, Priority species, Threatened Ecological Community (TEC) and Priority Ecological Community (PEC) databases.
 - A targeted search, involving a site walk-over, for conservation-significant species potentially occurring within the study area.

The fauna assessment included:

- A desktop literature review of databases and previous surveys completed in the vicinity, which included:
 - The online DPAW NatureMap database to identify potential vertebrate fauna within the study area based on previous fauna surveys conducted in the region.
 - DPAW’s Threatened and priority species database.
 - Commonwealth Government’s database of fauna MNES to identify species potentially occurring within the area that are protected under the EPBC Act or international migratory bird agreements.
 - Previous fauna surveys conducted in the area.
- A level 1 fauna survey, to:
 - Identify the major fauna habitats present within the study area.
 - Record opportunistic fauna sightings, including conservation significant fauna.



- Map the major fauna habitats present surrounding the study area to assess the regional significance of the study area and the importance of ecological linkages.
- Assess the likely presence of conservation significant fauna.
- Identify significant features or habitat for conservation significant fauna species.
- A Black Cockatoo habitat assessment, comprising:
 - A site walkover to search for signs of evidence that Black Cockatoo utilise the study area.
 - The determination of the density of Black Cockatoo breeding habitat.
 - The identification of Black Cockatoo feeding habitat.

2 ENVIRONMENTAL LEGISLATION AND POLICY

2.1 Environmental Legislation

The assessment of native vegetation within the study area was undertaken in accordance with the requirements of the following key environmental legislation and regulations:

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (Cwlth).
- *Environmental Protection Act 1986* (EP Act) (WA).
- *Wildlife Conservation Act 1950* (WC Act) (WA).
- *Biosecurity and Agriculture Management Act 2007* (BAM Act) (WA).
- State Planning Policy 2.8 Bushland Policy for the Perth Metropolitan Region.

2.2 Environmental Policies

The EPA has produced a number of policy statements, guidelines and technical guides, which provide guidelines and advice regarding the EPA's position. Position statements, guidelines and technical guides relevant to fauna, flora and vegetation, including:

- Guidance for the Assessment of Environmental Factors No. 51: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia (EPA, 2004a).
- Guidance for Assessment of Environmental Factors No. 56 – Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia (EPA, 2004b).
- Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA/DEC, 2010).
- Guidance for the Assessment of Environmental Factors No. 6 Rehabilitation of Terrestrial Ecosystems (EPA, 2006).
- Position Statement No. 2 Environmental Protection of Native Vegetation in Western Australia (EPA, 2000).
- Position Statement No. 3 Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA, 2002).
- Position Statement No. 7 Principles of Environmental Protection (EPA, 2004c).
- Western Australia Environmental Offset Guidelines (EPA, 2014) and WA Environmental Offsets Policy (EPA, 2011).

3 EXISTING ENVIRONMENT

3.1 Climate

Pearce RAAF Airbase in Bullsbrook is the nearest reliable Bureau of Meteorology (BOM) weather station to the study area approximately 20 km south. The climate of the Chittering region is described typically as Mediterranean with dry summers and wet winters. The average maximum temperature reaches 33.5°C in summer, while in winter the temperature drops to 8.1°C. The region receives an average annual rainfall of 680 mm, with the majority of this falling in the winter months (1937-2014) (BOM, 2014).

The three months prior to the survey commencing (April to June 2014), RAAF Airbase received 234.5 mm, or 7% below the long-term average rainfall of 253.2 mm (1937-2014) for the same period. The 12 months before the survey the rainfall was 683.8 mm (July 2013 to Jun 2014), which is 0.5% above the long term average of 680.0 mm (1939-2014) for the same period (Figure 3).

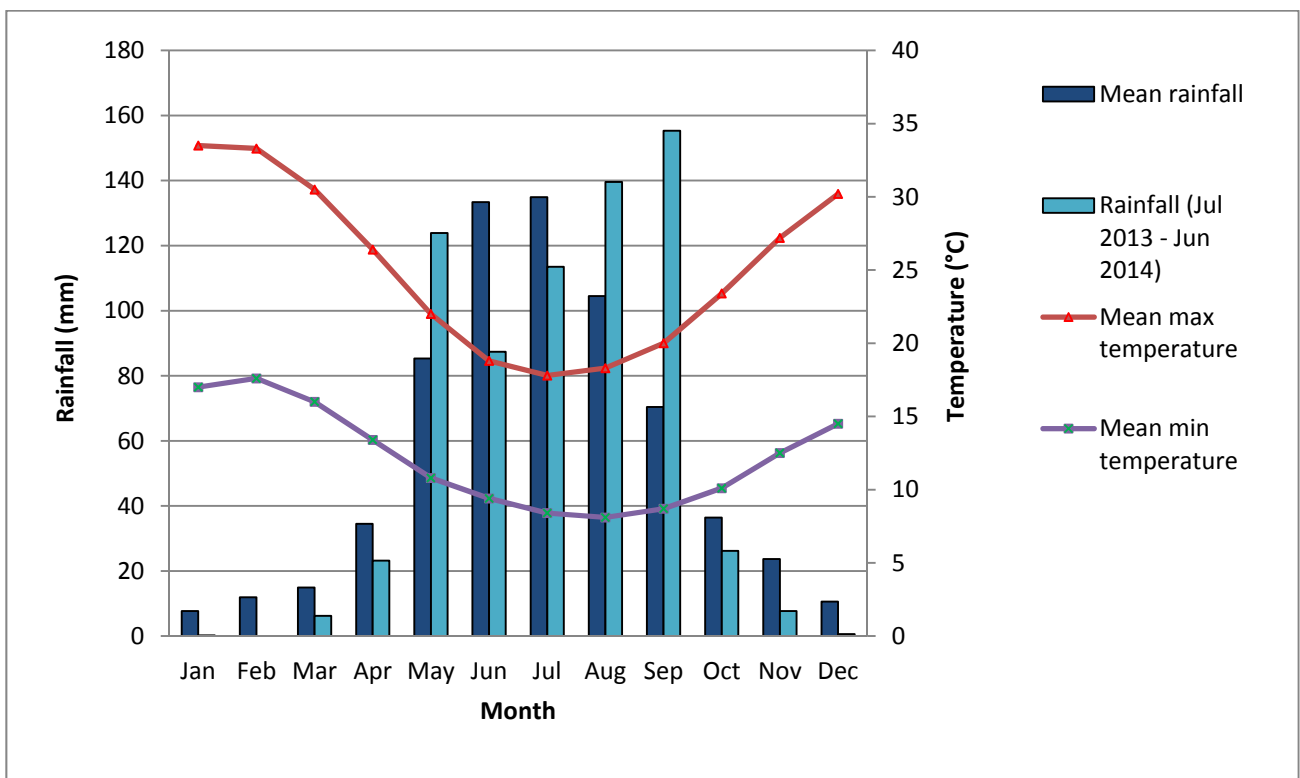


Figure 3 Climate

3.2 Topography and Landforms

The study area is situated on a consolidated sand dune consisting of hill rises, lateritic slopes and plains. A seasonally inundated depression (basin) in the southwest corner of the study area can be associated with Chandala Brook. The soil profile is medium to coarse-grained sand, therefore surface water would infiltrate readily through the porous nature of the soil.



3.3 Geology and Soils

The study area is located on the Swan Coastal Plain bioregion, which in the Perth Region is 34 km wide in the north and 23 km wide in the south and is bounded by the Gingin and Darling Fault Scarps, which rise to over 200 m above sea level (Davidson, 1995). The Swan Coastal Plain consists of a series of distinct landforms (McArthur and Bettenay 1974), roughly parallel to the coast. The distinct landforms, from east to west include the Ridge Hill Shelf, the Pinjarra Plain, the Bassendean Dune system, the Spearwood dune system and the Quindalup dune system (Davidson, 1995).

The study area is located on the Ridge Hill Shelf and the Pinjarra Plain, directly west of the Gingin Scarp and the Dandaragan Plateau. The Ridge Hill Shelf and the Pinjarra Plain are described as:

- Ridge Hill Shelf – comprises the colluvial slopes which form the foothills of the Darling and Dandaragan Plateaus and which represent dissected remnants of a sand covered, wave cut platform.
- Pinjarra Plain – a piedmont and valley-flat alluvial plain consisting predominantly of clayey alluvium that has been transported by rivers and streams from the Darling and Dandaragan Plateaus. The plain is generally about 5 km wide west of the colluvial slopes.

Churchward and McArthur (1978) mapped the soil landforms of the System Six region. According to the mapping by Churchward and McArthur (1978), the study area occurs in association five soil landforms.

- Yanga – Poorly drained plain with grey sandy benches and intervening swamps; also in areas of bog iron ore, marl or solonchic soils.
- Coonambidgee – Gently sloping fringe to the Dandaragan Plateau; deep grey sands.
- Reagan – Gently sloping scarp dominated by yellow or grey sands; some duricrust and gravels present.
- Mogumber – Gently undulating landscapes; duricrust and gravels on crests and grey sands in broad shallow depressions.
- Moondah – Valleys with deep red and yellow brown sands; occasional swamps.

3.4 Hydrology and Wetlands

According to the Department of Water's (DOWs) Hydrogeological Atlas, there are four aquifers occurring in close proximity to the study area. The four aquifers occur at three levels, with two unconfined aquifers, the Mirrabooka and Surficial, occurring at Level 1 (DOW, 2014). The Leederville-Parmelia confined aquifer occurs at Level 2, while the Perth-Yarragadee North confined aquifer is located at Level 3 and represents the bottom aquifer in relation to the study area (DOW, 2014).

According to drainage and contour mapping viewed on the Shared Land Information Platform, a small drainage line passes through the northwest corner of the study area and an additional drainage line, Chandala Brook, runs in a northeast to southwest direction just outside the southern boundary of the study area. The drainage contour in the northwest of the study area is considered to be minor and is unnamed. It does not have a formal channel, but more a flowline between two small rises.

The surface hydrology of the study area flows into the two drainage contours located in close proximity to the study area before discharging into Chandala Lake and other larger creek systems or floodplains in the vicinity of the study area.

DPAW's Geomorphic Wetlands Swan Coastal Plain dataset displays the location, boundary, geomorphic classification (wetland type) and management category of wetlands on the Swan Coastal Plain. The

information contained within this dataset was originally digitised from the Wetlands of the Swan Coastal Plain Volume 2B Wetland mapping, Classification and Evaluation: Wetland Atlas, which was captured at a scale of 1:25, 000 (Hill et al., 1996).

Wetlands on the Swan Coastal Plain have been classified using a geomorphic wetland classification system based on the characteristics of landform and water permanence. Table 1 below details the geomorphic classification of wetlands the DPAW (2014a) have adopted for the Swan Coastal Plain, which have been identified by Semeniuk and Semeniuk (1995).

Table 1 Geomorphic wetland classification types

Hydroperiod	Landform				
	Basin	Channel	Flat	Slope	Highland
Permanent inundation	Lake	River	-	-	-
Seasonal inundation	Sumpland	Creek	Floodplain	-	-
Intermittent inundation	Playa	Wadi	Barlkarra	-	-
Seasonal waterlogging	Dampland	Trough	Palusplain	Paluslope	Palusmont


DPAW has assigned wetland management categories based on their ecological, hydrological and geomorphological significance, and took into account the degree of disturbance that had occurred. The three Wetland Management Categories on the Swan Coastal Plain can be summarised as follows:

1. Conservation Category (CCW) – wetlands that support a high level of ecological attributes and functions (generally having intact vegetation and natural hydrological processes), or that have a reasonable level of functionality and are representative of wetland types that are rare or poorly protected.
2. Resource Enhancement (REW) – wetlands that have been modified (degraded) but still support substantial ecological attributes (wetland dependant vegetation covering more than 10%) and functions (hydrological properties that support wetland dependent vegetation and associated fauna), and have some potential to be restored to the Conservation management category. Typically, such wetlands still support some elements of the original native vegetation, and hydrological function.
3. Multiple Use (MUW) – wetlands that are assessed as possessing few remaining ecological attributes and functions. While such wetlands can still play an important role in regional or landscape ecosystem management, including water management, they are considered to have low intrinsic ecological value. Typically, they have very little or no native vegetation remaining (less than 10%).

According to DPAW's *Geomorphic Wetlands Swan Coastal Plain Dataset*, one MUW (UFI 15732; Palusplain) occurs in the extreme southwest of the study area. An additional four CCWs occur in close proximity to the study area. The four CCWs occur approximately 500 m to 1,200 m to the west of the southwest corner and are associated with Chandala Lake within Chandala Nature Reserve.

3.5 Biological Context of Study Area

The Interim Biogeographic Regionalisation for Australia (IBRA) divides Australia into 89 bioregions based on major biological and geographical attributes. The bioregions have been further divided into 419 subregions. The study area is located in the Swan Coastal Plain (SCP) bioregion, subregion Dandaragan Plateau (SWA01) and a small portion in the southwest of the study area in the Perth subregion (SWA02).



The Dandaragan Plateau (SWA1) subregion consists of cretaceous marine sediments with sand and lateritic mantle. It is bordered by the Derby and Dandaragan Faults. The vegetation includes scrub-heaths on laterite pavement and gravelly sandplains, Jarrah and Marri woodlands and *Banksia* low woodlands. Dominant land use is mainly dry-land agriculture and areas of conservation.

The Perth (SWA2) subregion is a low lying coastal plain which consists of colluvial and Aeolian sands, alluvial river flats and coastal limestone. In the east it rises to duricrusted Mesozoic sediments while to the south there are widespread outwash plains. A complex series of seasonal wetlands and swamps extend north to south. The vegetation includes heath and/or Tuart woodlands on limestone, *Banksia* and Jarrah- *Banksia* woodlands on Quaternary marine dunes of various ages, Marri on colluvial and alluvial soils *Casuarina obesa* on out wash plains and paperbark (*Melaleuca* sp.) in wetland areas (Mitchell et al., 2002.)

3.6 Regional Vegetation

Heddle et al. (1980) have described and mapped vegetation complexes of the Darling System at a floristic scale of 1:250,000 (as recognised by Diels, 1906; and Gardner, 1942). The vegetation complex mapping is based on data collected from the literature, ground surveys, road traverses and aerial photographs and is related to the landforms, soils and climatic conditions.

Based on the mapping undertaken by Heddle et al. (1980) the study area is considered to be representative of five vegetation complexes (Figure 4). The five vegetation complexes have been described as:

- Coonambidgee complex: consists of vegetation ranging from a low open forest and low woodland of Pricklybark (*Eucalyptus todtiana*) and *Banksia* species (*Banksia attenuata*, *Banksia menziesii* and *Banksia ilicifolia*) with local admixtures of *Banksia prionotes*, to open woodland of Marri (*Corymbia calophylla*) and *Banksias* (*Banksia* spp.). The Coonambidgee complex is located on the fluvial deposits of the Swan Coastal Plain.
- Karamal complex-south: is dominated by an open forest of Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*) with a definite second storey of *Banksia grandis* on the gravelly soils and *Banksia attenuata* and *Banksia menziesii* on the sandier soils. The Karamal complex-south is located on the lateritic uplands of the Dandaragan Plateau.
- Mogumber complex-south: dominated by an open woodland of Marri (*Corymbia calophylla*) with a well-defined second storey of Pricklybark (*Eucalyptus todtiana*) and *Banksia* species (*Banksia attenuata*, *Banksia menziesii* and *Banksia ilicifolia*). The Mogumber complex-south is located on the lateritic uplands of the Dandaragan Plateau.
- Moondah complex: supports predominantly a low closed to low open forest of *Banksia attenuata*, *Banksia menziesii*, *Banksia prionotes* and *Eucalyptus todtiana* on the slopes and an open woodland of Marri (*Corymbia calophylla*) and *Banksia* (*Banksia* spp.) in the valleys. The Moondah complex is located in the valleys of the Dandaragan Plateau.
- Reagan complex: supports vegetation ranging from low open woodland of *Banksia attenuata*, *Banksia menziesii* and *Eucalyptus todtiana* to closed heath, depending on the depth of soil. The Reagan complex is located on the scarps of the Dandaragan Plateau.

The extent of each vegetation complex located within the study area is presented in Table 2 below.



Table 2 **Vegetation complex extent**

Land unit	Extent within the study area (ha)	Extent within the study area (%)
Coonambidgee complex	8.7	0.9
Karamal complex-south	181.3	18.4
Mogumber complex-south	424.9	43.1
Moondah complex	105.2	10.7
Reagan complex	266.3	27.0

4 METHODS

4.1 Flora and Vegetation

4.1.1 Desktop Assessment

In accordance with the EPA's Guidance Statement No. 51 for a Level 1 flora and vegetation survey, a desktop assessment was undertaken prior to the field survey component of the assessment. The desktop assessment involved a review of existing environmental or biological data available for the study area and lands adjacent to the study area. The desktop assessment involved the review of State and Federal databases, regional and local contextual data for the northern Swan Coastal Plain and existing biological surveys undertaken on the Swan Coastal Plain. The results of the desktop assessment are detailed in Section 5.

4.1.1.1 Databases

A request for searches of DPAW's threatened flora and ecological community's database was submitted on 30 May 2014 for a central coordinate (-31.487441°S; 115.985779°E) within the study area with a 5 km buffer for Threatened and Priority listed flora and a 10 km buffer for Threatened and Priority listed ecological communities (Appendix A). The search was undertaken for:

- The Department's Threatened (Declared Rare) and Priority Flora database.
- The Western Australian Herbarium Specimen database for Priority species opportunistically collected in the area of interest.
- The Department's Threatened and Priority Flora List, which contains species that are declared rare (Conservation Code T or X for those presumed to be extinct), poorly known (Conservation Codes 1, 2 or 3), or require monitoring (Conservation Code 4).
- The Department's Threatened and Priority Ecological Communities database.

A search of DOTE (2014a) online publicly available database for MNES was undertaken for the study area. A central point (-31.48843S; 115.98843E) with a 10 km buffer was undertaken for the study area (Appendix B).

4.1.1.2 Regional Perspective

A review of regional and local contextual data, with reference to flora and vegetation, was completed prior to the field survey component of the assessment. The review was undertaken to identify the flora and plant communities considered to be significant from a regional and local context. The review also concentrated on broad scale mapping of plant communities and floristic units. The documents that have been reviewed include:

- Vegetation complexes of the Darling System Western Australia (Hedde et al., 1980).
- Floristic Survey of the Southern Swan Coastal Plain (Gibson et al., 1994).
- The Bush Forever Strategy: Volume 1 (Government of Western Australia, 2000a) and Volume 2 (Government of Western Australia, 2000).
- Plant Life of Western Australia (Beard, 1990).

- Local Government Biodiversity Planning Guidelines for the Perth Metropolitan Region (WALGA, 2004).
- The Darling System – System 6, Part I: General Principles and Recommendations (DCE, 1983).
- Native Vegetation in Western Australia: Technical Report 249 (Shepherd et al., 2002).

4.1.1.3 Existing Biological Surveys

Several biological surveys have been undertaken within the study area and in close proximity to the study area. These reports were reviewed to identify the known plant communities occurring within and adjacent to the study area. The review also identified the condition of the vegetation and the location of known conservation significant flora and ecological communities occurring within and adjacent to the study area. The existing biological surveys reviewed, included:

- Perth–Darwin National Highway – Tonkin Highway Link Alignment Definition Study: Environmental Impact Assessment and Biological Survey (GHD, 2013a).
- Swan Valley Bypass, Perth–Darwin National Highway: Level 2 Flora and Vegetation Survey (360 Environmental, 2014).
- A flora and vegetation survey of Lots 46 and 47 Maralla Road and Lexia Avenue, Ellenbrook (M.E. Trudgen & Associates, 1999).
- East Landsdale Flora and Fauna Assessment – Lots 50 and 51 (Ecoscape, 2009a).
- East Landsdale Flora and Fauna Assessment – Lot 154 (Ecoscape, 2009b).
- Level 2 Flora and Vegetation Survey, North Ellenbrook (360 Environmental, 2012).
- Level 1 flora and fauna assessment of Gaston Road, Muchea (GHD, 2009).
- Flora and fauna assessment, Mitchell Freeway Extension (Burns Beach Road to Romeo Road) (GHD, 2013b).
- Level 2 flora and vegetation survey of Lot 5 Mornington Drive, Mariginuiup (Monocot-Dicot Botanical Research, 2010).
- Flora and vegetation assessment, M70/138 Hopkins Road, Nowergup (Coffey Environments, 2010).

4.1.2 Field Survey

A Level 1 flora and vegetation survey, consistent with the EPA’s Guidance for the Assessment of Environmental Factors No. 51 (EPA, 2004a), was conducted of the study area. The survey was completed from 8 to 10 June and 17 June 2014.

The field survey component of the assessment was led by Mr Clinton van den Bergh, assisted by Ms Lucy Dadour and Ms Michelle Holliday. Clinton has over 8 years’ experience conducting flora and vegetation surveys in Western Australia with relevant experience on the Swan Coastal Plain.

The survey was conducted under a Licence to take flora for scientific or other prescribed purposes (licence number SL010743) and a Permit to take Declared Rare Flora (permit number 73–1314) from DPAW. All flora specimens were collected during the survey under these licences and permits, in accordance with the conditions required under each licence/permit.

4.1.2.1 Flora and Vegetation Assessment

A total of 30 relevés were sampled within the study area. Relevés are unmarked quadrats where a central point is marked with a Global Positioning System (GPS) and an approximate radius is sampled around this



point for the purpose of recording vegetation structure, species composition, dominance and compiling a species inventory. For the purpose of this assessment a radius of approximately 20 m was sampled. Flora sampling quadrats on the Swan Coastal Plain are 100 m² in size, therefore the size of the relevé was sufficient to sample the flora and vegetation within the study area.

Information recorded at each relevé included landform features, soil colour and texture, leaf litter cover, rock size and type, vegetation structure, vegetation condition and fire age. Structural information on the dominant species (species with a cover higher than 1%) including height and percentage cover were recorded for each relevé.

Common species that were well known to the survey botanists were identified in the field, while remaining species unknown to the survey botanist were collected during the field survey and assigned a unique number to facilitate tracking. The specimens were pressed during that day, following recommendations provided by the Western Australia Herbarium. The specimens were then sufficiently dried prior to submitting to a consultant taxonomist, Mr Malcolm Trudgen, for identification.

The broad floristic formations and vegetation associations were described based on the floristic data recorded from the relevés and from visual observations while traversing the study area, utilising the standardised terminology for vegetation structural classes detailed in the Australian Vegetation Attribute Manual (ESCAVI, 2003). The vegetation structural terminology of the National Vegetation Information System (NVIS) was adapted from Specht (1970), Specht et al. (1974), and Walker and Hopkins (1990) (ESCAVI, 2003).

The vegetation recorded from the study area has been described to a NVIS hierarchical level III (Broad Floristic Formation) and V (Vegetation Association). Hierarchical level III requires the dominant growth form, cover, height and dominant land cover genus for the upper most or the ecologically or structurally dominant stratum. Hierarchical level V requires the dominant growth form, cover, height and dominant species (three for each stratum) for each of the three traditional strata (i.e. upper, mid and ground). The hierarchical structure and the vegetation structural terminology are described in Table 3 and Table 4, while the NVIS height class definition is provided in Table 5.

Table 3 NVIS hierarchical structure

Hierarchical level	Description	NVIS structural/floristic component required
I	Class	Dominant growth form for the ecologically or structurally dominant stratum.
II	Structural Formation	Dominant growth form, cover and height for the ecologically or structurally dominant stratum.
III	Broad Floristic Formation	Dominant growth form, cover, height and dominant land cover genus for the upper most or the ecologically or structurally dominant stratum.
IV	Sub-formation	Dominant growth form, cover, height and dominant genus for each of the three traditional strata (i.e. Upper, Mid and Ground).
V	Association	Dominant growth form, height, cover and species (3 species) for each of the three traditional strata (i.e. Upper, Mid, Ground).
VI	Sub-Association	Dominant growth form, height, cover and species (5 species) for all layers/sub-strata.

Source: Table 1 from ESCAVI (2003).



Table 4 NVIS structural terminology

Stratum	Growth form	Height ranges (m) ¹	Structural formation classes (% cover)					
			80–100	50–80	20–50	0.25–20	0–0.25	Unknown
U	Tree, palm	<10 = low 10-30 = mid >30 = tall	Closed forest	Open forest	Woodland	Sparse woodland	Isolated trees	Isolated clumps of trees
	Tree mallee	<3 = low <10 = mid 10-30 = tall	Closed mallee forest	Open mallee forest	Mallee woodland	Sparse mallee woodland	Isolated mallee trees	Isolated clumps of tree mallees
M	Shrub, cycad, tree-fern	<1 = low 1-2 = mid >2 = tall	Closed shrubland	Shrubland	Open shrubland	Sparse shrubland	Isolated shrubs	Isolated clumps of shrubs
	Mallee shrub	<3 = low <10 = mid 10-30 = tall	Closed mallee shrubland	Mallee shrubland	Open mallee shrubland	Sparse mallee shrubland	Isolated mallee shrubs	Isolated clumps of mallee shrubs
	Heath shrub	<1 = low 1-2 = mid >2 = tall	Closed heath shrubland	Heath shrubland	Open heath shrubland	Sparse heath shrubland	Isolated heath shrubs	Isolated clumps of heath shrubs
	Chenopod shrub	<1 = low 1-2 = mid >2 = tall	Closed chenopod shrubland	Chenopod shrubland	Open chenopod shrubland	Sparse chenopod shrubland	Isolated chenopod shrubs	Isolated clumps of chenopod shrubs
	Samphire shrub	<0.5 = low >0.5 = mid	Closed samphire shrubland	Samphire shrubland	Open samphire shrubland	Sparse samphire shrubland	Isolated samphire shrubs	Isolated clumps of samphire shrubs
G	Hummock grass	<2 = low >2 = mid	Closed hummock grassland	Hummock grassland	Open hummock grassland	Sparse hummock grassland	Isolated hummock grasses	Isolated clumps of hummock grasses
	Tussock grass	<0.5 = low >0.5 = mid	Closed tussock grassland	Tussock grassland	Open tussock grassland	Sparse tussock grassland	Isolated tussock grasses	Isolated clumps of tussock grasses
	Other grass	<0.5 = low >0.5 = mid	Closed grassland	Grassland	Open grassland	Sparse grassland	Isolated grasses	Isolated clumps of grasses
	Sedge	<0.5 = low >0.5 = mid	Closed sedgeland	Sedgeland	Open sedgeland	Sparse sedgeland	Isolated sedges	Isolated clumps of sedges



Stratum	Growth form	Height ranges (m) ¹	Structural formation classes (% cover)					
			80–100	50–80	20–50	0.25–20	0–0.25	Unknown
	Rush	<0.5 = low >0.5 = mid	Closed rushland	Rushland	Open rushland	Sparse rushland	Isolated rushes	Isolated clumps of rushes
	Vine	<10 = low 10-30 = mid >30 = tall	Closed vineland	Vineland	Open vineland	Sparse vineland	Isolated vines	Isolated clumps of vines
	Herbs	<0.5 = low >0.5 = mid	Closed herbland	Herbland	Open herbland	Sparse herbland	Isolated herbs	Isolated clumps of herbs

Source: ESCAVI (2003). Note growth forms that do not occur or were not sampled within the study area were omitted (i.e. seagrass bed).
 1. Refer to Table 5 for height range information.

Table 5 NVIS height class definition

Height class	Height range (m)	Growth forms			
		Tree, palm, vine	Shrub, heath shrub, chenopod, samphire shrub, tree-fern	Tree mallee, mallee shrub	Hummock grass, tussock grass, other grass, sedge, rush, herb
8	>30	Tall			
7	10-30	Mid		Tall	
6	<10	Low		Mid	
5	<3			Low	
4	>2		Tall		Tall
3	1-2		Mid		Tall
2	0.5-1		Low		Mid
1	<0.5		Low		Low

Source: ESCAVI (2003).

The condition of the vegetation recorded within the study area was described based on the condition rating scale developed by Keighery (1994) and published in the Bush Forever Strategy (Government of Western Australia, 2000b) (Table 6).



Table 6 Vegetation condition rating scale

Condition code	Definition
P Pristine	Pristine or nearly so, no obvious signs of disturbance.
Ex Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are nonaggressive 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 disturbances. 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 area is completely or almost completely without native species. These areas are often referred to as parkland cleared with the flora composing weed or crop species with isolated native trees or shrubs.

Source: Bush Forever (Government of Western Australia, 2000), originally developed by Keighery (1994).

4.1.2.2 Targeted Searches

Sections of the study area were traversed on foot, with known locations of conservation significant flora or habitat likely to support conservation significant flora targeted during the searches. For populations of potential or known significant flora, a specimen, GPS location, photo, estimated population size and description of vegetation was documented. Further opportunistic collections of taxa not recorded in the relevés and introduced flora were also recorded. The focus of the targeted introduced flora surveys were:

- Weeds of National Significance listed under the EPBC Act.
- Declared Pests under Section 22 of the BAM Act.
- Environmental weed species with a “High” rating as listed by DPAW.

4.1.3 Limitations of Survey

The field survey component of the assessment was not undertaken at the most appropriate time for conducting flora and vegetation surveys on the Swan Coastal Plain. The survey was undertaken in winter, while the optimal time is spring. However, this is not considered to be a major limiting factor, as only a Level 1 flora and vegetation survey was required to identify the dominant vegetation structures.

No numerical analysis of the floristic data collected from the field survey was undertaken. Fungi and non-vascular flora (e.g. bryophytes, mosses etc.) were not collected or recorded during the field survey. The collection of fungi and non-vascular flora was outside the scope of this survey.

Table 7 below details the botanical survey limitations associated with the flora and vegetation assessment of the Study area.



Table 7 Botanical survey limitations

Limitation	Constraint and significance*	Comments
Competency/experience of the scientist conducting the survey	No	The survey and reporting was executed by Senior Botanist Clinton Van Den Bergh and Environmental Ecologist Lucy Dadour. A specialist consultant taxonomist, Malcolm Trudgen, undertook the specimen identifications.
Level of survey	No	A single phase Level 1 flora and vegetation survey was completed in accordance with the EPA's Guidance Statement 51 (EPA, 2004a).
Sources of information	No	The Swan Coastal Plain has been comprehensively surveyed in the past as a result of urban development. The sources of information were reviewed prior to, during and after the survey.
Scope	No	The entire scope was met.
Proportion of: a) Flora collected and identified. b) Task achieved and further work that may be required.	a) Yes; low b) No	a) It is estimated that between 70 and 80% of the potential flora occurring in the study area has been recorded. b) All tasks were achieved.
Completeness	No	The study area was adequately sampled and traversed.
Mapping reliability	No	The study area was traversed on foot and was easily accessible. The upper stratum of the plant communities were fairly homogenous over the entire study area. As a result the mapping reliability from a broad floristic formation is considered to be high. The mapping reliability at the vegetation association level is considered to be moderate to high.
Timing/weather/season/cycle	Yes	The survey was undertaken in winter so does not constitute a comprehensive inventory of annual and ephemeral species.
Disturbances which affected the results of the survey	No	The study area was considered to be in excellent condition with very minor disturbances. In some sections, the Banksia species were dying as a result of the drought or poor rainfall in the years preceding the survey.
Intensity of the survey	No	The survey was undertaken at an intensity which is in accordance with the EPA guidance (EPA, 2004a).
Completeness	No	The study area was adequately traversed on foot or via vehicle.
Resources	No	Adequate resources were assigned to the field surveys, specimen identifications and reporting components of the assessment.
Remoteness and/or access problems	No	Several unmade roads and informal tracks were located across the study area. These were accessed during the field survey component of the assessment.
Availability of contextual information	No	The greater Swan Coastal Plain region has been extensively surveyed, therefore a large amount of contextual information is available for the study area.

* Indicates whether the limitation is a constraint (yes/no) and, if yes, the significance of the constraint (low/moderate/high).

4.2 Fauna

4.2.1 Desktop Assessment

In accordance with the EPA's Guidance Statement No. 56 for a Level 1 fauna survey, a desktop assessment was undertaken prior to the field survey component of the assessment. The desktop assessment involved a review of existing environmental or biological data available for the study area and lands adjacent to the study area. The desktop assessment involved the review of State and Federal databases, regional and local contextual data for the northern Swan Coastal Plain and existing biological surveys undertaken on the Swan Coastal Plain. The results of the desktop assessment are detailed in Section 5.

4.2.1.1 State and Federal Government Databases

State and federal database searches were undertaken using:

- DPAW NatureMap online database (DPAW, 2014a). The search area was a 15 km circle around the coordinates 31°29'12"S 115°59'05"E.
- DPAW list of Threatened and Priority fauna (DPAW, 2014b). The search area was a 15 km circle around the coordinates 31°29'12"S 115°59'05"E.
- The Protected Matters Search Tool maintained by the DOTE bounded by a 10 km buffer area for the coordinates -31.486074°S, 115.989609°E (DOTE, 2014a).

4.2.1.2 Regional and Local Contextual Data

A review of regional and local contextual data, with reference to fauna, was completed prior to the field survey component of the assessment. The documents that have been reviewed include:


- Birds Australia Birddata (Birddata, 2014). The search area was a one degree square containing the point -31.41522 °S, 115.9935 °E.
- General texts to provide supplementary information including Tyler and Doughty (2009) for frogs; Storr et al., (1983, 1990, 1999, 2002), Bush et al. (2010), Bush et al. (2007) and Wilson and Swan (2010) for reptiles; Johnstone and Storr (1998; 2004), Simpson and Day (2010) and Johnstone and Storr (1998; 2004) for birds; and Menkhorst and Knight (2011) and van Dyck and Strahan (2008) for mammals; Churchill (2008) for bats.

4.2.1.3 Existing Biological Surveys

Several biological surveys have been undertaken within the study area and in close proximity to the study area. These reports were reviewed to identify the fauna assemblages occurring within and adjacent to the study area. The review also identified the location of known conservation significant fauna occurring within and adjacent to the study area. The existing biological surveys reviewed, included:

- Egerton Fauna Survey (Tingay and Associates, 1994).
- A Biological Survey of Boonaring Nature Reserve (Burbidge et al., 1996).
- Flora, Vegetation and Vertebrate Fauna Assessment Neerabup Industrial Area (ATA, 2007).
- Neerabup Road Extension Level 2 Fauna Survey (GHD, 2014).

Collectively these sources of information were used to create lists of species expected to utilise the study area. It should be noted that these lists include historic records of species that have since become locally extinct and species that have been recorded in the general region, but are vagrants, and are generally not found in the area because of a lack of suitable habitat. Many previously recorded fauna have specific habitat requirements that may be present in the general area but not located in the study area (e.g. marine



species). As such, erroneous records and species that have habitat specificity to habitats not present in the study area (wetland and marine species) have been omitted from the list of species expected to occur.

4.2.2 Field Survey

The field survey was conducted on 8 to 11 July by John Trainer and Michelle Holliday. The survey included an inspection of the major fauna habitats, Black Cockatoo habitat assessment and opportunistic fauna observations. The site was traversed by foot and a list of fauna recorded during the survey was assembled. The presence or evidence of any conservation significant fauna had its details recorded (GPS location, sex, habitat and picture taken if possible).

4.2.2.1 Fauna Habitat

Fauna habitats were classified according to vegetation and landform types and then mapped using a combination of aerial photography and ground-truthing. Fauna habitat assessments were conducted to record the habitat features and habitat values across the site. Fauna habitats were assessed on the microhabitats they provide to the expected faunal assemblage, habitat/vegetation condition and also the number of conservation significant fauna they potentially support.

4.2.2.2 Black Cockatoo Habitat Assessment

The vegetation of the study area was assessed on its ability to provide habitat to the three threatened species of Black Cockatoo. Based upon the current distribution maps in the EPBC Act referral guidelines for three threatened Black Cockatoo species (herein referred to as the Cockatoo referral guidelines) the study area is located in the known range of two of the three species: the Carnaby's Cockatoo and on the extreme northern range of the Forest Red-tailed Black Cockatoo (DSEWPAC, 2012). The methodology used to conduct the Black Cockatoo habitat assessment is consistent with that specified in the Cockatoo referral guidelines.

Habitats were mapped as High, Moderate or Low value for Black Cockatoos based on the level of suitable habitat they provide. High value habitats provide breeding, foraging and roosting habitat. Moderate value habitats provide quality foraging habitat or quality foraging habitat and roosting habitat. Low value habitats provide limited foraging habitat.

Foraging Assessment

The site was examined for evidence of current and historic foraging by Black Cockatoos, with particular focus upon the species of plant that are known foraging resources of these species (Valentine and Stock, 2008, Johnstone et al., 2008 and Chapman, 2007). Evidence in the form of chewed Marri or Jarrah nuts/fruits, chewed/broken Banksia seed pods and stripped tree bark are usually located on the ground underneath foraging resources. Due to the differing beak morphology of each of the Black Cockatoo species, characteristic chew marks are created upon Marri nuts which can be used to provide species identification (Fleming, 2011). Foraging habitat is mapped according to the presence of foraging resources.

Roosting Assessment

According to the Cockatoo referral guidelines roosting habitat is classified as a group of tall trees that are located close to riparian environments or other permanent water sources, usually close to or within foraging habitat (DSEWPAC, 2012). Trees or stands of trees that match this description were examined for evidence of recent use as a roost site (feathers and droppings) and a database searches was conducted for known roost sites in the vicinity of the site. Any stand of tall trees was classified and mapped as potential roosting habitat due to the study areas close proximity to riparian environments and permanent water sources.

Breeding Assessment

All three species of Black Cockatoo breed in large tree hollows which are found in trees usually more than 200 years old (DSEWPAC, 2012). The size of a tree is measured by its diameter at breast height (DBH) in millimetres (mm) and is used to establish its hollow bearing potential. Trees with a DBH of 500 mm or above (300 mm DBH for Salmon Gum and Wandoo) are classified as providing breeding habitat.

Due to the large size of the study area (988 ha) a tree density survey was deemed the most appropriate method to establish the level of breeding habitat present. Within each large stand of tree in the Eucalypt Woodland, a one hectare quadrat (100 m x 100 m) was conducted in an area of representative tree density. The number of trees with a DBH over 500 mm per quadrat and their details (species, height and presence of hollows) was recorded per site. This information was used to provide breeding tree density for each Eucalypt Woodland stand (number of trees/hectare) and extrapolated based on habitat mapping to give a total estimate of the number of breeding trees in the study area. In the stands of trees where multiple tree density surveys were completed an average of total tree density was used.

Additionally, the details (GPS location, species, height and size of hollows) of trees with suitable breeding hollows were opportunistically recorded while traversing the study area.

4.2.3 Limitations of Survey

As this survey was a level 1 survey with no trapping program, small ground dwelling fauna such as skinks, snakes and small mammals are unlikely to be recorded. However, the lack of conservation significant fauna that fall into this category and the high number of previous surveys completed in the vicinity should not impact upon this assessments ability to identify them as part of the wider fauna assemblage.

Both field participants (Mr John Trainer and Ms Michelle Holliday) are experienced in conducting fauna assessments in the South West.

As numerous terrestrial fauna surveys have been conducted in the region, fauna assemblages are well characterised. As such, there is sufficient quantitative terrestrial fauna data collected from study area to allow for comparison to regional data.

Weather was cold and intermittently wet during the assessment with maximum ambient temperatures between 15.7 and 17.2°C and minimum ambient temperatures down to 2.4°C (BOM, 2014). With 11 mm recorded over the survey period. The survey was conducted out of season (EPA, 2004b and EPA/DEC, 2010), which deem that late spring/early summer is the most appropriate time to conduct fauna surveys in the South West. However, as this was a Level 1 survey with no trapping program, the focus of the survey was on habitat assessments rather than recording the faunal assemblage and is considered a low value constraint. The cold weather experienced during the survey would have impacted the number of opportunistic fauna records obtained during the survey, in particular observations of reptiles.

There were no access issues throughout the study area and the entire area was adequately surveyed. A statement of the fauna survey limitations for the project is provided in Table 8.

Table 8 Fauna survey limitations

Limitation	Constraint and significance*	Comments
Competency/experience of the scientist conducting the survey	No	An experienced zoologist undertook the field survey and the reporting.
Level of survey	No	A Level 1 fauna survey was considered appropriate to identify the habitat and conservation significant fauna values of the study area.



Limitation	Constraint and significance*	Comments
Sources of information	No	The Swan Coastal Plain region has been extensively surveyed with several comprehensive fauna surveys undertaken in within comparable habitats to those found in the study area.
Scope	No	The entire scope was met.
Proportion of: a) Fauna identified, recorded and/or collected; and b) Task achieved and further work that may be required	a) Yes; low b) No	a) The lack of pit fall traps reduces the number of small reptiles and mammals identified. However, the lack of conservation significant fauna that fall into this category and the high number of previous surveys completed in the region should not impact upon this assessments ability to identify them as part of the wider fauna assemblage. b) No further work is considered necessary to meet the current objectives and scope.
Completeness	No	The study area was adequately sampled and traversed.
Mapping reliability	No	The mapping reliability is considered to be high due to the homogenous nature of the study area and the quadrat sampling undertaken across the study area.
Timing/weather/season/cycle	Low	The survey was conducted out of season (EPA, 2004b and EPA/DEC, 2010), which deem that late spring/early summer is the most appropriate time to conduct fauna surveys in the South West. However, as this was a Level 1 survey with no trapping program, the focus of the survey was on habitat assessments rather than recording the faunal assemblage and is considered a low value constraint.
Disturbances which affected the results of the survey	No	There were no disturbances that affected the results of the survey.
Intensity of the survey	No	The intensity of the survey is sufficient to identify the presence of conservation significant fauna within the study area and to conduct a Black Cockatoo habitat assessment.
Completeness	No	The study area was adequately traversed on foot or via vehicle.
Resources	No	Adequate resources were assigned to the field survey and the reporting associated with the project.
Remoteness and/or access problems	No	The study area was adequately traversed on foot or via vehicle.
Availability of contextual information	No	The Swan Coastal Plain has been extensively surveyed, with all contextual information accessed prior, during and after the field survey (refer to Section 4.2.1).

* Indicates whether the limitation is a constraint (yes/no) and, if yes, the significance of the constraint (low/moderate/high).



4.3 Dieback

Phytophthora Dieback (Dieback) is a soil borne pathogen. In the southwest of Western Australia there is a number of plant hosts, including the Ericaceae, Fabaceae, Myrtaceae, Proteaceae, and Xanthorrhoeaceae families. While not all plants are susceptible to the disease, the ones that are affected by the pathogen generally results in chlorosis, dieback and often death (Terratree, 2014).

A linear dieback assessment of the main access tracks (approximately 119 ha) was conducted for the study area (Terratree, 2014 Appendix C). The following categorisation for vegetation was applied to determine the risk of dieback:

- High Risk: Areas where *Phytophthora cinnamomi* has been recovered from samples and disease symptoms are consistent with the presence of Dieback.
- Moderate Risk: Areas exhibiting past or current disturbances (logging, grazing, dumping etc.) which has altered vegetation structure and composition and areas downslope of confirmed infestations, or vegetation exhibiting disease symptoms but have not returned positive results for *P. cinnamomi*.
- Low Risk: Areas of protectable uninfested vegetation (as determined by a registered Dieback interpreter), which exhibit multiple healthy indicator species, vegetation in Pristine to Very Good condition, no disease pattern or chronology, and no significant risks from disease vectors or current land use.

5 RESULTS

5.1 Flora and Vegetation

5.1.1 Desktop Assessment

The desktop review and database searches yielded a total of 55 conservation significant taxa occurring or potentially occurring within the proximity of the study area (Appendix D). The 55 conservation significant taxa occurring or potentially occurring in the study area included 20 Threatened (declared rare-extant) taxa, three Priority 1 taxa, eight Priority 2 taxa, seventeen Priority 3 taxa and six Priority 4 taxa.

The desktop review identified one Threatened, *Chamelaucium* sp. Gingin (D. Marchant 6), and six Priority taxa (*Acacia cummingiana* (P3); *Caustis* sp. Gigas (A.S. George 9318) (P2); *Hypolaena robusta* (P4); *Schoenus griffinianus* (P3); *Verticordia rutilastra* (P3); and *Verticordia serrata* var. *linearis* (P3)) as occurring within the study area (Figure 5). The likelihood of the remaining 19 Threatened and 29 Priority listed taxa is detailed in Appendix D and is based on the following criteria:

- **Likely:** suitable habitat present and records within or less than 2 km from the study area.
- **Possible:** suitable habitat present, with records within 2-10 km from the study area.
- **Unlikely:** lacks of suitable habitat present, and/or there are no records closer than 10 km from the study area.

Based on the assessment of likelihood of occurrence, ten conservation significant taxa are known to occur or expected to occur within the study area, and a further 15 conservation significant taxa may potentially occur within the study area based on known locations and habitat preferences. The remaining 30 conservation significant taxa are not expected to occur within the study area based on habitat preferences and the current known locations (Appendix D).

Of the ten conservation significant taxa known to occur or expected to occur within the study area, only *Chamelaucium* sp. Gingin (N.G. Marchant 6) is listed as Threatened taxa under the WC Act and the EPBC Act. The remaining nine conservation significant taxa are listed as Priority taxa by DPAW.

Seven ecological communities listed as conservation significant, including four Threatened Ecological Communities and three Priority Ecological Communities are known to occur. Of the four TECs, three are listed as TECs under the EPBC Act. The list of TECs and PECs known to occur or potentially occur in the study area are presented in Table 9. The TEC SCP20c and the PECs SCP23b and Banksia yellow-orange sands, occur within the study area (see Figure 5), while the buffer for the Wooded waterbird wetlands PEC occurs across the southwest corner of the study area. The remainder of the TECs occur between 7 and 10 km of the study area.

Table 9 Threatened and Priority Ecological Communities occurring within close proximity to the study area

Community name	Community description	Federal listing ¹	State listing ¹
NTHIRON	Perth to Gingin Ironstone Association.	Endangered	Critically Endangered
Mound Springs SCP	Communities of Tumulus Springs (Organic Mound Springs, Swan Coastal Plain).	Endangered	Critically Endangered
Muchea Limestone	Shrublands and woodlands on Muchea Limestone.	Endangered	Endangered
SCP20c	<i>Banksia attenuata</i> woodland over species rich dense shrublands.		Endangered
Banksia yellow-orange sands	<i>Banksia</i> woodland of the Gingin area restricted to soils dominated by yellow to orange sands.		Priority 2
Wooded waterbird wetlands	Wooded wetlands which support colonial waterbird nesting areas.		Priority 2
SCP23b	Swan Coastal Plain <i>Banksia attenuata</i> – <i>Banksia menziesii</i> woodlands.		Priority 3

1. See Appendix E for the definitions of Federal and State listing categories.

5.1.2 Vegetation Condition

The condition of the vegetation recorded within the study area ranged from Good to Pristine (Figure 6) according to the vegetation condition rating scale in Table 6. The majority (84%) of the vegetation was in excellent condition due to the intact vegetation structure, minimal anthropogenic disturbances and minimal signs of disturbance as a result of pathogens, diseases and overgrazing from native and non-native fauna.

The sections of vegetation in good condition were generally located in areas of higher visitation from humans and non-native fauna. These areas were located in the southwest corner, the eastern and northern boundaries of the study area and along the unmade Reserve Road that goes through the centre of the study area. Old car bodies and higher concentrations of introduced taxa were located along the eastern boundary, associated with a gate in the fence that allowed stock to graze within the study area and uncontrolled movement from the paddocks.

In addition to the areas of the study area that were considered to have a lower condition rating, there were several areas that were considered to have a higher condition rating. The areas of vegetation considered to be pristine were generally located within the middle of the study area where introduced taxa and human visitation is low to non-existent.

5.1.3 Dieback

The majority of the study area (87.6 ha) is categorised as Low risk vegetation, with 12.2 ha rated as moderate and 19.4 ha assessed as high risk. Most of the study area is uninfested and presents a low risk of spreading the disease into other areas (Terratree, 2014; Appendix C).

5.1.4 Vegetation Units

The vegetation units recorded from the study area can be broadly categorised into four broad floristic formations. The broad floristic formations have been mapped on Figure 7 and are described below:

- *Corymbia* woodland – The *Corymbia* woodland broad floristic formation occurred as a dominant and as a co-dominant with *Eucalyptus* species along the higher landforms of the study area and generally in association with lateritic soils. The dominant upper stratum species was *Corymbia calophylla*. The extent of *Corymbia* woodland covers 17% of the study area.
- *Eucalyptus* woodland – The *Eucalyptus* woodland broad floristic formation occurred across the study area and occurred as either the dominant upper stratum or as a co-dominant with *Corymbia calophylla*. The *Eucalyptus* woodland occurred on lateritic soils and deep sands higher in the landscape. The dominant species in the upper stratum was *Eucalyptus marginata*. The extent of *Eucalyptus* woodland covers 56% of the study area.
- *Banksia* woodland – The *Banksia* woodland occurred in small isolated patches and has been identified as a separate formation compared to the *Banksia* shrubland due to the height of woodland (over 10 m) and the lack of *Eucalyptus* or *Corymbia* species. The dominant *Banksia* species were *Banksia attenuata* and *Banksia menziesii*. The extent of *Banksia* woodland covers 10% of the study area.
- *Banksia* shrubland – The *Banksia* shrubland is distinct from the *Banksia* woodland due to the isolated or sparse presence of *Eucalyptus tottiana* in the upper stratum. The *Banksia* species (commonly *Banksia attenuata* and *Banksia menziesii*) were generally lower than 10 m in height. The *Banksia* shrubland broad floristic formation was the dominant formation across the study area. The extent of *Banksia* shrubland covers 17% of the study area.

A total of 16 vegetation units were identified from the study area (Table 10). The vegetation units have been described to a vegetation association level (Hierarchical Level V) and have been divided further from the four broad floristic formations. The vegetation association units have been mapped on Figure 8, while the floristic data collected from the 30 relevés sampled within the study area are provided in Appendix F.



5.1.5 Vegetation Significance



5.1.5.1 Boregional and Subregional Protection



The bioregions and subregions are the reporting unit for assessing the status of native ecosystems and their level of protection in the National Reserve System. In this way, IBRA is used as a dynamic tool for monitoring progress towards building a comprehensive, adequate and representative (CAR) reserve system (DOTE, 2014b). Such information assists governments to decide how to best prioritise funding to meet national protection targets.



The study area is located within the Swan Coastal Plain bioregion and the Perth subregion. According to the National Reserve System, the Swan Coastal Plain bioregion is not considered to be a bioregion with less than 10% protection. Both the Swan Coastal Plain bioregion and the Perth subregion have between 10-15% of their current area protected within International Union for Conservation of Nature (IUCN) Class I-IV Reserves (i.e. National Parks, Nature Reserves).



Table 10 **Vegetation units recorded**



Unit code	Quadrats	Broad floristic formation and site preference	Vegetation description	Area of study area	Photograph
EmCc ¹	COR01 & COR09	<i>Eucalyptus</i> woodland Lateritic slopes and rises	<i>Eucalyptus marginata</i> and occasional <i>Corymbia calophylla</i> mid sparse woodland over <i>Xanthorrhoea preissii</i> and <i>Allocasuarina humilis</i> mid open to mid sparse shrubland over <i>Hibbertia hypericoides</i> , <i>Conostephium pendulum</i> and occasional <i>Hakea stenocarpa</i> low open shrubland over <i>Lepidosperma pubisquamum</i> (flat form) and <i>Mesomelaena tetragona</i> and <i>Mesomelaena pseudostygia</i> low sparse sedgeland on lateritic coarse black, brown sandy loam on lateritic rises and slopes.	1.2% / 11.5 ha	
BaBmNf	COR03, COR11, COR18, COR26 & COR27	<i>Banksia</i> shrubland Consolidated dunes and plains	<i>Banksia attenuata</i> , <i>Banksia menziesii</i> and <i>Nuytsia floribunda</i> tall sparse to tall open shrubland over <i>Allocasuarina humilis</i> , <i>Xanthorrhoea preissii</i> and <i>Daviesia divaricata</i> subsp. <i>divaricata</i> mid sparse to mid open shrubland over <i>Eremaea pauciflora</i> var. <i>pauciflora</i> , <i>Melaleuca systema</i> and <i>Leucopogon conostephioides</i> low open shrubland over <i>Mesomelaena pseudostygia</i> and <i>Schoenus efoliatus</i> low sparse sedgeland on yellow, grey-brown coarse grained sand on consolidated dunes.	15.0% / 147.9 ha	



Unit code	Quadrats	Broad floristic formation and site preference	Vegetation description	Area of study area	Photograph
EmCc ²	COR05	<i>Eucalyptus</i> woodland Lateritic slopes	<i>Eucalyptus marginata</i> and <i>Corymbia calophylla</i> mid woodland over <i>Xanthorrhoea preissii</i> mid sparse shrubland over <i>Hibbertia hypericoides</i> low open shrubland over <i>Mesomelaena tetragona</i> low sparse sedgeland on a lateritic slope with brown coarse grained sandy loam with a laterite subsurface on lateritic slopes.	0.5% / 4.8 ha	
Em ¹	COR06	<i>Eucalyptus</i> woodland Consolidated plains	<i>Eucalyptus marginata</i> low sparse woodland over <i>Banksia attenuata</i> , <i>Banksia menziesii</i> and <i>Adenanthos cygnorum</i> subsp. <i>cygnorum</i> tall open shrubland over <i>Jacksonia floribunda</i> mid isolated shrubs over <i>Hibbertia hypericoides</i> and <i>Stirlingia latifolia</i> low open shrubland over <i>Hypolaena exsulca</i> , <i>Lyginia imberbis</i> and <i>Alexgeorgea nitens</i> low sparse rushland on a plain with grey brown coarse grained sand on consolidated plain.	3.6% / 35.9 ha	



Unit code	Quadrats	Broad floristic formation and site preference	Vegetation description	Area of study area	Photograph
EtNf	COR10 & COR24	<i>Eucalyptus</i> woodland Consolidated dunes	<i>Eucalyptus tottiana</i> and <i>Nuytsia floribunda</i> mid sparse to mid isolated mallee woodland over <i>Banksia attenuata</i> , <i>Banksia menziesii</i> and <i>Adenanthos cygnorum</i> subsp. <i>cygnorum</i> tall open to tall sparse shrubland over <i>Beaufortia elegans</i> , <i>Xanthorrhoea preissii</i> and <i>Jacksonia floribunda</i> mid sparse shrubland over <i>Calothamnus sanguineus</i> , <i>Scholtzia involucreta</i> , and <i>Eremaea pauciflora</i> var. <i>pauciflora</i> low open to low sparse shrubland over <i>Mesomelaena pseudostygia</i> low isolated sedges over <i>Lyginia imberbis</i> low isolated rushes on grey coarse-grained sand on consolidated dunes.	25.0% / 246.3 ha	
Cc ¹	COR12 & COR13	<i>Corymbia</i> woodland Lateritic slopes and rises	<i>Corymbia calophylla</i> with occasional <i>Eucalyptus marginata</i> and <i>Nuytsia floribunda</i> mid sparse woodland over emergent patches of <i>Banksia sessilis</i> var. <i>sessilis</i> tall sparse shrubland over <i>Xanthorrhoea preissii</i> mid open shrubland over <i>Hibbertia hypericoides</i> , <i>Acacia celastrifolia</i> and <i>Calothamnus sanguineus</i> low open to low sparse shrubland on black, brown coarse-grained loamy, sand on lateritic rises and slopes.	3.0% / 29.3 ha	

Unit code	Quadrats	Broad floristic formation and site preference	Vegetation description	Area of study area	Photograph
Ba	COR14	<i>Banksia</i> woodland Seasonally waterlogged depressions	<i>Banksia attenuata</i> mid sparse woodland over <i>Kunzea glabrescens</i> and <i>Banksia menziesii</i> tall shrubland over <i>Macrozamia riedlei</i> and <i>Xanthorrhoea preissii</i> mid sparse shrubland over various sparse herbs with brown grey white coarse grained sand in a seasonally inundated depression.	0.4% / 4.2 ha	
CcEm	COR15 & COR17	<i>Corymbia</i> woodland Consolidated dunes with lateritic subsurface	<i>Corymbia calophylla</i> and <i>Eucalyptus marginata</i> mid sparse woodland over <i>Banksia attenuata</i> and <i>Banksia menziesii</i> low sparse to isolated woodland over <i>Xanthorrhoea preissii</i> and <i>Daviesia divaricata</i> subsp. <i>divaricata</i> tall sparse shrubland over <i>Hakea trifurcata</i> and <i>Macrozamia riedlei</i> mid sparse shrubland over <i>Hibbertia hypericoides</i> , <i>Conostephium pendulum</i> and <i>Stirlingia latifolia</i> low open shrubland over <i>Mesomelaena pseudostygia</i> low sparse sedgeland on grey, brown coarse-grained sand on consolidated dunes with lateritic subsurface.	11.0% / 108.6 ha	

Unit code	Quadrats	Broad floristic formation and site preference	Vegetation description	Area of study area	Photograph
BaBm ¹	COR19	<i>Banksia</i> shrubland Consolidated dunes	<i>Banksia attenuata</i> and <i>Banksia menziesii</i> low sparse woodland over <i>Adenanthos cygnorum</i> subsp. <i>cygnorum</i> tall open shrubland over <i>Xanthorrhoea preissii</i> and <i>Beaufortia elegans</i> mid sparse shrubland over <i>Hibbertia hypericoides</i> , <i>Scholtzia involucrata</i> and <i>Calothamnus sanguineus</i> low sparse shrubland over <i>Mesomelaena pseudostygia</i> low sparse sedgeland with grey brown coarse grained sandy loam on consolidated dunes.	2.4% / 23.7 ha	
Cc ²	COR20	<i>Corymbia</i> woodland Consolidated dunes	<i>Corymbia calophylla</i> with occasional <i>Eucalyptus marginata</i> mid isolated trees over <i>Banksia attenuata</i> tall sparse shrubland over <i>Allocasuarina humilis</i> and <i>Xanthorrhoea preissii</i> mid sparse shrubland over <i>Eremaea pauciflora</i> var. <i>pauciflora</i> , <i>Calothamnus sanguineus</i> and <i>Stirlingia latifolia</i> low open shrubland over <i>Mesomelaena pseudostygia</i> low sparse sedgeland with yellow brown coarse grained sand on consolidated dunes.	1.3% / 12.5 ha	

Unit code	Quadrats	Broad floristic formation and site preference	Vegetation description	Area of study area	Photograph
Em ²	COR25	<i>Eucalyptus</i> woodland Consolidated dunes	<i>Eucalyptus marginata</i> mid woodland over <i>Banksia attenuata</i> and <i>Banksia menziesii</i> tall sparse shrubland over <i>Eremaea pauciflora</i> var. <i>pauciflora</i> , <i>Hibbertia hypericoides</i> and <i>Daviesia triflora</i> low open shrubland over <i>Mesomelaena pseudostygia</i> low isolated sedges over <i>Lyginia imberbis</i> low isolated rushes with grey white coarse grained sand on consolidated dunes.	7.1% / 70.1 ha	
Cc ³	COR28	<i>Corymbia</i> woodland Consolidated dunes	<i>Corymbia calophylla</i> mid isolated trees over <i>Eucalyptus todtiana</i> mid isolated mallee trees over <i>Banksia attenuata</i> , <i>Banksia menziesii</i> and <i>Daviesia divaricata</i> subsp. <i>divaricata</i> tall sparse shrubland over <i>Eremaea pauciflora</i> var. <i>pauciflora</i> , <i>Calothamnus sanguineus</i> and <i>Hibbertia hypericoides</i> low sparse heath shrubland over <i>Mesomelaena pseudostygia</i> low sparse sedgeland with yellow brown coarse grained sand on consolidated dunes.	2.0% / 19.2 ha	

Unit code	Quadrats	Broad floristic formation and site preference	Vegetation description	Area of study area	Photograph
BaBm ²	COR30	<i>Banksia</i> woodland Seasonally waterlogged swale	<i>Banksia attenuata</i> and <i>Banksia menziesii</i> low woodland over <i>Melaleuca preissiana</i> and <i>Adenanthos cygnorum</i> subsp. <i>cygnorum</i> tall sparse shrubland over <i>Calytrix angulata</i> and <i>Xanthorrhoea preissii</i> mid sparse shrubland over <i>Leucopogon conostephioides</i> and <i>Hibbertia subvaginata</i> low sparse shrubland with grey brown coarse grained sand in a swale.	1.0% / 9.7 ha	
Em ³	COR02, COR07 & COR21	<i>Eucalyptus</i> woodland Consolidated dunes	<i>Eucalyptus marginata</i> with occasional <i>Corymbia calophylla</i> mid sparse woodland over <i>Xanthorrhoea preissii</i> mid sparse shrubland over <i>Hibbertia hypericoides</i> , <i>Calothamnus sanguineus</i> and <i>Conostephium pendulum</i> low heath shrubland over <i>Mesomelaena pseudostygia</i> and <i>Lepidosperma pubisquameum</i> (flat form) low sparse sedgeland over <i>Lyginia imberbis</i> low isolated rushes on grey, yellow, white coarse-grained sand on consolidated dunes.	12.7% / 125.5 ha	

Unit code	Quadrats	Broad floristic formation and site preference	Vegetation description	Area of study area	Photograph
Em ⁴	COR04	<i>Eucalyptus</i> woodland Consolidated dunes	<i>Eucalyptus marginata</i> mid sparse woodland over <i>Banksia attenuata</i> , <i>Banksia grandis</i> and <i>Nuytsia floribunda</i> tall sparse shrubland over <i>Jacksonia floribunda</i> and <i>Adenanthos cygnorum</i> subsp. <i>cygnorum</i> mid open shrubland over <i>Eremaea pauciflora</i> var. <i>pauciflora</i> , <i>Hibbertia hypericoides</i> and <i>Melaleuca systema</i> low heath shrubland over <i>Mesomelaena pseudostygia</i> low sparse sedgeland with white brown coarse grained sand on consolidated dune rises.	5.1% / 50.6 ha	
Et	COR08, COR16, COR22, COR23 & COR29	<i>Eucalyptus</i> woodland Consolidated dunes	<i>Eucalyptus todtiana</i> mid sparse to mid isolated mallee woodland with occasional <i>Nuytsia floribunda</i> low isolated trees over <i>Banksia attenuata</i> , <i>Banksia menziesii</i> and <i>Adenanthos cygnorum</i> subsp. <i>cygnorum</i> tall sparse shrubland over <i>Allocasuarina humilis</i> , <i>Xanthorrhoea preissii</i> and <i>Jacksonia floribunda</i> mid open shrubland over <i>Eremaea pauciflora</i> var. <i>pauciflora</i> , <i>Hibbertia hypericoides</i> and <i>Calothamnus sanguineus</i> low open to low sparse shrubland over <i>Mesomelaena pseudostygia</i> low sparse sedgeland on yellow, brown coarse-grained sand on consolidated dunes.	8.7% / 86.3 ha	

5.1.5.2 Floristic Community Types

The floristic information collected from the 30 relevés was compared against the floristic data from 'A Floristic Survey of the southern Swan Coastal Plain' (Gibson *et al.*, 1994) to determine the nearest match to the Floristic Community Types (FCTs) known to occur on the Swan Coastal Plain.

The results of the presence/absence comparison between the 30 relevés and the floristic data collected by Gibson *et al.* (1994) are presented in Table 11.

Table 11 Inferred floristic community types

Relevé	Nearest matches (FCT)	Landform	Inferred match	Description
COR01	28; 1a; 20a; 20b; & 21a	Ridge Hill/ Pinjarra	20b	Eastern <i>Banksia attenuata</i> and/or <i>Eucalyptus marginate</i> .
COR02	28; 20a; 21a; 21b; & 23a	Spearwood	28	Spearwood <i>Banksia attenuata</i> or <i>Banksia attenuata-Eucalyptus marginata</i> woodlands.
COR03	28; 23b; 20a; 20b; & 21a	Spearwood/ Pinjarra	20a	<i>Banksia attenuata</i> woodlands over species rich dense shrublands.
COR04	28; 20a; 23a; 23b; & 21a	Bassendean	23b	Northern <i>Banksia attenuata-Banksia menziesii</i> woodlands.
COR05	28; 1a; 20b; 21a; & 3a	Ridge Hill/ Pinjarra	20b	Eastern <i>Banksia attenuata</i> and/or <i>Eucalyptus marginate</i> .
COR06	28; 21c; 23a; 23b; & 21a	Bassendean	23b	Northern <i>Banksia attenuata-Banksia menziesii</i> woodlands.
COR07	28; 21a; 1a; 21b; & 21c	Bassendean/ Spearwood	21a	Central <i>Banksia attenuata-Eucalyptus marginata</i> woodlands.
COR08	28; 20a; 21a; 23a ;& 23b	Spearwood/ Pinjarra	20a	<i>Banksia attenuata</i> woodlands over species rich dense shrublands.
COR09	28; 1a; 3b; 3b ;& 1b	Bassendean/ Spearwood	21a	Central <i>Banksia attenuata-Eucalyptus marginata</i> woodlands.
COR10	23a; 28; 23b; 21a; & 20a	Bassendean	23b	Northern <i>Banksia attenuata-Banksia menziesii</i> woodlands.
COR11	28; 23b; 20b; 20a; & 21a	Bassendean	23b	Northern <i>Banksia attenuata-Banksia menziesii</i> woodlands.
COR12	28; 1a; 21a; 3b; & 3b	Bassendean/ Spearwood	21a	Central <i>Banksia attenuata-Eucalyptus marginata</i> woodlands.
COR13	28; 1a; 21a; 1b; & 21b	Bassendean/ Spearwood	21a	Central <i>Banksia attenuata-Eucalyptus marginata</i> woodlands.
COR14	28; 21a; 24; 21c; & 23a	Bassendean	21c	Low lying <i>Banksia attenuata</i> woodlands or shrublands.
COR15	28; 21a; 23a; 24; & 26b	Bassendean/ Spearwood	21a	Central <i>Banksia attenuata-Eucalyptus marginata</i> woodlands.
COR16	28; 21a; 23a; 23b; & 20a	Bassendean/ Spearwood	21a	Central <i>Banksia attenuata-Eucalyptus marginata</i> woodlands.



Relevé	Nearest matches (FCT)	Landform	Inferred match	Description
COR17	28; 20b; 21a; 1a; & 21b	Ridge Hill/ Pinjarra	20b	Eastern <i>Banksia attenuata</i> and/or <i>Eucalyptus marginate</i> .
COR18	21a; 23b; 28; 23a; & 20a	Bassendean	23b	Northern <i>Banksia attenuata</i> - <i>Banksia menziesii</i> woodlands.
COR19	28; 23b; 23a; 20a; & 21c	Bassendean	23a	Central <i>Banksia attenuata</i> - <i>Banksia menziesii</i> woodlands.
COR20	28; 20a; 21b; 23a; & 20b	Spearwood/ Pinjarra	20a	<i>Banksia attenuata</i> woodlands over species rich dense shrublands.
COR21	28; 21a; 23a; 26b; & 26b	Bassendean	23b	Northern <i>Banksia attenuata</i> - <i>Banksia menziesii</i> woodlands.
COR22	28; 23b; 23a; 20a; & 21a	Bassendean	23a	Central <i>Banksia attenuata</i> - <i>Banksia menziesii</i> woodlands.
COR23	28; 20a; 23a; 23b; & 20b	Spearwood/ Pinjarra	20a	<i>Banksia attenuata</i> woodlands over species rich dense shrublands.
COR24	23b; 23a; 28; 21c; & 20a	Bassendean	23a	Central <i>Banksia attenuata</i> - <i>Banksia menziesii</i> woodlands.
COR25	28; 20a; 21a; 23a; & 23b	Spearwood/ Pinjarra	20a	<i>Banksia attenuata</i> woodlands over species rich dense shrublands.
COR26	28; 20a; 23b; 21a; & 23a	Bassendean	23b	Northern <i>Banksia attenuata</i> - <i>Banksia menziesii</i> woodlands.
COR27	28; 20a; 23b; 20b; & 21a	Bassendean	23b	Northern <i>Banksia attenuata</i> - <i>Banksia menziesii</i> woodlands.
COR28	28; 20a; 23b; 20b; & 21a	Bassendean	23b	Northern <i>Banksia attenuata</i> - <i>Banksia menziesii</i> woodlands.
COR29	28; 20a; 23b; 21a; & 23a	Bassendean	23b	Northern <i>Banksia attenuata</i> - <i>Banksia menziesii</i> woodlands.
COR30	21c; 23a; 23b; 28; & 20c	Bassendean	21c	Low lying <i>Banksia attenuata</i> woodlands or shrublands.

It must be noted that the determination of the FCTs from the floristic data collected from the 30 relevés is considered to be an inference. To accurately determine the FCTs, systematic sampling of quadrats located in representative vegetation associations and multivariate analysis against the floristic data collected by Gibson *et al.* (1994), is required.

According to the comparison (Table 11), the following FCTs potentially occur in the study area:

- FCT20a – *Banksia attenuata* woodlands over species rich dense shrublands.
- FCT20b – Eastern *Banksia attenuata* and/or *Eucalyptus marginate*.
- FCT21a – Central *Banksia attenuata*-*Eucalyptus marginata* woodlands.
- FCT21c – Low lying *Banksia attenuata* woodlands or shrublands.
- FCT23a – Central *Banksia attenuata*-*Banksia menziesii* woodlands.

- FCT23b – Northern *Banksia attenuata*-*Banksia menziesii* woodlands.
- FCT28 – Spearwood *Banksia attenuata* or *Banksia attenuata*-*Eucalyptus marginata* woodlands.

According to DPAW information on ecological communities on the Swan Coastal Plain, FCT20a (also known as SCP20a) and FCT20b (also known as SCP20b) are considered to be Threatened Ecological Communities. FCT21c and FCT23b, also known as SCP21c and SCP23b respectively, are considered to be Priority Ecological Communities.

The locations of the inferred TECs and PECs are provided in Figure 9 and discussed in more detail in Section 5.1.4.3.

5.1.5.3 Threatened and Priority Ecological Communities

The floristic information collected from the 30 relevés was compared against the floristic data collected from the Gibson *et al.* (1994) survey of the Southern Swan Coastal Plain and the descriptions available for the TECs and PECs from DPAW to infer the presence of any additional TECs and PECs.

The majority of the study area is considered to be representative of the P2 PEC *Banksia* Yellow-Orange Sands and the PEC SCP23b. Both PECs are known to occur extensively within and adjacent to the study area. The description for the PEC Yellow-Orange Sands is:


Species-rich *Banksia* woodlands on deep yellow-red sands that appears restricted to the western Dandaragan Plateau. The vegetation is described as scattered *Eucalyptus todtiana* and *Corymbia calophylla* over *Banksia menziesii* and *Banksia attenuata* low open woodland over *Jacksonia sternbergiana* and *Adenanthos cygnorum* high open shrubland over *Allocasuarina humilis* and *Chamaelucium* sp. Gingin (N.G. Marchant 6)(T) open shrubland over *Eremaea pauciflora* and *Astroloma xerophyllum* low shrubland over *Mesomelaena pseudostygia* open sedgeland.

Vegetation associations BaBm¹, BaBmNf, Et and EtNf are considered to be representative of the Priority 2 *Banksia* Yellow-Orange Sands. The four vegetation associations listed above consist of *Eucalyptus todtiana* over *Banksia* spp. with an understorey layer dominated by *Allocasuarina humilis* and *Eremaea pauciflora* var. *pauciflora* over a sedge layer consisting of *Mesomelaena pseudostygia* on coarse-grained deep yellow-brown sands. This is considered to be consistent with the description of the PEC.

In addition to the known locations of the TEC and the PECs, based on a comparison between the floristic data collected from the 30 relevés with Gibson *et al.* (1994), an additional two TECs (SCP20a, SCP20b) and one PEC (SCP21c) potentially occur within the study area. The comparison confirmed the presence of the PEC SCP23b, known to occur within the study area. The location of the TECs and the PECs are presented in Figure 9.

The descriptions as provided by DPAW, for the additional TECs and the PECs are detailed below:

- Threatened Ecological Communities:
 - SCP20a – *Banksia attenuata* woodland over species rich dense shrublands. The TEC SCP20a is classified as Endangered. SCP20a corresponded with relevés COR03, COR08, COR20, COR23 and COR25. These relevés correspond with vegetation associations BaBmNf, Et, Cc² and Em².
 - SCP20b – *Banksia attenuata* and/or *Eucalyptus marginata* woodlands of the eastern side of the Swan Coastal Plain. The TEC SCP20b is classified as Endangered. The TEC SCP20b corresponded with relevés COR01, COR05 and COR17, which corresponded with vegetation associations EmCc¹, EmCc² and CcEm.
 - SCP20c – Shrublands and woodlands of the eastern side of the Swan Coastal Plain. The TEC SCP20c is classified as Critically Endangered. According to DPAW data, the TEC SCP20c occurs



in the southeast of the study area. The exact location is difficult to determine based on the information provided by DPAW. The buffer associated with the TEC is 500 m which indicates that the TEC is located in association with vegetation association Em³ and relevé COR07. Relevé COR07 was inferred to represent FCT21a, which is not listed as a TEC or a PEC.

- Priority Ecological Communities:

- SCP21c – Low lying *Banksia attenuata* woodlands or shrublands. This P3 PEC occurs sporadically between Gingin and Bunbury, and is largely restricted to the Bassendean system. The PEC tends to occupy lower lying wetter sites and is variously dominated by *Melaleuca preissiana*, *Banksia attenuata*, *Banksia menziesii*, *Regelia ciliata*, *Eucalyptus marginata* or *Corymbia calophylla*. Structurally, this community type may be either a woodland or occasionally shrubland. The PEC SCP21c corresponded with relevés COR14 and COR30 and occurred in low lying areas with *Melaleuca preissiana* present. The vegetation associations that correspond with COR14 and COR30 are Ba and BaBm².
- SCP23b – Swan Coastal Plain *Banksia attenuata* - *Banksia menziesii* woodlands. These woodlands occur in the Bassendean system, from Melaleuca Park to Gingin. The P3 PEC occurs in reasonably extensive *Banksia* woodlands north of Perth. The PEC SCP23b is represented by relevés COR04, COR06, COR10, COR11, COR18, COR21, COR26, COR27, COR28 and COR29. These relevés corresponded with vegetation associations Em⁴, Em, EtNf, BaBmNf, Em³, Cc³ and Et.

There is significant overlap between the inferred TECs and PECs and the known TECs and PECs (according to DPAW data). To remove the overlap and accurately confirm the presence of TECs or PECs, a systematic quadrat sampling survey with multivariate analysis needs to be completed across the study area.

In the case of an overlap between the PEC *Banksia* Yellow-Orange Sands and the inferred TECs and PECs, the PEC *Banksia* Yellow-Orange Sands has been mapped. This is based on the accurate vegetation description provided by DPAW compared to the data available on the remaining TECs and PECs and the reliance on multivariate analysis.

DPAW also identify *Banksia* dominated woodlands on the Swan Coastal Plain bioregion as a Priority 3 ecological community. The main feature of these *Banksia* woodlands is the presence of *Banksia attenuata* and/or *Banksia menziesii* occurring on deep sands, with the species commonly co-occurring. The community occurs on the Quindalup, Spearwood and Bassendean dunes and rarely on the Pinjarra Plain landforms, which comprise the dominant landforms of the Swan Coastal Plain.

5.1.5.4 Vegetation Complexes

The study area is located across five vegetation complexes; the Mogumber complex-south, Reagan complex, Karamal complex-south, Coonambidgee complex and Moondah complex. The pre-European extent, extent remaining in 2013 and the pre-European extent remaining in formal protection is provided in Table 12. Formal protection includes native vegetation remaining in conservation estate, Bush Forever sites in conservation estate and Bush Forever sites in Regional Parks.

The National Objectives and Targets for Biodiversity Conservation 2001-2005 recognises that a retention of 30% or more of the pre-clearing extent of each ecological community is necessary if Australia's biological diversity is to be protected (ANZECC, 2000). In addition to the Australian and New Zealand Environment and Conservation Council (ANZECC) 30% retention target, the EPA has adopted a 10% level of pre-clearing extent as representing 'endangered' (EPA, 2000).

The pre-European extent remaining on the Swan Coastal Plain for each vegetation complex is greater than 30%; however, only the Coonambidgee (10%) and the Karamal Complex-South (27%) have greater than 10% of the pre-European extent remaining in formal protection.

Table 12 Native vegetation extent by vegetation complexes on the Swan Coastal Plain

Vegetation Complex	Pre-European extent (ha)	2013 extent (ha)	Pre-European extent remaining (%)	Formal protection ¹ (ha)	Pre-European extent with formal protection (%)	Extent within the study area	Inclusion of the study area (%)
Coonambidgee	6,272.3	2,859.5	45.6	647.7	10.3	8.7	10.5
Karamal (south)	24,016.7	15,225.9	63.4	6,513.5	27.1	181.3	27.9
Mogumber (south)	13,985.5	5,621.9	40.2	175.3	1.3	424.9	4.3
Moondah	17,858.8	7,279.8	40.8	1,742.8	9.8	105.2	10.4
Reagan	9,080.5	3,052.4	33.6	341.4	3.8	266.3	6.7

Source: Perth Biodiversity Program (WALGA 2013).

1: Formal protection includes DPAW conservation estates, Bush Forever on conservation estate and Bush Forever in Regional Parks.

The vesting of the study area as conservation estate will increase the formal protection of each of the vegetation complexes. However, the increase is not sufficient to increase the pre-European extents above the 30% threshold.

The inclusion of the study area into the conservation estate will not increase the pre-European extent within formal protection above the endangered 10% level for any of the vegetation complexes within the study area. However, the pre-European extent of the Moondah vegetation complex within formal protection will be increased above the 10% endangered level (an increase of 0.6% to 10.4%).

5.1.6 Ecological Corridors

The study area is located within the Perth subregion which has historically been cleared for urban development, industrial development and agriculture. As a result only 42% (or 473,176 ha) of the pre-European extent for the Perth subregion (1,117,757 ha) remains intact (DPAW, 2013a).

The study area is located within an ecological corridor linking Boonanarring Nature Reserve and Leda Nature Reserve. The corridor runs in a north to south alignment and is fragmented in sections and crosses the Great Northern Highway.

The study area is not located within an east-west ecological corridor. The east-west movement of flora and fauna is impeded by the historical clearing of native vegetation along both sides of the Brand Highway.

5.1.7 Taxa Recorded

A total of 154 vascular taxa were recorded from the study area during the site visit. This included 148 native taxa and six introduced taxa from 36 families and 88 genera. Two taxa were not identified to genus level, one was from the Orchidaceae family. The taxon was not identified to genus level because only the basal leaf was present. The remaining taxon that was not identified to genera level had inadequate material to make an accurate identification to genera.



An additional seven taxa, *Austrodanthonia* sp., *Haemodorum* sp., *Anigozanthos* sp., *Pimelea* sp. 1, *Pimelea* sp. 2, *Stylidium* sp. and **Lupinus* sp., were only identified to genus level. The taxa within the field were not flowering and/or fruiting at the time of the survey which is required to ensure a positive identification.

The dominant families recorded from the study area are listed in Table 13, while the dominant genera recorded from the study area is listed in Table 14. The entire list of vascular taxa recorded from the study area is provided in Appendix G.

Table 13 Dominant families recorded from the study area

Family name	Common name	Native taxa	Introduced taxa
Proteaceae	Banksia family	28	0
Fabaceae	Legume or Pea family	24	1
Myrtaceae	Myrtle family	19	0
Ericaceae	Heath family	12	0
Cyperaceae	Sedge family	8	0

Of the 36 families recorded from the study area, 18 families were only represented by one genera, while the vast majority of the taxa were members of four families, the Proteaceae, Fabaceae, Myrtaceae and Ericaceae, which constituted approximately 55% of the total number of taxa recorded.

Table 14 Dominant genera recorded from the study area

Genera	Common name	Native taxa	Introduced taxa
Acacia	Wattle	10	0
Banksia	Banksias	7	0
Hakea	Hakeas	7	0
Daviesia	Daviesias	6	0

Of the 88 genera recorded from the study area, 58 genera were only represented by one taxon. The dominant nine genera (*Acacia*, *Banksia*, *Hakea*, *Daviesia*, *Calytrix*, *Hibbertia*, *Lepidosperma*, *Lomandra* and *Petrophile*) represented approximately 33% of the total number of taxa recorded.

5.1.8 Taxa of Significance

One Threatened and six Priority listed taxa are known to occur in the study area. The known locations were traversed to locate the conservation significant taxa and to further refine the population size. The Threatened taxa, *Chamelaucium* sp. Gingin (N.G. Marchant 6), was located in the northwest of the study area. *Chamelaucium* sp. Gingin (N.G. Marchant 6) (Plates 1 to 3) is a Threatened taxon under the WC Act with a classification of Vulnerable and it is listed as Endangered under the Commonwealth EPBC Act (see Figure 9).

Chamelaucium sp. Gingin (N.G. Marchant 6) is endemic to Western Australia and is apparently confined to the Gingin/Chittering area where it is known from a range of only 3 km and six populations (Stack and English, 2003). The six known populations contain a total of approximately 4700 adult plants and 1800 juveniles. This species occurs on white/yellow sand supporting open low woodland with *Eucalyptus todtiana*, *Banksia attenuata* and *Hibbertia* species.



Plate 1 *Chamelaucium* sp. Gingin (N.G. Marchant 6) growing along fence line between offset site and nature reserve



Plate 2 *Chamelaucium* sp. Gingin (N.G. Marchant 6), close-up of buds before flowering



Plate 3 *Chamelaucium* sp. Gingin (N.G. Marchant 6), close-up of flowers



Plate 4 *Hypolaena robusta* (Priority 4)*



Plate 5 Arum Lily (**Zantedeschia aethiopica*)

* Photography by A.D. Crawford. Image used with the permission of the Western Australian Herbarium, Department of Parks and Wildlife (<http://florabase.dpaw.wa.gov.au/help/copyright>). Accessed on Tuesday, 26 August 2014.



Chamelaucium sp. Gingin (N.G. Marchant 6) is an open straggly shrub growing to a height of 1 to 2 m tall and has many slender stiff branches that bear numerous long axillary shoots. Its erect, glandular, bright green leaves are 5.4-11.5 mm long by 1.2-1.4 mm wide, and are scattered along the main branches, but are mostly crowded on numerous short axillary shoots. The inflorescence is composed of a small head on short axillary shoots or sometimes a larger flower head at the end of main branches. The flowers occur in groups of two to nine in small heads on axillary shoots. Up to 20 flowers are held in clusters at the end of main branches. The flowers are pale pinkish-white, and the buds are tinged a deeper pink (adapted from Stack and English, 2003).

Critical habitat is defined as habitat that is identified as being critical to the survival of the threatened taxon. The critical habitat for *Chamelaucium* sp. Gingin (N.G. Marchant 6) comprises:

- The area of occupancy of known populations.
- Areas of similar habitat within 200 m of known populations, i.e. white/yellow sand supporting open low woodland over open scrub (these provide potential habitat for natural range extensions).
- Corridors of remnant vegetation that link populations (these are necessary to allow pollinators to move between populations and are usually road and rail verges).
- Additional occurrences of similar habitat that do not currently contain the species but may have done so in the past (these represent possible translocation sites).

The study area represents critical habitat for *Chamelaucium* sp. Gingin (N.G. Marchant 6) for the existing population and areas of similar habitat within 200 m and providing a vegetated corridor linking populations.

Of the six Priority listed taxa recorded from the study area, only one was re-recorded, *Hypolaena robusta* (P4). The remaining five Priority listed taxa were not identified during the July 2014 site visit. No other Priority listed taxa were recorded from the study area.

Hypolaena robusta is listed a Priority 4 taxon and is a member of the Restionaceae or rush family. *Hypolaena robusta* (see Plate 4) is described as a tall stout, dioecious rhizomatous, perennial rush with well-spaced culms on thick rhizomes (Meney and Pate, 1999; DPAW, 2014c). It is known to occur on white sand on the sandplains of the northern Swan Coastal Plain and the Northern Sandplain (DPAW, 2014c). It flowers in early to mid-spring (September and October) (DPAW, 2014c; Meney and Pate, 1999).

The locations of *Chamelaucium* sp. Gingin (N.G. Marchant 6) (T) and *Hypolaena robusta* (P4) recorded from the study area are provided in Table 15. The locations of Threatened and Priority listed flora within the study area is provided in Figure 9.

Table 15 Threatened and Priority listed taxa recorded from the study area

Taxa	Phenology and life form	Individuals	Zone 50J, GDA 94	
			Easting	Northing
<i>Chamelaucium</i> sp. Gingin (N.G. Marchant 6) (T)	Adults and seedlings. Buds present on adults.	50+	402225	6517206
<i>Chamelaucium</i> sp. Gingin (N.G. Marchant 6) (T)			402229	6517194
<i>Chamelaucium</i> sp. Gingin (N.G. Marchant 6) (T)			402235	6517193
<i>Chamelaucium</i> sp. Gingin (N.G. Marchant 6) (T)			402222	6517190
<i>Chamelaucium</i> sp. Gingin (N.G. Marchant 6) (T)			402226	6517212
<i>Chamelaucium</i> sp. Gingin (N.G. Marchant 6) (T)	Adults with buds.	10+	402227	6517251



Taxa	Phenology and life form	Individuals	Zone 50J, GDA 94	
			Easting	Northing
<i>Chamelaucium</i> sp. Gingin (N.G. Marchant 6) (T)	Adults with buds.	20+	402232	6517409
<i>Chamelaucium</i> sp. Gingin (N.G. Marchant 6) (T)	Adults with buds.	30+	402298	6517414
<i>Chamelaucium</i> sp. Gingin (N.G. Marchant 6) (T)	Adults and seedlings. Adults with buds.	70+	402324	6517417
<i>Chamelaucium</i> sp. Gingin (N.G. Marchant 6) (T)	Adults.	3	402365	6516987
<i>Chamelaucium</i> sp. Gingin (N.G. Marchant 6) (T)	Adults.	1	402383	6516980
<i>Chamelaucium</i> sp. Gingin (N.G. Marchant 6) (T)	Adults and seedlings. Adults with buds.	10+	402460	6517417
<i>Hypolaena robusta</i> (P4)	Last season's flowers and buds.	Unknown	403976	6514919
<i>Hypolaena robusta</i> (P4)	Last season's flowers and buds.	Unknown	403985	6516766

5.1.9 Introduced Taxa

A total of six introduced taxa were recorded from the study area during the site visit. The six introduced taxa were reviewed to determine if they are WONS, a Declared Pest under the BAM Act or an Environmental Weed with a 'High' rating (Table 16).

Table 16 Introduced taxa recorded from the study area

Species	Common name	Family	WONS (EPBC Act)	Declared pest (BAM Act)	Environmental weed rating (CALM, 1999)	Species-led ranking (DPAW, 2013b)
<i>*Zantedeschia aethiopica</i>	Arum Lily	Araceae	No	Declared Pest (s22)	High	Medium
<i>*Lupinus</i> sp.	Lupin	Fabaceae	No	Permitted (s11)	High	High ¹
<i>*Brassica tournefortii</i>	Wild Turnip	Brassicaceae	No	Permitted (s11)	High	Low
<i>*Briza maxima</i>	Quaking Grass	Poaceae	No	Permitted (s11)	Moderate	Low
<i>*Hypochaeris glabra</i>	Smooth Catsear	Asteraceae	No	Permitted (s11)	Moderate	Low
<i>*Gladiolus caryophyllaceus</i>	Wild Gladiolus	Iridaceae	No	Permitted (s11)	Moderate	Medium

1: The highest ranked Lupin (**Lupinus angustifolia* and **Lupinus cosentinii*) has been chosen to ensure the introduced taxa is appropriately managed at the upper limit.

5.1.9.1 WONS and Declared Pests

None of the six introduced taxa are WONS. Arum Lily (**Zantedeschia aethiopica*) is considered to be a Declared Pest under Section 22 of the BAM Act (see Figure 6). The remaining five introduced taxa are classified as Permitted under Section 11 of the BAM Act.

The BAM Act and regulations were enacted on 1 May 2013. The BAM Act replaces the *Agriculture and Related Resources Protection Act 1976*. The main purposes of the BAM Act that relate to weeds are to:

- Prevent new animal and plant pests (vermin and weeds) and diseases from entering Western Australia.
- Manage the impact and spread of those pests already in Western Australia.

Organisms are grouped into four main classifications:

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

Under the BAM Act, all Declared Pests are placed in one of three categories, namely C1 (exclusion), C2 (eradication) or C3 (management). Arum Lily has been placed in the C3 (management) category and it is prohibited to keep in WA. Arum Lily was recorded from one location in the southwest corner of the study area (Table 17; see Plate 5).

Table 17 GPS coordinate (Zone 50J, GDA94) for the known Arum Lily location

	Easting	Northing
Arum Lily (<i>*Zantedeschia aethiopica</i>)	402409	6514543

5.1.9.2 Environmental Weeds and Weed Prioritisation Process

The Environmental Weed Strategy for Western Australia (EWSWA) (CALM, 1999) has detailed criteria for the assessment and rating of introduced flora based on their impact on biodiversity. The criteria included:

- Invasiveness – ability to invade bushlands in good to excellent condition or ability to invade waterways (score of yes or no).
- Distribution – wide current or potential distribution including consideration of known history of widespread distribution elsewhere in the world (score as a yes or no).
- Environmental impacts – ability to change the structure, composition and function of ecosystems in particular an ability to form a monoculture in a vegetation community (score as a yes or no).

The EWSWA uses the following scoring system:

- High – an introduced flora species that scores yes to all three criteria. An introduced flora species with a high rating would indicate prioritising this weed for control and/or research.
- Moderate – an introduced flora species that scores yes to two of the three criteria. Rating an introduced flora species as moderate would indicate that control or research effort should be directed if funds are available, however it should be monitored.

- Mild – an introduced flora species that scores yes to one of the three criteria. A mild rating would indicate that monitoring and control of the introduced flora species is necessary where appropriate.
- Low – an introduced flora species that scores no to all three criteria. A low rating would mean that this species would require a low level of monitoring.

The EWSWA (CALM, 1999) provided a ranking of weed species on a state-wide basis against three criteria – invasiveness, distribution and environmental impacts (as detailed above). A total of 1350 weeds were rated through this process as high, moderate, mild or low, with 34 weed species being rated as high.

The State-wide ratings from the Strategy are now considered to be too broad to be of use from an on-ground operational perspective and are now out of date (DPAW, 2013b). In an effort to address these issues and implement an integrated approach to weed management on DPAW-managed lands in WA, the Weed Prioritisation Process for DPAW was developed in 2008.

DPAW proposed that the Weed Prioritisation Process was to prioritise in each DPAW Region, with the aim being to establish both a species-led and an asset-protection-based approach to weed management (DPAW, 2013b). The species-led process assessed weed species for their invasiveness, ecological impacts, potential and current distribution and feasibility of control. The resulting priorities focus on infestations of species which are considered to be high impact, rapidly invasive and still at a population size which is feasible to eradicate or contain to a manageable size. Hence, weed species which are already widespread did not rank as a high priority through this part of the process.

The rating for each of the six introduced taxa with regards to the EWSWA and the Species-led process is detailed in Table 16.

5.2 Fauna

5.2.1 Fauna Habitats

A total of three fauna habitats were recorded in the study area: Banksia Woodland, Eucalypt Woodland and a Dampland (Figure 10). Tracks comprised 9 ha. Habitat assessments were completed at 26 sites across the study area (Appendix H). Habitats are summarised in Table 18 and detailed in the following sections.

Table 18 Fauna habitat types

Habitat type	Area (ha)	Habitat value	Black Cockatoo value
Banksia Woodland	663	Moderate	Moderate
Eucalypt Woodland	315	High	High
Dampland	3	Moderate	Low

5.2.1.1 Banksia Woodland

The vegetation of this habitat type is typified by *Banksia attenuata*, *Banksia menziesii*, *Eucalyptus todtiana* and *Nuytsia floribunda* woodland over *Allocasuarina humilis*, *Xanthorrhoea preissii* and *Macrozamia riedlei* over various herb and sedge species. The Banksia Woodland habitat is generally located on the geographically flat section of the study area. This habitat type has occasional and sporadic mature Jarrah trees growing with in it and they are usually associated with the buffer zone between the Banksia woodland and Eucalypt Woodland habitats. The sandy soils of this habitat provide ideal substrate for burrowing species such as dragons and goannas. Microhabitats provided by this habitat include leaf litter, exfoliating bark and Banksia flowers which provide a feeding resource to nectivores. Due to the dominance of the Banksia species this habitat type does not contain many tree hollows or hollows logs. The Banksia



Woodland habitat is classified as being in excellent condition with little weed impact, old fire age and some dieback effected areas and it provides moderate habitat value.

5.2.1.2 Eucalypt Woodland

The vegetation of this habitat type is typified by *Eucalyptus marginata*, *Eucalyptus todtiana* and *Corymbia calophylla* over *Banksia attenuata* and *Banksia menziesii* over herbs and sedges. The Eucalypt Woodland habitat is generally dominated by jarrah over most of the study area with Marri becoming increasingly more common along the western border of the site. The sandy soils of this habitat provide ideal substrate for burrowing species such as dragons and goannas. Microhabitats provided by this habitat include sandy soils, leaf litter, exfoliating bark, hollow logs and tree hollows. The dense canopy foliage and presence of tree hollows provides suitable habitat for a range of birds, specifically for the species that nest in tree hollows such as parrots. The abundant leaf litter and fallen logs produce refuge for ground dwelling fauna. The Eucalypt Woodland habitat is classified as being in excellent condition with little weed impact, old fire age and some dieback effected areas and it provides high habitat value.

5.2.1.3 Dampland

The vegetation of this habitat type is typified by *Banksia attenuata* woodland over *Kunzea glabrescens* and *Banksia menziesii* shrubland over *Macrozamia riedlei* and *Xanthorrhoea preissii* over various sparse herbs in a seasonally inundated depression. The Dampland habitat is located in the low lying part, in the southwest of the study area. The Dampland is a small remnant (3 ha) after the rest of the habitat was cleared and used as pastures in the surrounding properties. This habitat type as its name suggests is an area where moisture collects and during the winter months becomes seasonally waterlogged. The damp nature of this habitat provides an ideal environment for amphibians. Microhabitats provided by this habitat include damp soil, leaf litter, exfoliating bark and dense mid-story vegetation which provide habitat for many bird species. The Dampland habitat is classified as being in excellent condition with little weed impact, old fire age and it provides moderate habitat value.

5.2.2 Black Cockatoo Habitat Assessment

The habitat types of the study area were assessed upon the habitat they provide to Black Cockatoos and classified as being high, moderate or low value habitats. The Eucalypt Woodland provides quality foraging, roosting and breeding habitat and is classified as being high value Black Cockatoo habitat. The Banksia Woodland provides quality foraging habitat and is classified as being moderate value Black Cockatoo habitat, due to the lack of breeding habitat. The Dampland provides limited foraging habitat and is classified as being low value Black Cockatoo habitat (Table 18 and Figure 11). A description of the foraging, roosting and breeding habitat is provided in the following sections.

5.2.2.1 Foraging Assessment

The study area contains 17 plant species that are known foraging resources for Black Cockatoos (Valentine and Stock, 2008, and Chapman, 2007) (Table 19). All habitat types contained multiple foraging resources, as such the entire study area can be classified as foraging habitat for Black Cockatoos which equates to approximately 981 ha of foraging habitat. No signs of current and historical foraging evidence were located.

Table 19 Foraging Resources of the study area

Foraging species	Foraging resource
<i>Banksia attenuata</i>	flowers, seeds
<i>Banksia dallanneyi</i>	flowers, seeds
<i>Banksia grandis</i>	flowers, seeds



Foraging species	Foraging resource
<i>Banksia menziesii</i>	flowers, seeds
<i>Banksia sessilis</i>	flowers, seeds
<i>Corymbia calophylla</i>	flowers, seeds, nectar
<i>Eucalyptus marginata</i>	seeds
<i>Eucalyptus todtiana</i>	seeds
<i>Hakea costata</i>	seeds
<i>Hakea lissocarpha</i>	seeds
<i>Hakea prostrata</i>	seeds
<i>Hakea ruscifolia</i>	seeds
<i>Hakea stenocarpa</i>	seeds
<i>Hakea trifurcata</i>	seeds
* <i>Lupinus</i> sp.	seeds
<i>Mesomelaena tetragona</i>	seeds
<i>Mesomelaena pseudostygia</i>	seeds
<i>Xanthorrhoea preissii</i>	seeds

5.2.2.2 Roosting Assessment

The Eucalypt Woodland habitat contains stands of tall trees that are located close to riparian environments and permanent water sources, which according to the Cockatoo referral guidelines constitutes roosting habitat for Black Cockatoos (DSEWPAC, 2012). Trees or stands of trees that match this description were examined for evidence of recent use as a roost site (feathers and droppings), however none was located.

A database search was completed for known roost locations for Carnaby’s Cockatoos with none located in the study area or its immediate surrounds. The closest known roost sites occur in Gingin and Yanchep which are approximately 17 km north and west of the study area respectively (Burnham et al., 2010).

5.2.2.3 Breeding Assessment

As the study area was too large to accurately measure individual trees, a tree dentistry survey was used to give an estimate of the number of potential breeding trees (Appendix I). The study area contains an estimated 6,353 trees that have a DBH over 500 mm. This number is most likely an underestimate as the Banksia Woodland contained some suitable sized trees, however these were omitted from the total tree estimate as their sporadic nature would make the tree density estimates inaccurate. The Cockatoo referral guidelines states “in a woodland stand with trees of suitable diameter at breast height, all trees of all ages and size are potentially important for maintaining breeding in the long term,” as such the Eucalypt Woodland is classified as breeding habitat (approximately 315 ha). The tree density survey identified areas of high, moderate and low tree densities within the Eucalypt Woodland. Areas containing a tree density of between 0-9 trees per hectare were classified as low density, areas with densities of 10-19 trees per hectare were classified as moderate density and areas containing 20 or more trees per hectare were classified as being high density (Table 20 and Figure 11).



Table 20 Breeding tree density

Tree density	Area (ha)
Eucalypt Woodland – High Density	193
Eucalypt Woodland – Moderate Density	112
Eucalypt Woodland – Low Density	10

A total of 30 trees with hollows classified as suitable for current breeding (with an opening greater than 20 cm diameter) were opportunistically identified across the site (Appendix I). However, there was no evidence of their use as historic breeding sites (chew marks around hollow openings and droppings). As stated these records were opportunistically recorded while walking around the study area and do not represent the full breeding capability of the site.

The availability of foraging habitat within 6 to 12 km of breeding sites is important in providing the resources necessary for raising chicks (DSEWPAC, 2012). The study area and the surrounding nature reserves (Boonanarring Nature Reserve and Leda Nature Reserve) contain large amounts of quality foraging habitat supporting any potential breeding sites in the vicinity.

5.2.3 Faunal Assemblage

From the desktop assessment a total of 221 species have been previously recorded in the vicinity of the study area (Appendix J). These include 12 amphibians, 47 reptiles, 134 birds and 28 mammals. As stated earlier all marine and aquatic species have been omitted from this list as no suitable habitat is present. Of these 39 species were recorded during the survey including one species of amphibian, three species of reptile, 32 species of bird and three species of mammal. The Black-eared Cuckoo (*Chrysococcyx osculans*) was recorded during the survey but has not been previously recorded from the vicinity. This record is just outside of the southerly distribution of this otherwise common species.

5.2.3.1 Amphibians

From the desktop review a total of 12 species of amphibian were identified as being previously recorded in the vicinity of the study area. One species, the Quacking Frog (*Crinia georgiana*) was recorded in the Eucalypt Woodland habitat type during the survey (Appendix J).

5.2.3.2 Reptiles

From the desktop review a total of 47 species of Reptile were identified as being previously recorded in the vicinity of the study area. Three species, the Buchanan’s Snake-eyed Skink (*Cryptoblabpharus buchananii*), West Coast *Ctenotus* (*Ctenotus fallens*) and the Southern Shovel-nosed Snake (*Brachyuropus semifasciatus*) were recorded in the Eucalypt Woodland habitat type during the survey (Appendix J).

5.2.3.3 Birds

From the desktop review a total of 134 species of birds were identified as being previously recorded in the vicinity of the study area. A total of 32 species were recorded during the survey. The most speciose families recorded during the survey were Psittacidae (Parrots) with four species, Meliphagidae (Honeyeaters) with four species and Cuculidae (Cuckoos) with three species (Appendix J).

5.2.3.4 Mammals

From the desktop review a total of 28 species of mammals were identified as being previously recorded in the vicinity of the study area. A total of three species of mammal were recorded during the survey, the Western Grey Kangaroo (*Macropus fuliginosus*), Western Brush Wallaby (*Macropus irma*) and the Red Fox (*Vulpes vulpes*) which is an introduced species (Appendix J).

5.2.4 Conservation Significant Fauna

The Western Brush Wallaby (*Macropus irma*) listed as Priority 4 was the only conservation significant fauna species recorded during the survey (Table 21 and Figure 10).

From the desktop assessment a total of 14 conservation significant species have been previously recorded in the study area. Of these one species was recorded, six species are classified as 'Likely' to occur, three species are classified as 'Possible' to occur and four species are classified as 'Unlikely' to occur (Table 22).

Table 21 Location of recorded conservation significant fauna

Species	Conservation status	Habitat type	Easting	Northing
Western Brush Wallaby (<i>Macropus irma</i>)	P4	Eucalypt Woodland	50J 404973	6515779

Table 22 Likelihood of occurrence for conservation significant fauna

Species	Conservation status	Habitat relevance	Likelihood ¹
Western Carpet Python (<i>Morelia spilota imbricata</i>)	S4	All habitat types within the study area provide habitat for this species. Especially the Eucalypt Woodland which contains Tree hollows and hollow logs used by this species to shelter in. The Western Carpet Python has been previously recorded 20 km southwest of the study area (GHD, 2013a).	Likely
Black-striped Snake (<i>Neelaps calonotos</i>)	P3	The Banksia and Eucalypt Woodland of the study area contain the leaf litter and loose soil preferred by this species. The Black-striped Snake has been previously recorded 8 km south of the study area in Muchea (DPAW, 2014b).	Likely
Peregrine Falcon (<i>Falco peregrinus</i>)	S4	The study area does not contain the cliff faces this species prefers to nest on. However, due to the vagrant nature of the Peregrine Falcon it may use the study area as part of a wider foraging territory. This species has been previously recorded in the vicinity of the study area (ATA, 2007, DPAW, 2014a and Birdata, 2014).	Possible
Bush Stone-curlew (<i>Burhinus grallarius</i>)	P4	Although suitable habitat exists in the study area for this species there have been limited recent records of this species on the Swan Coastal Plain and is thought to be locally extinct due to predation from feral species.	Unlikely
Brush Bronzewing (<i>Phaps elegans</i>)	P4	The Eucalypt Woodlands provides marginal habitat for this species, but lacks the dense shrubs and understory this species prefers. This species is thought to be locally extinct on the Swan Coastal Plain (Johnstone and Storr, 1998).	Unlikely
Forest Red-tailed Black Cockatoo (<i>Calyptorhynchus banksii naso</i>)	Vu, S1	The Eucalypt Woodland provides both foraging and breeding habitat for this species and the Banksia Woodland provides foraging habitat for this species. Based upon the distribution map in the referral guidelines the study area is at the northern extent of this species distribution. There have been no records of this species in the vicinity of the study area, the closest occurring approximately 40 km south of the study area (DPAW, 2014b).	Possible
Carnaby's Cockatoo (<i>Calyptorhynchus latirostris</i>)	En, S1	The Eucalypt Woodland provides both foraging and breeding habitat for this species and the Banksia Woodland provides foraging habitat for this species. There have been numerous records of this species occurring in the vicinity of the study area (Burbidge <i>et al</i> , 1996; ATA, 2007; GHD, 2013a; DPAW, 2014a, b).	Likely

Species	Conservation status	Habitat relevance	Likelihood ¹
Baudin's Cockatoo (<i>Calyptorhynchus baudinii</i>)	Vu, S1	The Eucalypt Woodland provides both foraging and breeding habitat for this species and the Banksia Woodland provides foraging habitat for this species. The study area is mapped as occurring outside of this species current distribution (DSEWPAC, 2012) and the most recent record of this species in the vicinity is from more than 30 years ago (DPAW, 2014a).	Unlikely
Barking Owl (<i>Ninox connivens</i>)	P2	This species prefers the thick vegetation present in the forests of the deep southwest of Western Australia, rather than the open woodlands located in the study area. The closest recent record of this species is from an isolated record approximately 50 km south of the study area.	Unlikely
Fork-tailed Swift (<i>Apus pacificus</i>)	Mi, S3	The Fork-tailed Swift is an almost exclusively aerial species, foraging and sleeping on the wing. This species is independent of terrestrial habitats. This species has been previously recorded in the vicinity of the study area (Birddata, 2014).	Possible
Rainbow Bee-eater (<i>Merops ornatus</i>)	Mi, S3	The Rainbow Bee-eater is one of the most widespread bird species in Australia (Barrett et al., 2003) occurring in a range of habitats. All habitat types of the study area provide suitable habitat for the Rainbow Bee-eater. This species has been previously recorded in the vicinity of the study area (Tingay, 1994, Burbidge, 1996, ATA, 2007, GHD, 2013a, DPAW, 2014a and DPAW, 2014b)	Likely
Western Quoll (<i>Dasyurus geoffroii</i>)	Vu, S1	The Western Quoll occurs in a wide range of habitats including woodlands, dry sclerophyll forests and riparian vegetation, where it creates dens in hollow logs, burrows, tree hollows and cavities. All habitats in the study area provide foraging habitat for this species with the Eucalypt Woodland providing potential den sites with the presence of tree hollows and hollow logs. There are scattered records of this species in the vicinity of the study area, the closest occurring in Bindoon (DPAW, 2014a).	Likely
Southern Brown Bandicoot (<i>Isodon obesulus fusciventer</i>)	P5	The Southern Brown Bandicoot occurs in areas containing dense ground cover such as forests, woodlands, scrub and heathlands. It is particularly prevalent in areas surrounding wetlands and damplands. The Dampland habitat provides ideal habitat for this species however the conical diggings typical of this species were not identified during the survey. This species has been previously recorded in Bindoon (DPAW, 2014a) and in the vicinity of the study area (Tingay, 1994, GHD, 2013a and DPAW, 2014b).	Likely

Species	Conservation status	Habitat relevance	Likelihood ¹
Western Brush Wallaby (<i>Macropus irma</i>)	P4	The Western Brush Wallaby occurs in open forests or woodlands, favouring open seasonally wet flats and thickets (van Dyck and Strahamn, 2008). The Eucalypt Woodland and Banksia Woodland provide ideal habitat for this species and one individual was recorded in the Eucalypt Woodland during the survey. This species has been previously recorded in the vicinity to the study area (Burbidge, 1996).	Recorded

1. Likelihood definitions:

Recorded – The species was recorded within the study area, historically or during the survey.

Likely – Suitable habitat is present and records of this species exist close to the study area.

Possible – Suitable habitat is present however no records exist in the vicinity, or records exist in the vicinity but suitable habitat is nearby but not in the study area.

Unlikely – Neither suitable habitat nor records exist near the study area.



6 DISCUSSION

6.1 Flora

A detailed Level 1 flora and vegetation assessment, in accordance with the EPA's Guidance Statement No. 51 (EPA, 2004a), was undertaken. The assessment involved a desktop review of available and relevant literature and a site reconnaissance involving the sampling of 30 relevés (simplified floristic sampling points) located throughout the study area.

The site reconnaissance survey involved the identification of vascular plant taxa recorded from the 30 relevés and from site traverses to identify additional vascular plant taxa not identified at each of the relevés. The survey also included an assessment of the presence/absence and population size of the Threatened and Priority listed taxa known to occur in the study area.

6.1.1 Vegetation


A total of four broad floristic formations and 16 vegetation associations were delineated from the study area during the July 2014 site visit. The vegetation associations recorded from the study area were considered to be in excellent condition with isolated patches of very good and good condition vegetation. The areas of vegetation in good and very good condition were located on the outer edges of the study area against the cleared paddocks and along areas of previously disturbed areas (i.e. the power line infrastructure corridor along the western boundary).

The four broad floristic formations included: *Eucalyptus* woodland, *Corymbia* woodland, *Banksia* woodland and *Banksia* shrubland. The dominant formation across the study area was *Eucalyptus* woodland which included vegetation associations with an upper storey dominated by *Eucalyptus todtiana* and *Eucalyptus marginata*. The *Banksia* shrubland and *Banksia* woodland was separated into two separate formations based on the height and dominance of the *Banksia* species. The *Banksia* woodland formation consisted of associations with *Banksia attenuata* and *Banksia menziesii* greater than 10 m high.

The sixteen vegetation associations are not considered to be unique to the study area, however they do represent two Priority Ecological Communities (SCP23b and Banksia Yellow-Orange Sands) and one Threatened Ecological Community (SCP20c) according to data provided by DPAW. The presence of the TEC and two PECs was identified during the desktop review, while the distribution and extent of the PEC Banksia Yellow-Orange Sands is considered to be wider spread throughout the study area based on the vegetation association descriptions and extent.

In addition to the TEC and two PECs identified by DPAW during the desktop review, an additional two TECs, SCP20a and SCP20b, and one PEC, SCP21c, are inferred to occur in the study area. The TECs and PECs are located throughout the study area and in association with the known TEC and PECs locations, the majority of the vegetation within the study area is considered to be significant.

The presence and extent of the TECs and the two PECs cannot be accurately confirmed due to the lack of systematic quadrat sampling of the floristic composition recorded within the study area and a multivariate analysis and comparison of regional and existing datasets (including the dataset from Gibson *et al.*, 1994) has not been completed. However, a comparison of the floristic information collected at each of the 30 relevés and the biological and geological information known for each of the TEC and PECs has been completed. An inference on the floristic community type described from Gibson *et al.* (1994) can be made to identify possible TECs and PECs present within the study area.



The retention and vesting of the study area into a DPAW conservation estate will increase the pre-European extent within formal protection (DPAW conservation estates, Bush Forever sites in DPAW managed lands and Bush Forever sites in Regional Parks). The new extent within formal protection will not significantly increase to ensure they are above the 30% threshold however will push the Moondah complexes above the 10% endangered level.

The study area is located within a north-south ecological corridor that connects the Boonanarring Nature Reserve in the north and Leda Nature Reserve in the south. The corridor will allow the continual movement of genetic material (via insect and wind pollination) in a north-south movement to maintain genetic integrity.

6.1.2 Flora

A total of 154 vascular plant taxa from 38 families and 88 genera were recorded from the study area, including 148 native taxa and six introduced taxa. This number is considered to significantly increase if the survey was undertaken at the optimum time in spring for the Swan Coastal Plain.

One Threatened taxon, *Chamelaucium* sp. Gingin (N.G. Marchant 6) and one Priority listed taxon, *Hypolaena robusta* (P4), were recorded from the study area. An additional five Priority listed taxa, *Acacia cummingiana* (P3); *Caustis* sp. Gigas (A.S. George 9318) (P2); *Schoenus griffinianus* (P3); *Verticordia rutilastra* (P3); and *Verticordia serrata* var. *linearis* (P3), have previously been recorded from the study area. These five Priority listed taxa were not recorded at the time of the site reconnaissance.

The five Priority listed taxa not recorded at the time of the survey may still persist in the study area. The timing of the survey was not optimal for identifying the two *Verticordia* species and the *Schoenus* and *Caustis* species. Searches were conducted for *Acacia cummingiana* at the known location along Reserve Road but it was not recorded.

Chamelaucium sp. Gingin (N.G. Marchant 6) was recorded from 12 point locations totalling approximately 200 individuals. This number is considered to only represent a subset of the individuals known to occur in the northwest corner of the study area and the adjacent DPAW managed lands.


The study area is considered to represent critical habitat for *Chamelaucium* sp. Gingin (N.G. Marchant 6) according to the interim recovery plan (Stack and English, 2003). The study area represents current known occupancy, similar within 200 m and a corridor for pollination between populations located adjacent to the study area (Stack and English, 2003).

Hypolaena robusta (P4) was recorded from two locations within the study area and is known from one other location within the study area.

An assessment of the likelihood of the conservation significant flora identified from the desktop review occurring within the study area, concluded that ten conservation significant taxa are likely to occur within the study area. An additional 15 conservation significant taxa may potentially occur within the study area based on known locations and habitat preferences. The remaining 30 conservation significant taxa are not expected to occur within the study area based on habitat preferences and the current known locations of these taxa (Appendix D).

Of the ten conservation significant species likely to occur in the study area, only one, *Chamelaucium* sp. Gingin (N.G. Marchant 6), is listed Threatened (Declared Rare-Extant) under the WC Act and the EPBC Act. The remaining 19 Threatened taxa identified from the desktop review are not expected to occur in the study area based on their known distribution and preferred habitat requirements.

A total of six introduced taxa were recorded from the study area. The six introduced taxa are not considered to be WONS, while the Arum Lily (*Zantedeschia aethiopica*), recorded from the southwest corner in vegetation association Ba, is considered to be a Declared Pest under the BAM Act. The remaining



five introduced taxa are common weed species of disturbed or degraded sites and are present within the study area in low densities. The majority of the weeds are encroaching from the cleared paddocks located to the southwest and east of the study area.

6.2 Fauna

6.2.1 Fauna Habitats

The study area contains approximately 663 ha of Banksia Woodland, 315 ha of Eucalypt Woodland and 3 ha of Dampland habitat. The majority of the study area is classified as excellent condition, with dieback being the only major disturbance.

The fauna habitats present in the study area are considered to be common on a local scale with similar habitat existing in the immediate vicinity. Chandala Nature Reserve, Barracca Nature Reserve, Breera Road Nature Reserve and Yeal Nature Reserve are all located within 10 km of the study area. The close proximity of the study area to these permanent sections of native vegetation increases its local importance and value as an offset site. Habitat connectivity occurs with Breera nature reserve to the north, Chandala Nature Reserve to the east and even Bullsbrook Nature Reserve along a drainage line to the south of the study area. Drainage lines are well known conduits for fauna movement as they provide a well-covered/vegetated habitat to provide safe passage between areas. Due to its position and surrounding habitats the study area has an importance far greater than its 988 ha size suggests.

The large size of the study area and the excellent condition of the habitats indicates the full suite of microhabitats native fauna rely upon is present, e.g.: thick leaf litter, old logs and hollows, fruit/flower bearing trees. As such, the vast majority of the species in Appendix J are expected to occur in the study area. The large area of Banksia Woodland (663 ha) provides a wealth of foraging resource for nectivorous species such as honeyeaters and Honey Possums that are not readily supported by the fragmented landscapes present in urban areas.

The moderate to old age of the trees in the study area means they have become a hollow bearing resource, many species of bird and mammal rely on as integral part of their life cycle e.g.: for breeding and shelter. Galahs and Australian Ringnecks were seen using hollows during the survey. The lack of recent fire in some sections of the study area has meant that tree branches and limbs have fallen but are yet to produce tree hollows or hollow logs, which would increase the habitat value of the study area.

6.2.2 Black Cockatoo Habitat

The study area provides suitable foraging, roosting and breeding habitat for the Carnaby's Cockatoo and to a lesser extent the Forest Red-tailed Cockatoo (due to the study area occurring at the northern extent of its distribution). During the survey no evidence of either species of Black Cockatoo was recorded in the study area however the presence of such species can be difficult to assess due to their seasonal movement patterns and sporadic nature.

The location of the study area is strategic as it supports Carnaby's Cockatoos during their migration to and from breeding sites in the Wheatbelt. Carnaby's Cockatoos that have been breeding in the Dandaragan, Moora and Bindoon regions potentially move through the vicinity of the study area prior to their movement south through the Swan Coastal Plain. Bindoon and the areas around it have been identified as an appropriate location to be recommended as offset site and Chittering has been identified as an area under pressure (Johnstone and Kirkby, 2011).

The study area contains 17 species of known foraging resources for Black Cockatoos and approximately 981 ha classified as foraging habitat. The habitats present are dominated by Jarrah, Marri and *Banksia* species which are all important foraging species. The mature age of the foraging species (predominantly



Jarrah, Marri and *Banksia* species) allows a greater yield of fruiting bodies/seed pods as compared to immature habitats. Given the large area of foraging habitat and the excellent condition of the vegetation the study area provides an important foraging resource for Black Cockatoos in the vicinity.

Roost sites for Black Cockatoos typically have tall, dense canopied trees, are close to water where the birds can drink and close to food trees such as *Banksias* and Marri. The roost trees are usually clumped and at larger roosts, cover an area of at least five hectares (Burnham et al., 2010). The study area provides ideal setting as a potential roost site, as it contains these conditions. The closest known roost sites for Carnaby's Cockatoos occur in Gingin and Yanchep which are approximately 17 km north and west of the study area respectively (Burnham et al., 2010). These sites are known from their inclusion in the Great Cocky Count where potential roost sites are surveyed. As no roost surveys have been conducted in the study area or its direct surrounds an accurate assessment of its use as a roost site cannot be ascertained. The entire Eucalypt Woodland habitat is classified as containing roosting habitat which equates to approximately 315 ha.

The tree age in the study area is sufficient to produce large hollows with potential to yield more with subsequent fires. For hollows to be of use to Carnaby's Cockatoos dimensions must be a minimum of 14 cm entrance size and at least 50 cm deep (Groom, 2011). As such, the study area contains habitat that can be classified as having current breeding potential for Carnaby's Cockatoos in a region known to have breeding records (Johnstone and Kirkby, 2011). The Cockatoo referral guidelines states "in a woodland stand with trees of suitable diameter at breast height, all trees of all ages and size are potentially important for maintaining breeding in the long term," as such the Eucalypt Woodland is classified as breeding habitat (approximately 315 ha). The tree density survey results show that the study area contains large areas (192 ha) with a high tree density, with more than 20 trees with a DBH over 500 mm per hectare. An estimated 6,353 trees with a DBH over 500 mm occur in the study area. As such, the study area contains large areas of high quality breeding habitat for Black Cockatoos.

6.2.3 Conservation Significant Fauna

The only conservation significant fauna recorded in the study area was the Priority 4 listed Western Brush Wallaby (*Macropus irma*). A further six species of conservation significance are considered Likely to occur in the study area.

The Western Brush Wallaby is listed as Priority 4, rare, near threatened and other species in need of monitoring under the DPAW Priority listings. It occurs only in the South West of Western Australia and has undergone a massive decline due to habitat fragmentation in the Wheatbelt and fox predation. Due to foxes some populations have experienced an 80% reduction between the 1970s and 1990s. However, fox control has allowed this species to become more common throughout its range (Van Dyck and Strahan, 2008). Limited records for this species occur for the vicinity of the study area (DPAW, 2014b). One individual was recorded in the Eucalypt Woodland but it is also expected to occur across the Banksia Woodland habitat.

The Western Carpet Python (*Morelia spilota imbricata*) occurs only along the southwestern portions of Western Australia and is listed as Schedule 4 under the WC Act. Threatening processes include habitat destruction and changed fire regimes, with the impact of feral predators being unknown (Pearson et al., 2005 and DEC, 2012). This species requires large areas of undisturbed bushland (Bush et al., 2007) and is expected to occur in all habits types of the study area. The large area of excellent condition habitat and abundance of logs and tree hollows suggest the study area is ideal habitat for this species.

The Black-striped Snake (*Neelaps calonotos*) is listed as Priority 3, poorly-known species under the DPAW Priority listings. It occurs only along the Swan Coastal Plain with the bulk of this species known distribution occurring in the Perth region, however there have been recent records of this species further north near Dongara and Eneabba suggesting it has a broader distribution (Bush et al., 2010). Threatening processes



involve habitat destruction within its small distribution. Both the Banksia Woodland and Eucalypt Woodland provide ideal habitat for this species. There have been records of this species from the vicinity of the study area from Muchea and Gingin (DPAW, 2014b).

The Carnaby's Cockatoo (*Calyptorhynchus latirostris*) is listed as Endangered under the EPBC Act and Schedule 1 under the WC Act. This species is endemic to the southwest of Western Australia, from Kalbarri in the north to Esperance (DSEWPAC, 2012). In the last 45 years the Carnaby's Cockatoo population has dropped to by 50% to an estimated 40,000 individuals (Johnstone et al., 2008 and Cale, 2003). The major threats to this species include clearing of their core breeding habitat in the Wheatbelt and the clearing of foraging resources on the Swan Coastal Plain (Cale, 2003). There are numerous records of this species in the vicinity of the study area (Burbidge et al., 1996, ATA, 2007, GHD, 2013a, b, DPAW, 2014a and DPAW, 2014b), including breeding records from Bindoon and Gingin (Johnstone and Kirkby, 2011). As mentioned previously the Banksia Woodland provides foraging habitat for this species and the Eucalypt Woodland provides foraging, roosting and breeding habitat for this species.

The Rainbow Bee-eater (*Merops ornatus*) is listed as Migratory under the EPBC Act and Schedule 3 under the WC Act. The Rainbow Bee-eater is one of the most widespread birds species in Australia distributed across mainland Australia (Barrett et al., 2003). There are no known threats to this common species. All habitat types are expected to be used by this species.

The Western Quoll (*Dasyurus geoffroii*) is listed as Vulnerable under the EPBC Act and Schedule 1 under the WC Act. Once distributed over 70% of Australian this species distribution is now down to 5% of its former range, restricted to the southwest of Western Australia (Orell and Morris, 1994). The major threats to this species include feral predators, habitat clearing and changed fire regimes (Smith et al., 2004). The Western Quoll has large home range, 400 ha for females and 900 ha for males. Given the connectivity with surrounding areas of bush and the large size of the site the potential exists for this species to reside in the study area or its surrounds. All habitat types would be used as foraging habitat and the hollows logs found in the Eucalypt Woodland provides suitable den site locations. The Western Quoll has been recently recorded in Bindoon.

The Southern Brown Bandicoot (*Isodon obesulus fusciventer*) is listed as Priority 5, conservation dependent species under the DPAW Priority listing. The West Australian sub species is distributed along the coast from Guilderton to Esperance (DPAW, 2014b). The major threatening processes for this species are fragmentation and loss of habitat, predation by foxes, cats and in residential areas dogs. The Dampland habitat and the surrounding Woodlands provide habitat for this species. This species has been previously recorded in Bindoon and in the vicinity of the study area (Tingay, 1994, GHD, 2013a and DPAW, 2014b).

6.3 Conservation Value

In summary, the study area is considered to be of high conservation value comprising habitat for a significant number of threatened flora and fauna species. Some of these species are likely to be impacted by the NorthLink WA project. The vegetation is representative of a number of Threatened and Priority Ecological Communities, some of which likely to be impacted by the NorthLink WA Project. The addition of the study area to the conservation estate will substantially increase the estate with the adjacent Class C Reserve and provide protection of an important ecological linkage.

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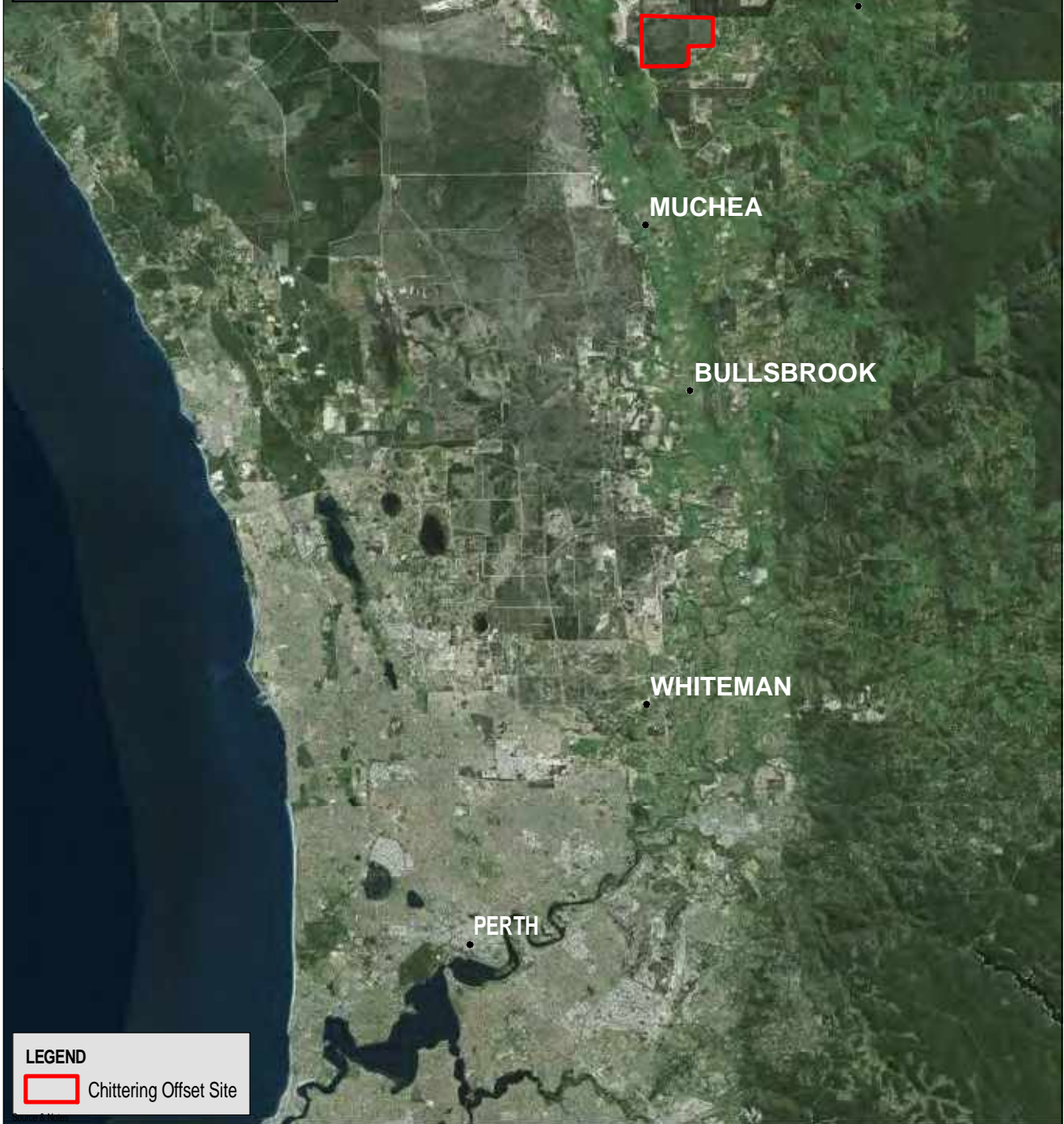
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Figures




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LEGEND

Chittering Offset Site



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14.04.2015
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Main Roads WA



Regional Location
Flora, Vegetation and
Fauna Assessment

Figure No:

1



Source & Notes
Aerial Imagery from Google Earth Pro (10.01.2015).



Date:
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Main Roads WA



Study Area
Flora, Vegetation and
Fauna Assessment

Figure No:

2



Source & Notes
 Vegetation complex mapping from DPAW (January 2015).
 Aerial Imagery from Google Earth Pro (10.01.2015).



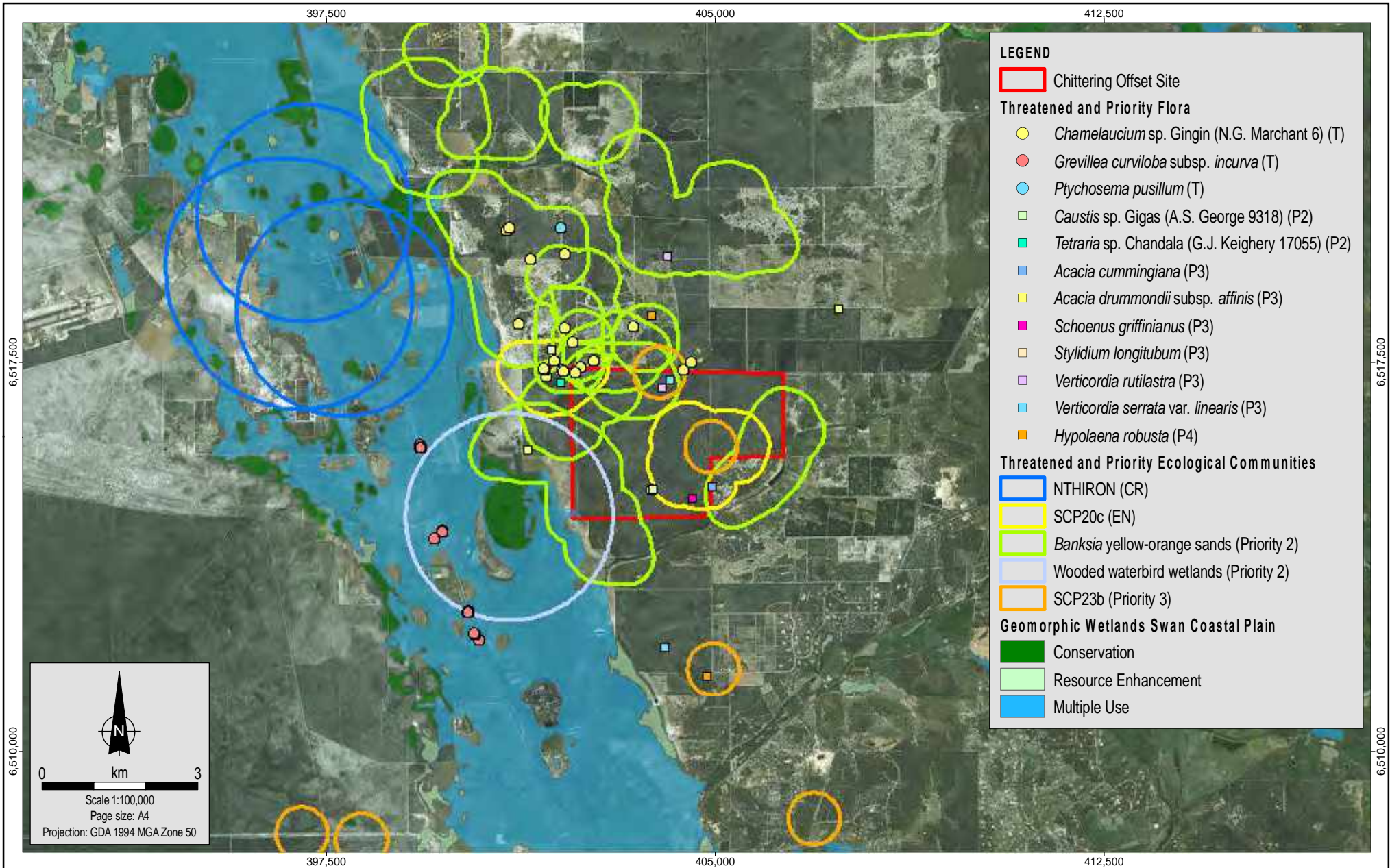
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Main Roads WA



Vegetation Complexes
 Flora, Vegetation and
 Fauna Assessment

Figure No:
4



LEGEND

- Chattering Offset Site
- Threatened and Priority Flora**
- *Chamelaucium* sp. Gingin (N.G. Marchant 6) (T)
- *Grevillea curviloba* subsp. *incurva* (T)
- *Ptychosema pusillum* (T)
- Caustis* sp. Gigas (A.S. George 9318) (P2)
- *Tetralix* sp. Chandala (G.J. Keighery 17055) (P2)
- *Acacia cummingiana* (P3)
- *Acacia drummondii* subsp. *affinis* (P3)
- *Schoenus griffinianus* (P3)
- *Stylidium longitubum* (P3)
- *Verticordia rutilastra* (P3)
- *Verticordia serrata* var. *linearis* (P3)
- *Hypolaena robusta* (P4)
- Threatened and Priority Ecological Communities**
- NTHIRON (CR)
- SCP20c (EN)
- Banksia* yellow-orange sands (Priority 2)
- Wooded waterbird wetlands (Priority 2)
- SCP23b (Priority 3)
- Geomorphic Wetlands Swan Coastal Plain**
- Conservation
- Resource Enhancement
- Multiple Use

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Source & Notes
 Conservation significant flora and vegetation mapping from Coffey (August 2014).
 Aerial imagery from ArcGIS Online.



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Main Roads WA
 NorthLinkWA

Flora and Vegetation Constraints
 Flora, Vegetation and
 Fauna Assessment

Figure No:
 5



LEGEND

- **Zantedeschia aethiopica*
- Chittering Offset Site

Vegetation Condition

- Excellent
- Very good to excellent
- Very good

Source & Notes
 **Zantedeschia aethiopica* location and vegetation condition mapping from Coffey (2014)
 Aerial Imagery from Google Earth Pro (10.01.2015).

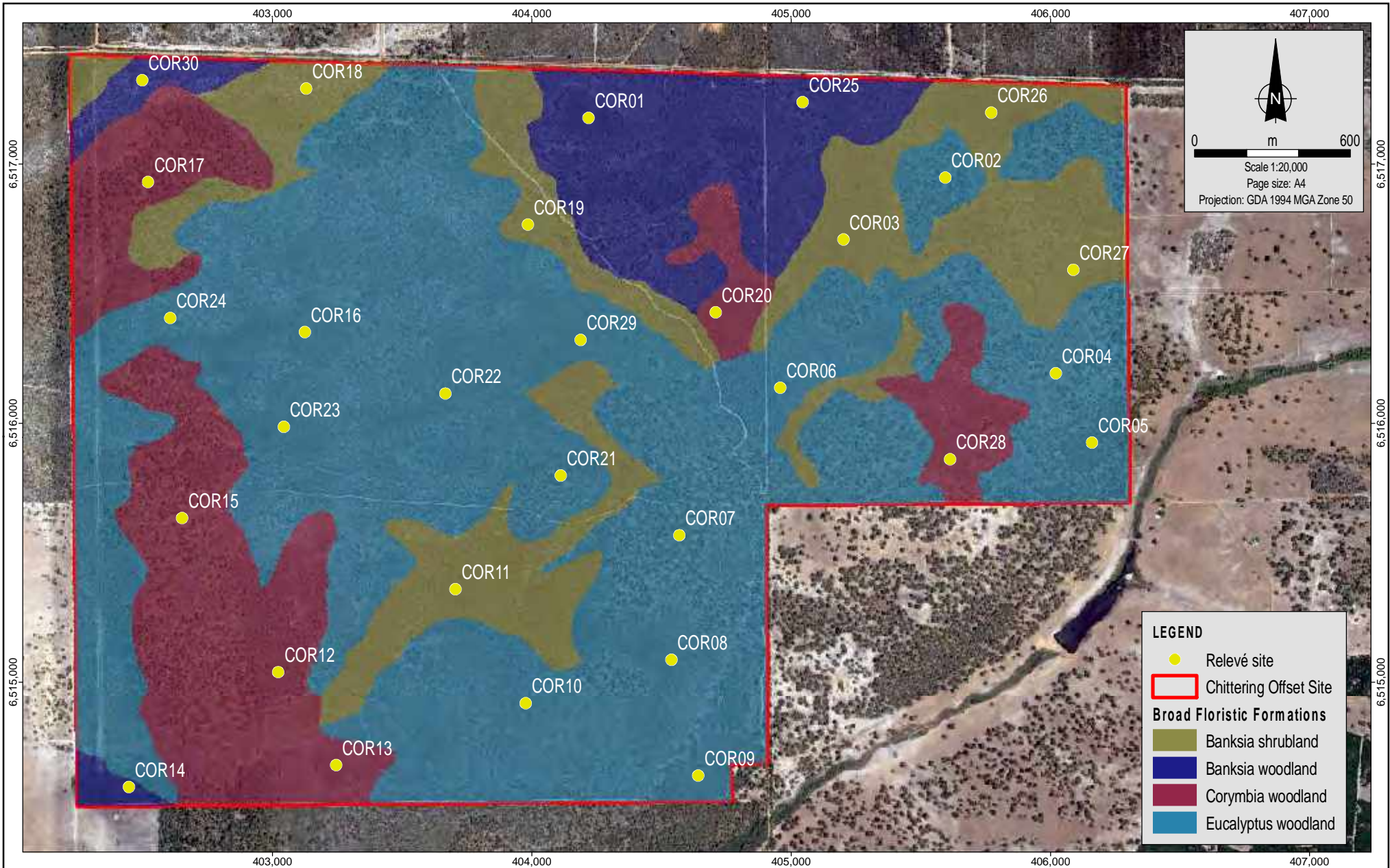


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Main Roads WA
 NorthLinkWA

Vegetation condition and introduced flora
 Flora, Vegetation and Fauna Assessment

Figure No:
 6



Source & Notes
 Relevé sites and broad floristic formation mapping from Coffey (2014).
 Aerial Imagery from Google Earth Pro (10.01.2015).



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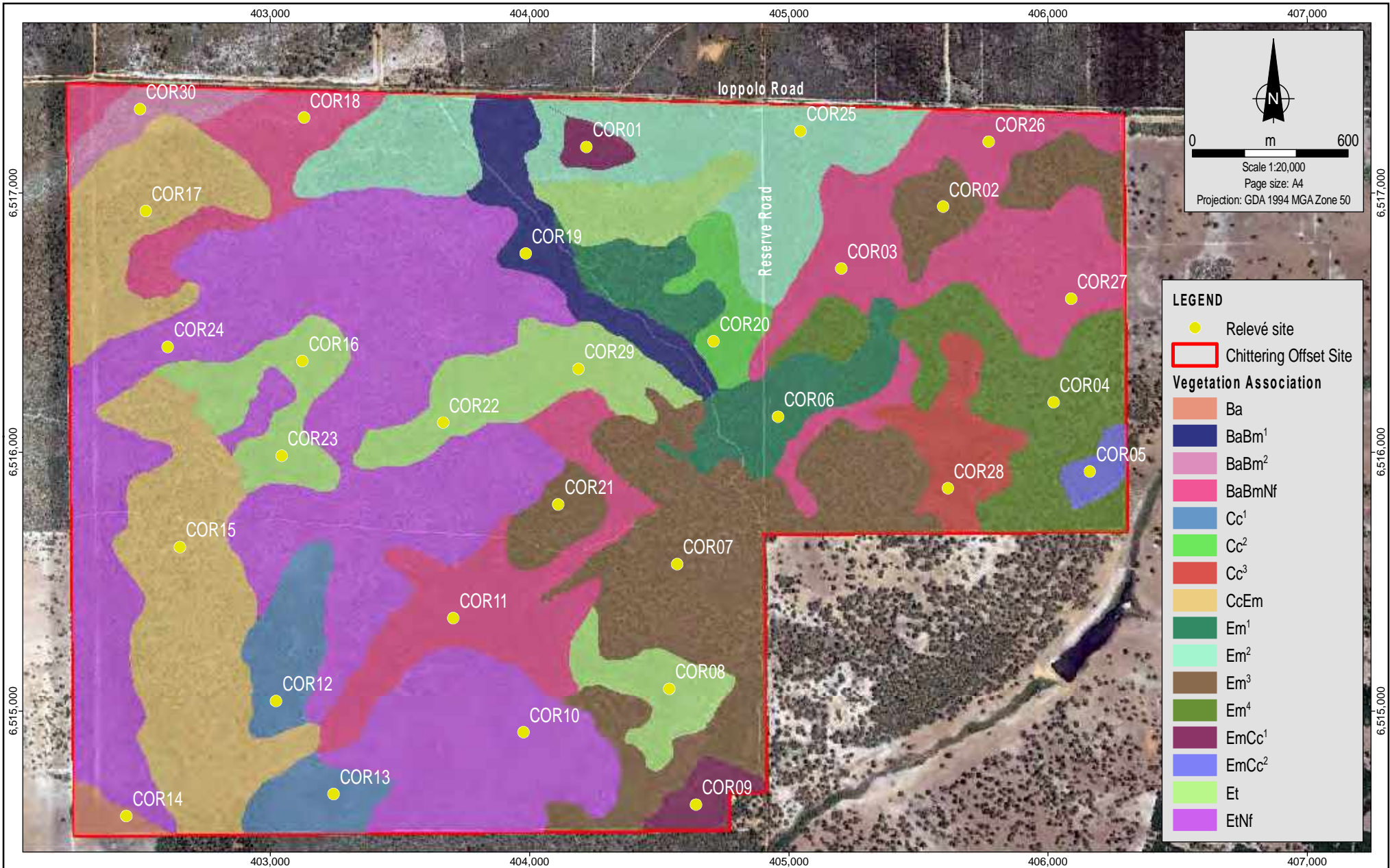
Main Roads WA



Broad Floristic Formations
 Flora, Vegetation and
 Fauna Assessment

Figure No:

7



Source & Notes
 Relevé sites and vegetation association mapping from Coffey (August 2014).
 Aerial imagery from Google Earth Pro (10.01.2015).



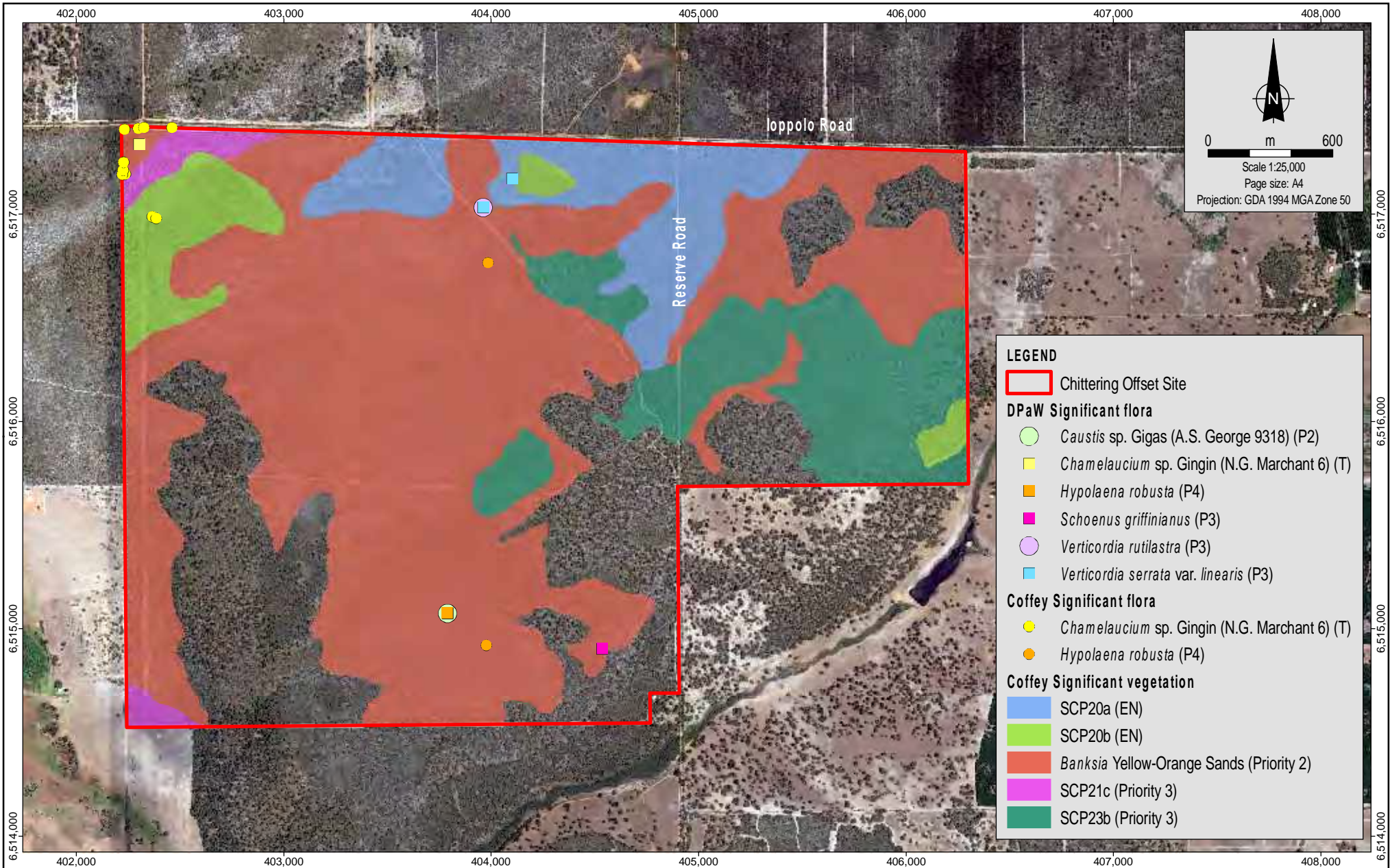
Date:
14.04.2015
 MXD:
4483AA_06_GIS022_1
 File Name:
4483AA_06_F008_GIS

Main Roads WA



Vegetation Associations
 Flora, Vegetation and
 Fauna Assessment

Figure No:
8



Source & Notes
 Conservation significant flora and vegetation mapping from Coffey (August 2014).
 Aerial imagery from Google Earth Pro (10.01.2015).



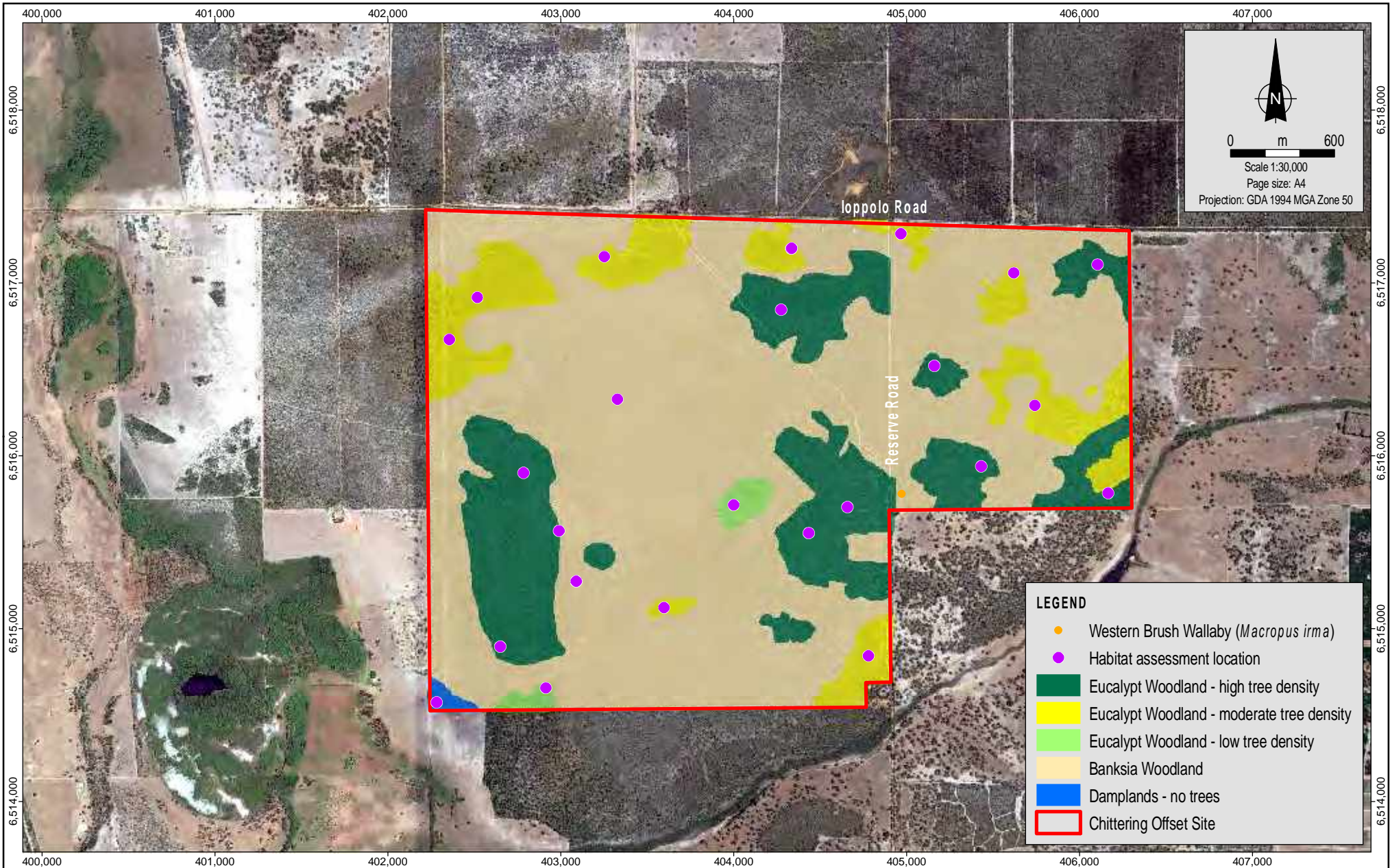
Date:
14.04.2015
 MXD:
4483AA_06_GIS021_1
 File Name:
4483AA_06_F009_GIS

Main Roads WA



Conservation Significant Flora and Vegetation
 Flora, Vegetation and
 Fauna Assessment

Figure No:
9



Source & Notes
 Fauna habitat and tree density from Coffey (August 2014).
 Aerial Imagery from Google Earth Pro (10.01.2015).



Date:
14.04.2015
 MXD:
4483AA_06_GIS011_1
 File Name:
4483AA_06_F010_GIS

Main Roads WA



Fauna Habitat and Tree Density
 Flora, Vegetation and
 Fauna Assessment

Figure No:
10



Source & Notes
 Black Cockatoo habitat mapping from Coffey (August 2014).
 Aerial Imagery from Google Earth Pro (10.01.2015).



Date:
14.04.2015
 MXD:
4483AA_06_GIS020_1
 File Name:
4483AA_06_F011_GIS

Main Roads WA
 NorthLinkWA

Black Cockatoo Habitat
 Flora, Vegetation and
 Fauna Assessment

Figure No:
11



APPENDIX A

Department of Parks and Wildlife Database Searches



Your Ref:
Our Ref: **12-0614FL**
Enquiries: Myrto Robert
Phone: (08) 9218 8760
Fax: (08)
Email: flora.data@dpaw.wa.gov.au

Coffey Environments
PO Box 4223
Victoria Park WA 6979

Attention: John Trainer

Dear John Trainer,

REQUEST FOR THREATENED AND PRIORITY FLORA INFORMATION

I refer to your request of 30 May 2014 for Threatened (Declared Rare) and Priority Flora information in the Chittering area. The search was conducted within 5km radial area of the central coordinates you submitted.

A search was undertaken for this area of **(1)** the Department's *Threatened (Declared Rare) and Priority Flora* database (for results, *if any*, see "TPFL" – coordinates are GDA94), **(2)** the *Western Australian Herbarium Specimen* database for priority species opportunistically collected in the area of interest (for results, *if any*, see "WAHERB"- coordinates are GDA94 – see condition number 9 in the attached 'Conditions in Respect of Supply' and **(3)**, the Department's *Threatened and Priority Flora List* [this list is searched using 'place names'. This list, which may also be used as a species target list, 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) – for results, *if any*, see "TP List"]. The results are attached electronically to this email.

Attached also are the conditions under which this information has been supplied. Your attention is specifically drawn to the seventh point, which refers to the requirement to undertake field investigations for the accurate determination of Threatened and Priority flora occurrence at a site. *The information supplied should be regarded as an indication only of the Threatened and Priority flora that may be present and may be used as a target list in any surveys undertaken.*

The information provided does not preclude you from obtaining and complying with, where necessary, land clearing approvals from other agencies.

An invoice for \$300 (plus GST) to supply this information will be forwarded.

It would be appreciated if any populations of Threatened and Priority flora you encounter in the area could be reported to this Department to ensure their ongoing management.

If you require any further details, or wish to discuss Threatened and Priority flora management, please contact Dr Ken Atkins, Manager, Species and Communities Branch, on (08) 9334 0455.

Yours faithfully

Miss Myrto Robert

.....
A/THREATENED FLORA DATABASE OFFICER
for the Director General

9 June 2014

DEPARTMENT OF PARKS AND WILDLIFE

THREATENED (DECLARED RARE) AND PRIORITY FLORA INFORMATION

CONDITIONS IN RESPECT OF SUPPLY OF INFORMATION

1. All requests for data to be made in writing to the Director General, Department of Parks and Wildlife, Attention: Threatened Flora Database Officer, Species and Communities Branch.
2. The data supplied may not be supplied to other organisations, nor be used for any purpose other than for the project for which they have been provided, without the prior written consent of the Director General, Department of Parks and Wildlife.
3. Specific locality information for Threatened and Priority Flora is regarded as confidential, and should be treated as such by receiving organisations. Specific locality information may not be used in public reports without the written permission of the Director General, Department of Parks and Wildlife. Publicly available reports may only show generalised locations or, where necessary, show specific locations without identifying species. Species and Communities Branch is to be contacted for guidance on the presentation of Threatened and Priority Flora information.
4. Note that the Department of Parks and Wildlife respects the privacy of private landowners who may have Threatened and Priority Flora on their property. Threatened and Priority Flora locations identified in the data as being on private property should be treated in confidence, and contact with property owners made through the Department of Parks and Wildlife.
5. Receiving organisations should note that while every effort has been made to prevent errors and omissions in the data provided, they may be present. The Department of Parks and Wildlife accepts no responsibility for this.
6. Receiving organisations must also recognise that the database is subject to continual updating and amendment, and such considerations should be taken into account by the user.
7. **It should be noted that the supplied data do not necessarily represent a comprehensive listing of the Threatened and Priority Flora of the area in question. Its comprehensiveness is dependant on the amount of survey carried out within the specified area. The receiving organisation should employ a botanist, if required, to undertake a survey of the area under consideration.**
8. Acknowledgment of the Department of Parks and Wildlife as source of the data is to be made in any published material. The unique reference number that is given upon the request for information should be quoted when referencing the data. Copies of all such publications are to be forwarded to the Department of Parks and Wildlife, Attention: The Manager, Species and Communities Branch.
9. The development of the PERTH Herbarium database was not originally intended for electronic mapping (eg. GIS ArcView). The latitude and longitude coordinates for each entry are not verified prior to being databased. It is only in recent times that collections have been submitted with GPS coordinates. Therefore, be aware when using this data in ArcView that some records may not plot to the locality description given with each collection.

Species and Communities Branch

17 Dick Perry Ave, Technology Park, Kensington

Phone: (08) 9334 0455 Fax: (08) 9334 0278

Locked Bag 104, Bentley Delivery Centre, Bentley, Western Australia 6983

www.dpaw.wa.gov.au

DECLARED RARE AND PRIORITY FLORA LIST

CONSERVATION CODES

for Western Australian taxa

T: **Threatened Flora** (Declared Rare Flora - Extant)
Schedule 1 under the *Wildlife Conservation Act 1950* Rare Flora Notice

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. The assessment of the conservation status of these species is based on their national extent.

X: **Presumed Extinct Flora** (Declared Rare Flora – Extinct)
Schedule 2 under the *Wildlife Conservation Act 1950* Rare Flora Notice

Taxa which have been adequately searched for and there is no reasonable doubt that the last individual has died, and have been gazetted as such.

Threatened Flora (Schedule 1) are further ranked by the Department according to their level of threat using IUCN Red List criteria:

CR: **Critically Endangered** – considered to be facing an extremely high risk of extinction in the wild.

EN: **Endangered** – considered to be facing a very high risk of extinction in the wild.

VU: **Vulnerable** – considered to be facing a high risk of extinction in the wild.

A list of the current rankings can be downloaded from DPAW's [Listing of species and ecological communities](http://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities) webpage at

<http://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities>

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Species that have not yet been adequately surveyed to be listed under Schedule 1 or 2 are added to the Priority Flora and Priority Fauna Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora or fauna. Species that are adequately known, are rare but not threatened, or meet criteria for Near Threatened, or that have been recently removed from the threatened list for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring. Conservation Dependent species are placed in Priority 5.

Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.

1: Priority One: Poorly-known species

Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.

2: Priority Two: Poorly-known species

Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.

3: Priority Three: Poorly-known species

Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.

4: Priority Four: Rare, Near Threatened and other species in need of monitoring

(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands.

(b) Near Threatened. Species that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.

(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

5: Priority Five: Conservation Dependent species

Species that are not threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

Recommendations for additions, deletions or changes to the Declared Rare and Priority Flora List should be forwarded to the Flora Administration Officer or Senior Botanist Species and Communities Branch, DEC.

Species and Communities Branch

17 Dick Perry Ave, Technology Park, Kensington

Phone: (08) 9334 0455 Fax: (08) 9334 0278

Locked Bag 104, Bentley Delivery Centre, Bentley, Western Australia 6983

www.dpaw.wa.gov.au

ABBREVIATIONS USED IN THREATENED AND PRIORITY FLORA DATABASE

VESTING

AAP	Aboriginal Planning Authority
AGR	Chief Executive, Dep. of Agriculture
ALT	Aboriginal Land Trust
APB	Agricultural Protection Board of WA
BGP	Botanical Gardens & Parks Authority
BSA	Boy Scouts Association
CC	Conservation Commission – NPNCA - LFC
CGT	Crown Grant in Trust
COM	Commonwealth of Australia
CRO	Crown Freehold-Govt Ownership
CRW	Crown
DAG	Dep. of Agriculture
DOW	Dep. of Water
DPI	Dep. of Planning
EXD	Exec Direc CALM
FES	Fire and Emergency Services Aust.
HOW	Dep. of Housing/State Housing Commission
ILD	Industrial Lands Develop. Auth
LAC	LandCorp
LGA	Shire/LGA
MAG	Minister for Agriculture
MCB	Metropolitan Cemeteries Board
MED	Ministry of Education
MHE	Minister for Health
MIN	Minister for Mines
MPL	Ministry for Planning
MPR	Minister for Prisons
MRD	Main Roads WA
MTR	Minister for Transport
MWA	Minister for Water Resources
MWO	Minister for Works
NAT	Natural Trust of Australia WA
NON	Not Vested
PLB	Pastoral Lands Board
PRI	Private/Freehold
RAI	Public Transport Authority
REL	Religious Organisation
SPC	State Planning Commission
SYN	Synergy (ex Western Power)
SWA	State of Western Australia
TEL	Telstra
UNK	Unknown
WAT	Water Corporation
WEL	Minister Community Welfare
WRC	Water & Rivers Commission
XPL	Ex-Pastoral Lease

PURPOSES

ABR	Aboriginal Reserve
ACC	Access Track
AER	Aerodrome
AIR	Airport
ARS	Agricultural Research Station
BAP	Baptist Union of WA
CAM	Camping
CAR	Caravan park
CEM	Cemetery
CFA	Conservation of Fauna
CFF	Conservation Of Flora & Fauna
CFL	Conservation of Flora
CHU	Church
CMN	Communications
COM	Common
CON	Conservation Park
CPK	Car Park
CRM	Conservation & Resource Management
DEF	Defence
DRA	Drain

EDE	Educational Endowment
EDU	Educational purposes UWA
ENE	Enjoyment of Natural Environ.
EPL	Ex-pastoral Lease (Sect 33(2) CALM Act)
EPS	Explosives
EXC	Excepted from sale
EXL	Exploration Lease
EXP	Experimental Farm
FIR	Firing Range
FOR	State Forest
FP	Foreshore Purposes
GE	General Lease
GHA	Grain Handling
GOL	Golf
GRA	Gravel Pit
GVT	Government Requirements
HAR	Harbour Purposes
HEP	Heritage Purposes
HER	Heritage trail
HOS	Hospital
KEN	Kennels
LGA	LGA/Shire Requirements
LPR	Landscape Protection
MIN	Mining lease
MUN	Municipal Purposes
NPK	National Park
NRE	Nature Reserve
OTH	Other
PAR	Parkland (& Recreation)
PAS	Pastoral lease
PCR	Proposed for Conservation
PFF	Protection of Flora & Fauna
PFL	Protection of Flora
PIC	Picnic ground
PLA	Plantation
PMC	Protection of Meteorite Crater
POS	Public Open Space
PPA	Public parkland
PRS	Prison site
PUR	Purchase Lease
PUT	Public Utility
QUA	Quarry
RAC	Racecourse
RAD	Radio Station
REC	Recreation
REH	Rehabilitation/Re-establish Native Plants
RRE	Railway Reserve
RUB	Rubbish
SAL	Saleyards
SAN	Sand
SCH	School-site
SET	Settlers requirements
SHO	Showgrounds
SNN	Sanitary
SOI	Soil Conservation
STO	Stopping place
STK	Stock Route
TIM	Timber
TOU	Tourism
TOW	Town-site
TRA	Training Ground
TRI	Trig station
UCL	Unallocated Crown Land
UNK	Unknown
VER	Road Verge
VPF	Vermin Proof Fence
WAT	Water
WLS	Wildlife Sanctuary
WOO	Firewood

ABBREVIATIONS USED IN THE WESTERN AUSTRALIAN HERBARIUM DATABASE

Geocode Method - The method that was used to record the latitude and longitude.

Auto - Indicates that the coordinate data in the record was created automatically (i.e. by software), usually by creating a coordinate from information provided in the Nearest Named Place or Locality textual description fields.

GAP - Acronym for "Generalised Arbitrary Point" as used in HISPID. GAP indicates that the coordinate data was obtained manually from the Nearest Named Place or Locality textual description fields.

GPS - Acronym for "Global Positioning System". GPS indicates that the coordinate data in the record was obtained from a GPS unit by the collector of the specimen.

MAN - Shorthand for manual. MAN indicates that the coordinate data was created by hand using some method not allowed for by one of the other manual Geocode Method values, in particular, TOPO, GAP, or GPS.

TOPO - Shorthand for topographic map. TOPO indicates that the coordinate data was obtained by plotting textual locality details against a topographic map.

None - Indicates that no coordinate data has been supplied by the collector.

Unknown - Indicates that there is no known method for determining the coordinate data. Should be used if the collector provided no indication of how they sampled the specimen's coordinate data.

PREC (Precision) - precision ratings for coordinates.

Precision 1: Absolutely precise (to nearest 100m or nearest second) and must be GPS determined. For example 35°26'42"S 123°40'26"E

Precision 2: Falling within a diameter of 3km (ca 2 minutes) or if no GPS mentioned in collecting notes. (The location must be able to be pinpointed on a 1:250 000 map, a spot locality. For example 35°26'42"S 123°40'26"E

Precision 3: Falling within a diameter of 10km (ca 7 minutes) or for degrees and minutes, where seconds have not been given. For example 35°26'_"S 123°40'_"E

Precision 4: Falling within a diameter of ca 50km (30 minutes). For example 35°26'_"S 123°40'_"E

Precision 5: Where a location is a prescribed large geographical area within a state or only the state is given. Diameter is greater than 50km. For example 35°_"_"S 123°_"_"E

Precision 6: used when localities are New Holland, Eastern Australia or Not given. Fields will be left blank.

Clinton Van Den Bergh

From: Communities Data <Communities.Data@DPaW.wa.gov.au>
Sent: Tuesday, 10 June 2014 2:56 PM
To: John Trainer; Fauna Data; Flora Data; Communities Data
Cc: Denise True; Clinton Van Den Bergh; Paul Mitrovski; Natassja Raymond
Subject: Results of TEC/PEC Search - Coffey (Bindoon) (Our Ref:08-0614EC) (Your Ref:)
Attachments: TEC-PEC_metadata_26072011.pdf; Conditions of supplying TEC and PEC data.pdf; Bindoon_Coffey_TecPecSearchResults_10062014.dbf; Bindoon_Coffey_TecPecSearchResults_10062014.prj; Bindoon_Coffey_TecPecSearchResults_10062014.sbn; Bindoon_Coffey_TecPecSearchResults_10062014.sbx; Bindoon_Coffey_TecPecSearchResults_10062014.shp; Bindoon_Coffey_TecPecSearchResults_10062014.shp.xml; Bindoon_Coffey_TecPecSearchResults_10062014.shx

Hi,

I refer to your request on the 30 of May 2014 for information on threatened and priority ecological communities occurring within a 10km radius of the co-ordinates provided in the email below.

A search was undertaken on the Department's Threatened Ecological Communities database. Please find attached a buffer shapefile from the database where records were found. If you do not use shapefiles please use the (.dbf file) this can be open in excel as a spreadsheet. Please note that this information is not to be given to any external third parties as it may contain information regarding private property.

Please note not all priority ecological communities are currently recorded on our database. You may like to view the current list in related documents at http://www.dpaw.wa.gov.au/images/documents/plants-animals/threatened-species/Listings/Priority_ecological_communities_list_Sept2013.pdf

Attached are the conditions under which this information has been supplied. The information supplied should be regarded as an indication only of the threatened and priority ecological communities that may be present.

It would be appreciated if any occurrences of threatened and priority ecological communities encountered by you in the area could be reported to this Department to ensure their ongoing management. An occurrence report form and associated manual can be found at <http://www.dpaw.wa.gov.au/plants-and-animals/monitoring/96-standards/140-standard-report-forms?showall=&start=2>

Search area response information is only accurate at the time of provision. Over time, new occurrences or modifications to existing occurrences may occur as information becomes available. It is recommended that searches be re-submitted every six months where projects occur over a long period of time.

An invoice for \$220 (including GST) for the supply of this information will be forwarded.

Your request for information reference number for this search is: 08-0614EC. Please quote this unique reference number when acknowledging the Department of Parks and Wildlife as a source of the data in any published material.

Kind Regards

Wendy Chow | TEC Ecologist | Species & Communities Branch
Department of Parks and Wildlife | Kensington | Ph. 9334 0554 | wendy.chow@dpaw.wa.gov.au



From: John Trainer [<mailto:John.Trainer@coffey.com>]
Sent: Friday, 30 May 2014 3:23 PM
To: Fauna Data; Flora Data; Communities Data
Cc: Denise True; Clinton Van Den Bergh; Paul Mitrovski; Natassja Raymond
Subject: ecological database search

Hi All,

Could I please request a threatened fauna, flora and ecological communities database searches for the following area with a 10km buffer (or whichever you deem appropriate). This information will be used for a consultant's report.

Fauna: Species list format
Flora: CSV and DBF format
Ecological Communities: CSV and DBF format

Ippollo Rd Muchea

50J 403670 E
6515930 S

Please respond to all parties CC'd into this email as not all members will be in the office.

Thanks

John Trainer
Senior Environmental Consultant/ Zoologist

Suite 2, 53 Burswood Road, Burswood WA 6100
PO Box 4223 Victoria Park WA 6979

t: +61 8 9269 6200

m: +61 400 224 012



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DEPARTMENT OF ENVIRONMENT AND CONSERVATION

THREATENED AND PRIORITY ECOLOGICAL COMMUNITIES INFORMATION

CONDITIONS IN RESPECT OF SUPPLY OF INFORMATION

1. All requests for data are to be made in writing to the Director General, Department of Environment and Conservation Attention: Species and Communities Branch
2. The data supplied may not be supplied to other organisations, nor be used for any purpose other than for the project for which they have been provided, without the prior written consent of the data custodian (Val English), Species and Communities Branch.
3. Specific locality information for threatened and priority ecological communities (TECs/PECs) is regarded as confidential, and should be treated as such by receiving organisations. Specific locality information for TECs/PECs may not be used in public reports without the written permission of the Director General, Department of Environment and Conservation. Publicly available reports may only show generalised locations (ie buffer locations). The TEC database manager is to be contacted for guidance on the presentation of TEC/PEC information.
4. Note that the Department of Environment and Conservation respects the privacy of private landowners who may have threatened and priority ecological communities on their property. Locations of TECs/PECs identified in the data as being on private property should be treated in confidence, and contact with property owners made through the Department of Environment and Conservation.
5. Receiving organisations should note that while every effort has been made to prevent errors and omissions in the data provided, they may be present. The Department of Environment and Conservation accepts no responsibility for this.
6. Receiving organisations must also recognise that the Threatened Ecological Communities database is subject to continual updating and amendment, and such considerations should be taken into account by the user.
7. It should be noted that the supplied data do not necessarily represent a comprehensive listing of the threatened and priority ecological communities of the area in question. Its comprehensiveness is dependant on the amount of survey carried out within the specified area. Private property has been relatively little surveyed. The receiving organisation should employ a consultant, if there is any likelihood of the presence of any threatened or priority ecological community, to undertake a survey of the area under consideration.
8. Acknowledgment of the Department of Environment and Conservation as source of the data is to be made in any published material. Copies of all such publications are to be forwarded to the Department of Environment and Conservation, Attention: Manager, Species and Communities Branch.

Threatened and Priority Ecological Community buffers in WA

UNDER NO CIRCUMSTANCES IS THIS DATA TO BE PROVIDED TO ANY THIRD PARTIES, for more details see conditions for the supply of this information.

Citation

Title: Threatened and Priority Ecological Community buffers in WA
Custodian: Department of Environment & Conservation

Description

Abstract: Ecological communities throughout WA that are "Presumed Totally Destroyed", "Critically Endangered", "Endangered", "Vulnerable", "Priority 1-5", "Lower Risk" and "Not evaluated". Communities are based on various life-forms including plants, invertebrates and micro-organisms.

Geographical Bounding Box

North: -14.788854
South: -35.005719
East: 128.870214
West: 113.765525

Data Currency and Status

Beginning Date: 1/1/94
Ending Date: current
Maintenance/Update: As requested

Access

Stored Data Format: ESRI shapefile
Coordinate System: GCS_GDA_1994

Access Constraints: Digital data is only available with written permission of the custodian. In addition, some occurrence data eg. location of sites on private land, is password restricted.

Data Quality

Positional Accuracy: Point location data within occurrences usually from GPS fix, usually within 100 metres. Some digitized from hard copy.

Attribute Accuracy: Not documented.

Logical Consistency: Not documented.

Completeness: Information on specific communities was obtained from regional, subregional or specific habitat surveys of floristic communities, invertebrate communities, wetland assemblages and communities of micro-organisms.

Attributes List:

<u>Name</u>	<u>Description</u>
BDY_ID	Associated boundary polygon unique identifier
OCC_UNIQUE	Unique occurrence identifier
COM_ID	Shortened community name identifier
COM_NAME	Community name
CT_DESC	State listed Category of Threat
S_ID_COUNT	Number of Site IDs within a buffer
FIRST_S_ID	First site identifier
LAST_S_ID	Last site identifier
BUFFER	Buffer radius from site ID or boundary in metres

General Information:

Priority Ecological Communities

- There are 284 known PECs and subtypes , 271 (~95%) of these on the TEC/PEC database
- The location of priority communities is good, but not complete across the state
- There is a formal list of PECs at <http://www.dec.wa.gov.au/content/view/849/2017/>
- Many PECs are awaiting endorsement as TECs

buffers

- The buffer radius around each occurrence of a TEC or PEC is included to help ensure that developments with potential to impact groundwater or surface water are picked up.
- For wetland TEC or PECs we seek to include an area within the buffer zone that is intended to help protect groundwater and surface water. The area required to protect different types of wetlands from a variety of hydrological impacts will, of course, differ.

- For upland TEC or PECs that are believed not to be groundwater dependent, the buffer area radius encompasses the TEC or PEC site location recorded in the TEC database, and extends at least to the furthest point in the occurrence. This is to ensure that the 'buffer' area encompasses at least the entire TEC or PEC. This means that some linear occurrences may need a larger buffer radius to encompass the entire occurrence.
- Occurrences with a buffer distance of 0 are no longer extant.

Contact Information

Contact Organisation: Department of Environment & Conservation
Contact Position: TEC Database Administrator - Species and Communities Branch
Mail Address: Locked Bag 104, Bentley Delivery Centre
Suburb/Locality: Kensington
Country/State: WA
Postcode: 6983
Telephone: (08) 9334 0116
Fax: (08) 9334 0300
Email: communities.data@dec.wa.gov.au

Metadata Information

Metadata Date: current



APPENDIX B

EPBC Act Database Search for MNES



EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

Report created: 04/07/14 11:16:40

[Summary](#)

[Details](#)

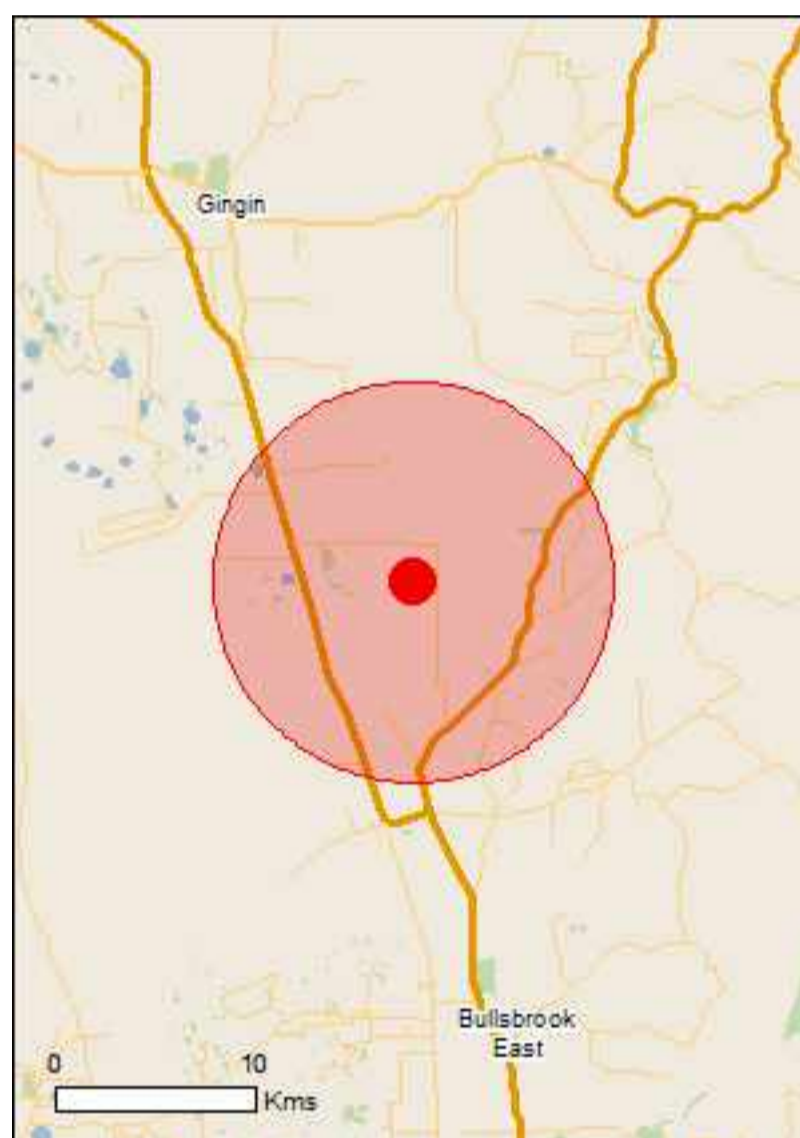
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

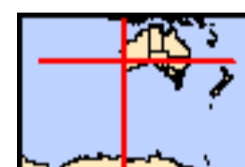
[Acknowledgements](#)



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

[Coordinates](#)

[Buffer: 10.0Km](#)



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the [Administrative Guidelines on Significance](#).

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Listed Threatened Ecological Communities:	1
Listed Threatened Species:	26
Listed Migratory Species:	6

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As [heritage values](#) of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate.

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

A [permit](#) may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	1
Commonwealth Heritage Places:	1
Listed Marine Species:	7
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

Place on the RNE:	3
State and Territory Reserves:	6
Regional Forest Agreements:	1
Invasive Species:	38
Nationally Important Wetlands:	1
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities

[\[Resource Information \]](#)

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Shrublands and Woodlands on Perth to Gingin ironstone (Perth to Gingin ironstone association) of the Swan Coastal Plain	Endangered	Community known to occur within area

Listed Threatened Species

[\[Resource Information \]](#)

Name	Status	Type of Presence
Birds		
Calyptorhynchus latirostris Carnaby's Black-Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Breeding likely to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Mammals		
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat likely to occur within area
Plants		
Andersonia gracilis Slender Andersonia [14470]	Endangered	Species or species habitat likely to occur within area
Anigozanthos viridis subsp. terraspectans Dwarf Green Kangaroo Paw [3435]	Vulnerable	Species or species habitat likely to occur within area
Caladenia huegelii King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Centrolepis caespitosa [6393]	Endangered	Species or species habitat likely to occur within area
Chamelaucium sp. Gingin (N.G.Marchant 6) Gingin Wax [64649]	Endangered	Species or species habitat known to occur within area
Conospermum densiflorum subsp. unicephalatum One-headed Smokebush [64871]	Endangered	Species or species habitat may occur within area
Darwinia foetida Mucheas Bell [83190]	Critically Endangered	Species or species habitat known to occur within area
Diuris micrantha Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat may occur within area
Diuris purdiei Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat may occur within area
Drakaea elastica Glossy-leaved Hammer-orchid, Praying Virgin [16753]	Endangered	Species or species habitat likely to occur within area
Eleocharis keigheryi Keighery's Eleocharis [64893]	Vulnerable	Species or species habitat likely to occur within area
Epiblema grandiflorum var. cyaneum Baby Blue Orchid, Blue Babe-in-the-cradle Orchid, Blue Babe-in-a-cradle [67182]	Endangered	Species or species habitat may occur within area
Eucalyptus balanites Cadda Road Mallee, Cadda Mallee [24264]	Endangered	Species or species habitat may occur within area
Eucalyptus leprophloia Scaly Butt Mallee, Scaly-butt Mallee [56712]	Endangered	Species or species habitat may occur within area
Grevillea corrugata a shrub [65445]	Endangered	Species or species habitat known to occur within area
Grevillea curviloba subsp. curviloba Curved-leaf Grevillea [64908]	Endangered	Species or species habitat known to occur within area
Grevillea curviloba subsp. incurva Narrow curved-leaf Grevillea [64909]	Endangered	Species or species habitat known to occur within area
Lepidosperma rostratum Beaked Lepidosperma [14152]	Endangered	Species or species habitat likely to occur within area
Ptychosema pusillum Dwarf Pea [11268]	Vulnerable	Species or species habitat likely to occur within area
Thelymitra manginii K.Dixon & Batty ms. [67443]	Endangered	Species or species habitat likely to occur within area
Thelymitra stellata Star Sun-orchid [7060]	Endangered	Species or species habitat known to occur within area

Name	Status	Type of Presence
Verticordia plumosa var. pleiobotrya Narrow-petalled Featherflower, Mundijong Featherflower [55803]	Endangered	Species or species habitat may occur within area
Listed Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Migratory Wetlands Species		
Ardea alba Great Egret, White Egret [59541]		Breeding known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat likely to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [\[Resource Information \]](#)

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Defence - MUCHEA ARMAMENT RANGE

Commonwealth Heritage Places [\[Resource Information \]](#)

Name	State	Status
Natural		
Muehea / Pearce Air Weapons Range	WA	Indicative Place

Listed Marine Species [\[Resource Information \]](#)

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Breeding known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat likely to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area

Extra Information

Places on the RNE [\[Resource Information \]](#)

Note that not all Indigenous sites may be listed.

Name	State	Status
Natural		
Mueha / Pearce Air Weapons Range	WA	Indicative Place
Lake Chandala Area	WA	Registered
Yeal - Gnangara Area	WA	Registered

State and Territory Reserves [\[Resource Information \]](#)

Name	State
Barracca	WA
Breera Road	WA
Burroloo Well	WA
Chandala	WA
Timaru	WA
Unnamed WA50678	WA

Regional Forest Agreements [\[Resource Information \]](#)

Note that all areas with completed RFAs have been included.

Name	State
South West WA RFA	Western Australia

Invasive Species [\[Resource Information \]](#)

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resources Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Funambulus pennantii Northern Palm Squirrel, Five-striped Palm Squirrel [129]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur

Name	Status	Type of Presence within area
Brachiaria mutica Para Grass [5879]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Genista linifolia Flax-leaved Broom, Mediterranean Broom, Flax Broom [2800]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area
Ramphotyphlops braminus Flowerpot Blind Snake, Brahminy Blind Snake, Cacing Besi [1258]		Species or species habitat likely to occur within area

Nationally Important Wetlands		[Resource Information]
Name		State
Chandala Swamp		WA

Coordinates

-31.48843 115.98843

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [-Department of Environment, Climate Change and Water, New South Wales](#)
- [-Department of Sustainability and Environment, Victoria](#)
- [-Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [-Department of Environment and Natural Resources, South Australia](#)
- [-Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts](#)
- [-Environmental and Resource Management, Queensland](#)
- [-Department of Environment and Conservation, Western Australia](#)
- [-Department of the Environment, Climate Change, Energy and Water](#)
- [-Birds Australia](#)
- [-Australian Bird and Bat Banding Scheme](#)
- [-Australian National Wildlife Collection](#)
- Natural history museums of Australia
- [-Museum Victoria](#)
- [-Australian Museum](#)
- [-SA Museum](#)
- [-Queensland Museum](#)
- [-Online Zoological Collections of Australian Museums](#)
- [-Queensland Herbarium](#)
- [-National Herbarium of NSW](#)
- [-Royal Botanic Gardens and National Herbarium of Victoria](#)
- [-Tasmanian Herbarium](#)
- [-State Herbarium of South Australia](#)
- [-Northern Territory Herbarium](#)
- [-Western Australian Herbarium](#)
- [-Australian National Herbarium, Atherton and Canberra](#)
- [-University of New England](#)
- [-Ocean Biogeographic Information System](#)
- [-Australian Government, Department of Defence](#)
- [-State Forests of NSW](#)
- [-Geoscience Australia](#)
- [-CSIRO](#)
- Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the [Contact Us](#) page.



APPENDIX C

Linear
Phytophthora
Dieback Risk
Assessment

**Linear *Phytophthora* Dieback Risk Assessment of
M2091 Ioppolo Road, Chittering**

Prepared for Coffey Environments Australia Pty Ltd

Ref: T14008

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Document Control

Version	Date	Author	Reviewer
Draft	13/10/2014	J. Grehan	C. McGary C. Van Den Bergh
Final	16/12/14	J. Grehan	C. Van Den Bergh



Author: Joseph Grehan
Principal Ecologist

DISCLAIMER

This document is prepared in accordance with and subject to an agreement between Terratree Pty Ltd (“Terratree”) and the client for whom it has been prepared (“Coffey Environments Australia Pty Ltd”) and is restricted to those issues that have been raised by the client in its engagement of Terratree and prepared using the standard of skill and care ordinarily exercised by Environmental Scientists in the preparation of such documents.

Any organisation or person that relies on or uses this document for purposes or reasons other than those agreed by Terratree and the client without first obtaining the prior written consent of Terratree, does so entirely at their own risk and Terratree denies all liability in tort, contract or otherwise for any loss, damage or injury of any kind whatsoever (whether in negligence or otherwise) that may be suffered as a consequence of relying on this document for any purpose other than that agreed with the client.

Terratree Pty Ltd

Executive Summary

Coffey Environments Australia Pty Ltd commissioned Terratree Pty Ltd to undertake a linear *Phytophthora* Dieback assessment of tracks and other potential disease vectors within and surrounding a block of native vegetation. The site is located in the Shire of Chittering approximately 80 km north of Perth. The site is 983 ha and mainly comprised of Banksia woodland with some areas of Marri (*Corymbia calophylla*) open forest.

The assessment was conducted in accordance with the Department of Parks and Wildlife's (DPaW) *Manual for detecting Phytophthora Dieback disease* (Procedures for DPaW managed lands) (DPaW 2013). Tracks, water courses and hard-hooved feral animals are considered to be the most likely vectors of disease into the study area. A linear Dieback assessment was determined to be an appropriate method for assessing the risk and likelihood of Dieback presence within and adjacent to the site.

Vegetation within the study area was categorised according to three different levels of risk:

1. High Risk: Areas where *P. cinnamomi* has been recovered from samples and disease symptoms are consistent with the presence of Dieback.

2. Moderate Risk: Areas exhibiting past or current disturbances (logging, grazing, dumping etc.) which has altered vegetation structure and composition and areas downslope of confirmed infestations, or vegetation exhibiting disease symptoms but have not returned positive results for *P. cinnamomi*.

3. Low Risk: Areas of protectable uninfested vegetation (as determined by a registered Dieback interpreter), which exhibit multiple healthy indicator species, vegetation in Pristine to Very Good condition (Keighery scale 1-3), no disease pattern or chronology, and no significant risks from disease vectors or current land use.

The total study area, in terms of the linear corridor that was assessed, is 119.2ha. This is comprised of 19.4 ha of High Risk (16.3 %), 12.2 ha of Moderate Risk (10.2 %) and 87.6 ha (73.5 %) of Low Risk vegetation

In total, 11 soil and tissue samples were taken from recently dead and dying disease indicator species. Two positive results for *P. cinnamomi* were reported. In addition, a tissue sample was taken to test for canker and this returned a positive result for *Cytospora* sp.

In conclusion, the linear assessment determined that the majority of the study area (linear assessment corridor) is uninfested and therefore presented a low risk of spreading Dieback into areas outside the study corridor. While it is likely that the majority of the 983 ha site is uninfested, caution must be exercised when extrapolating the disease status and/or risk to vegetation that has not been assessed outside the study area.

Terratree makes the following recommendations in relation to assessment and management of Dieback at the site:

- A comprehensive Dieback assessment of the site should be completed in accordance with current Department of Parks and Wildlife standards (DPaW 2013).
- Protectable areas should be clearly demarcated and signposted.
- Additional sampling should be done in moderate risk areas.
- A Dieback management plan, including an access management strategy, should be developed for the site.

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Appendix 1: Vegetation Health Services Laboratory report on positive identification of *Cytospora* sp. (canker) in CS11

Appendix 2: Sample Results from the Vegetation Health Services laboratory

1 Introduction

Coffey International (Coffey) commissioned Terratree Pty Ltd (Terratree) to undertake a linear *Phytophthora* Dieback (Dieback) assessment of tracks and other potential disease vectors within and surrounding a 983 ha block of native vegetation ('the site') in the Shire of Chittering. The linear assessment corridor includes a 25 m area either side of tracks and unsealed roads within and adjacent to the site, watercourses and other potential disease vectors (hereafter referred to as the 'study area').

1.1 Background

Phytophthora Dieback ('Dieback') is a soil borne pathogen with a range of plant hosts in the southwest of Western Australia. These predominantly belong to the Proteaceae, Ericaceae, Myrtaceae, Xanthorrhoeaceae and Fabaceae plant families. While some plant species are resistant, others are susceptible to the disease caused by the pathogen resulting in chlorosis, dieback and usually death.

According to the most recent Western Australian (WA) State of the Environment Report (Environmental Protection Authority 2007) *Phytophthora* Dieback, a Priority 1 Threat, is the third greatest threat to biodiversity after salinity and climate change. It is a more serious threat than weeds, native vegetation clearing, acid sulphate soils and soil erosion. It is significant in WA because:

- Over 40% (2,300) of the native plant species and half of the endangered plant species in the southwest of WA are susceptible to the pathogen
- The changes in plant community composition and structure that Dieback causes has impacts throughout the whole ecosystem, including on the indigenous fauna
- Dieback can lead to significant soil erosion as a result of the loss of susceptible vegetation

The Dieback pathogen is widespread in areas with greater than 800 mm of annual rainfall, less extensive in areas that receive between 600–800 mm and mainly restricted to water-gaining sites in areas that receive 400–600 mm. The pathogen does not occur in areas that receive less than 400 mm of annual rainfall. In WA, Dieback is a significant environmental issue for projects between Geraldton in the Midwest and Esperance on the South Coast and is widespread in the Southwest region.

1.2 Project Location and Description

The study area is located in the Shire of Chittering approximately 80 km north of Perth, approximately 15 km north of Muchea (**Figure 1**). The 960 ha site is mainly comprised of Banksia woodland with some Marri (*Corymbia calophylla*) open forest.

1.3 Regulatory Context

Phytophthora Dieback management is required under the following regulatory mechanisms in WA:

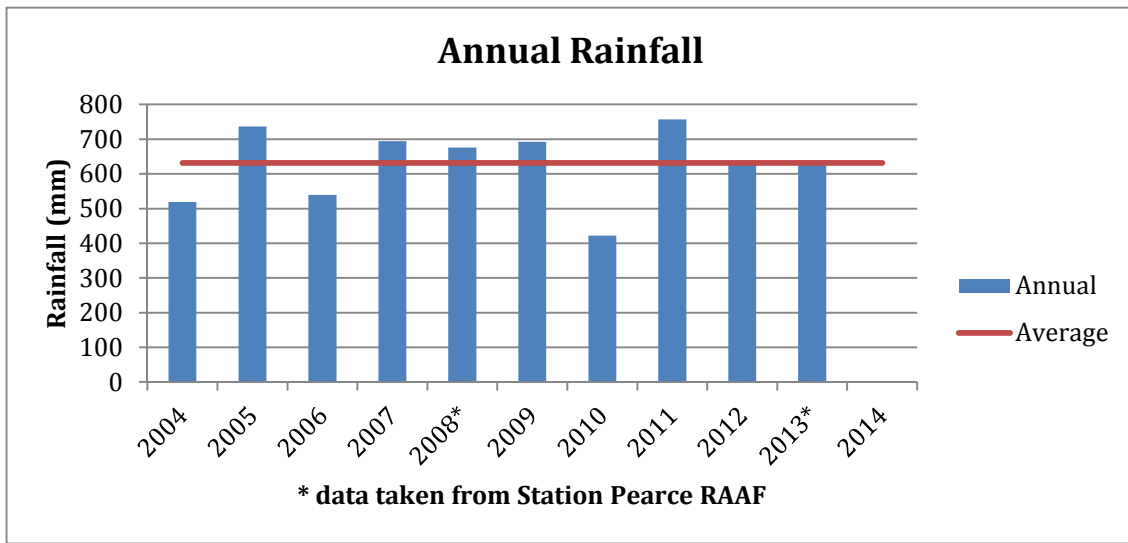
- *Phytophthora* Dieback is listed as a Key Threatening Process with the Federal Government under the *Environmental Protection and Biodiversity Conservation Act (1999)*
- *Environmental Protection Act (1986)* Part V S.50A "Serious Environmental Harm" provisions

2 Existing Environment

2.1 Climate

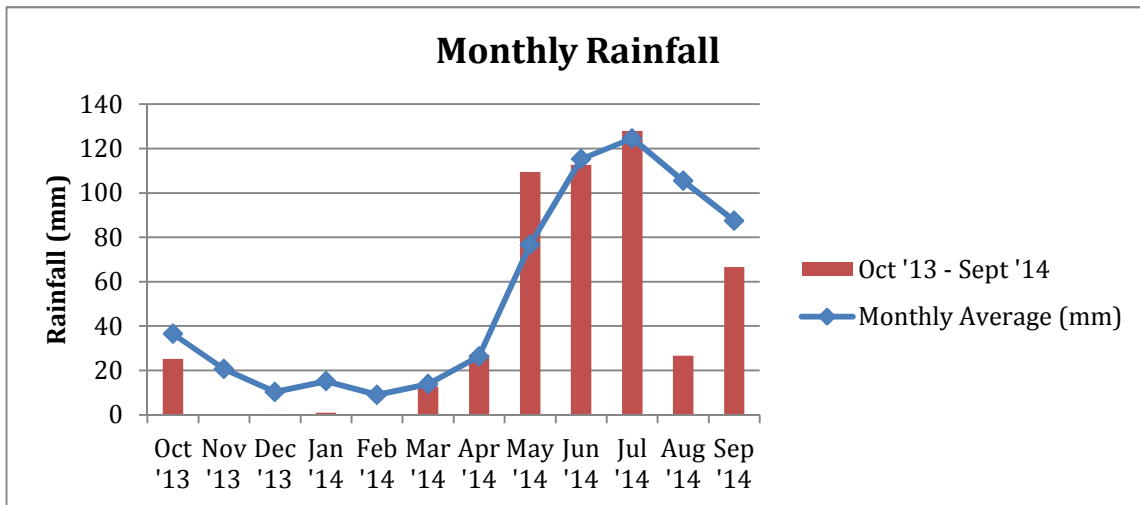
The Swan Coastal Plain region has a Mediterranean type climate with hot dry summers and cool wet winters. The warmest month is February, with an average monthly temperature of 30.4°C. The coolest month is July, with an average temperature of 18.3 °C.

Based on data from the Gingin Aero station (# 9178), the average annual rainfall for Muchea is 631.7 mm. The seasonal rainfall pattern for Muchea indicates an overall reduction in rainfall compared to historical averages, but exhibits variability in this trend, with years of significantly reduced rainfall interspersed with years of average to slightly above average rainfall (**Graph 1**). Significantly, the rainfall for 2010 was only 422 mm, which is 33% below average annual rainfall.



Graph 1: Annual rainfall at Gingin Aero station # 9178 (BoM, 2014)

Most rain falls in the cooler months of June-August. During winter 2014, this station received average or above-average rainfall until July, but a significant drop in rainfall was recorded during August and September compared to the long-term average.



Graph 2: Monthly rainfall at Gingin Aero station (# 9178) (2013-14) (BOM, 2014)

2.2 Biogeography

The study area is located in the Swan Coastal Plain Interim Biogeographic Regionalisation of Australia (IBRA) Bioregion, Perth Sub-Region (SWA02). This sub-region is dominated by woodlands of *Banksia* and Tuart on sandy soils, Sheoak on outwash plains, and paperbark in swampy areas. The colluvial and aeolian sand areas represent three phases of Quaternary marine sand dune development (which provide relief), and include a complex series of seasonal fresh water wetlands, alluvial river flats, coastal limestone and several off-shore islands. Younger sandy areas and limestone are dominated by heath and/or Tuart woodlands, while *Banksia* and Jarrah–*Banksia* woodlands are found on the older dune systems (Mitchell *et. al*, 2002).

2.3 Flora and Vegetation

Five vegetation complexes (Hedde *et. al* 1980) have been identified within the site. Descriptions of these vegetation complexes along with their interpretability for the presence of Dieback are presented below:

Moondah - supports predominantly a low closed to low open forest of *Banksia attenuata*, *B. menziesii*, *B. prionotes* and *Eucalyptus todtiana* on the slopes; and an open-woodland of Marri-*Banksia* in the valleys. Along the water courses, the vegetation is dominated by woodland of *E. rudis*, *Melaleuca raphiophylla* with some mixture of *M. preissiana* and thickets of *Kunzea vestita* in the understorey. One of the distinctive features of the Moondah vegetation complex is the presence of large number of *B. prionotes*. In other respects, due to the sandy soils, the vegetation has affinities with Mogumber, Cullala and Reagan complexes. Upland areas of the Moondah vegetation complex are highly interpretable for the presence of Dieback; however, the wetland areas are generally uninterpretable.

Reagan - supports vegetation ranging from low open-woodland of *B. attenuata*, *B. menziesii* and *E. todtiana* to closed heath depending on the depth of the soil. The composition of the understorey varies slightly depending on the proportion of sand and gravel. Plant species include *Adenanthos cygnorum*, *Petrophile linearis*, *Mesomelaena tetragona*, *Casuarina humilis*, *Mesomelaena stygia*, *Hakea trifurcata*, *Daviesia juncea* and species of *Hibbertia*, *Eremaea*, *Conospermum* and *Conostephium*. The Reagan complex is generally highly interpretable for the presence of Dieback.

Karamel South - is dominated by an open forest of Jarrah-Marri with a definite second storey of *B. grandis* on the gravelly soils with *B. attenuata* and *B. menziesii* on the sandier soils. Elsewhere on the Dandaragan Plateau, *B. grandis* is restricted mainly to the Gingin complex. Small areas of Wandoo occur in pockets on Karamal South. Other species in the open forest of Jarrah-Marri include *Stirlingia latifolia*, *B. sessilis*, *B. nivea*, *Hakea ruscifolia*, *Petrophile linearis*, *Jacksonia floribunda* and species of *Calytrix*, *Conostephium* and *Hakea*. The Karamel South complex is generally highly interpretable for the presence of Dieback.

Mogumber South - is dominated by an open-woodland of Marri with a well-defined second storey of Pricklybark-*Banksia* (*E. todtiana*, *B. attenuata*, *B. menziesii* and *B. ilicifolia*) The same pattern of Marri extending further north than Jarrah, seen of on the northern Swan Coastal Plain, is repeated in this area. Although localised patches of Jarrah are to be found, they are restricted in size and number. As one goes from the higher rainfall in the south to the lower rainfall in the north, Jarrah disappears first, then Marri. The intermingling of Pricklybark and Jarrah evident on the Bassendean sand dunes near Perth and Gnangara is repeated in the Mogumber complex. Understorey species vary considerably depending on proportion of sand and gravel, depth of sand and moisture levels, but include such species as *Nuytsia floribunda*, *Stirlingia latifolia*, *Petrophile linearis*, *Daviesia pectinata*, *Calothamnus sanguineus*, *Mesomelaena tetragona*, *Baeckea camphorosmae*, *Hypocalymma angustifolium*, *Leptocarpus scariosus*, *Casuarina humilis*, *Lyginia tenax* and *Bossiaea eriocarpa*. The Mogumber South complex is generally highly interpretable for the presence of Dieback.

Coonambidgee complex –this vegetation ranges from a low open forest to low woodland of *E. todtiana*, *Banksia attenuata*, *B. ilicifolia* with local admixtures of *B. prionotes*, to an open woodland of *Corymbia calophylla* and *Banksia* species. The Coonambidgee complex is generally highly interpretable for the presence of Dieback.

3 Methods

The Dieback assessment was done by DPAW registered Dieback Interpreter Joseph Grehan and Field Assistant Kelby Jennings in August 27th and 28th, 2014. While the assessment occurred during the optimal time of the year, sampling conditions were sub-optimal due to the lower than average winter rainfall.

The linear Dieback assessment was conducted in accordance with the *Manual for detecting Phytophthora Dieback disease* (Procedures for DPaW managed lands) (DPaW 2013). These recently updated Dieback Interpreters' guidelines now categorise land that has been cleared of native vegetation (such as farmland) as 'excluded' from assessment. Non-vegetated areas that are 'excluded' from assessment include pasture, pits, easements, development, large roads (sealed and unsealed) permanent flooding and parkland tree stands. Excluded areas are distinguished from unmappable areas by the fact that unmappable areas retain the ability to regenerate and eventually become mappable. **Table 1** presents the *Phytophthora* occurrence categories, impacts and syndromes (DPaW 2013), which include the unmappable category.

The unmappable category is allocated to areas of native vegetation which have been disturbed, but native vegetation will recover over time and may become interpretable and therefore mappable. Examples of unmappable areas include vegetation that has been impacted by fire, timber harvesting, flooding or mining with subsequent rehabilitation. The recovery time for unmappable areas may take longer than 3 years (DPaW 2013). **Table 1** presents details of the different Dieback occurrence categories as defined in DPaW's draft Dieback interpreter's guidelines (DPaW 2013).

Table 1: *Phytophthora* occurrence categories, impacts and syndromes (as cited in DPaW 2013)

<i>Phytophthora</i> occurrence mapping	Impact Rating	Syndrome	Comment
Infested: Impacts of <i>Phytophthora</i> Dieback are visible	High	Endemic or Extremely destructive Epidemic	
	Moderate	Commonly a variable epidemic but may also exist as or be progressing to an extremely destructive epidemic	This syndrome may not have reached full destructive potential, depending on the age of infestation. It might be progressing to High Impact, epidemic syndrome
	Low None of the susceptible overstorey is affected by disease	Variable epidemic Disease apparent	Although overall impact is low, it is not low enough to be given 'no apparent disease' syndrome
			May consist of very low level endemic disease in an environment not favourable to the pathogen
Uninfested: Areas of natural undisturbed or low disturbance vegetation free of symptoms that Indicate <i>Phytophthora</i> Dieback	Nil	No apparent disease	
Uninterpretable: Areas of natural undisturbed vegetation where susceptible plants are too few for interpretation of <i>Phytophthora</i> Dieback	None, or none perceptible	No apparent disease	May consist of very low level endemic disease in an environment not favourable to the pathogen
Unmappable: Keighery disturbance rating 4 or greater	Predicted impact rating may be forecast based using landform and vegetation types	Not assessable	

The Keighery vegetation disturbance scale (DPaW 2013) presented in **Table 2** was used to determine the interpretability of the vegetation. Areas with a vegetation condition rating of 1-3 (Pristine - Very Good) are considered to be mappable. In addition, there must be enough disease indicator species present to enable a diagnosis of the disease status. An area with a vegetation condition rating of 4 (Good) is possibly mappable; however, it is up to the interpreter's discretion. Unmappable and excluded areas are given a condition rating of 5 or 6 (Degraded or Completely Degraded).

Table 2: Keighery (1994) Vegetation Disturbance Scale and Assessability (as cited in DPaW 2013)

Interpretability	Scale		Condition
Mappable	1	Pristine	Pristine or nearly so, no obvious signs of disturbance
	2	Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species
	3	Very Good	Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing
Possibly Mappable, discretion required	4	Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, Dieback and grazing.
Unmappable or Excluded from assessment	5	Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, Dieback and grazing.
	6	Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as "parkland cleared" with the flora comprising weed or crop species with isolated native trees or shrubs.

3.1 Linear Assessment

A linear Dieback assessment was done on the tracks and unsealed roads within and adjacent to the study area. During the assessment, visual evidence of disease absence or presence was recorded within a 50 m wide corridor, 25m either side of the track or unsealed road. Other potential disease vectors including watercourses and disturbed areas in and adjacent to the site were also assessed. Reconnaissance of the study area was completed prior to commencing the linear assessment to determine the following:

- Access
- Identify interpretable vegetation and disease expression if present
- Identify possible disease vectors e.g. tracks, utility corridors, ground disturbance, feral animals etc.
- Determine the location of high risk areas (e.g. areas of high disturbance and water-gaining sites)
- Identify other impacts to vegetation (e.g. drought, cankers, herbivory, *Armillaria luteobubalina*, fire)

The assessment involved driving the tracks and unsealed roads within and surrounding the study area recording evidence of presence or absence of Dieback. When necessary areas outside the linear corridor were assessed, including watercourses and disturbed areas, to determine the broader landscape context and to ensure uninfested areas were protectable.

3.2 Disease Risk Categories

Vegetation within the study area was categorised into three different disease risk categories as described below in **Table 3**.

Table 3: Disease Risk Categories

Disease Risk Category	Description
High	Areas where <i>Phytophthora cinnamomi</i> has been recovered from samples and disease symptoms are consistent with the presence of Dieback.
Medium	Areas exhibiting past or current disturbances (logging, grazing, dumping etc.) which have altered vegetation structure and composition. Also includes areas downslope of confirmed infestations, or which exhibit disease symptoms but have not returned positive results for <i>P. cinnamomi</i> .
Low	Areas of protectable uninfested vegetation (as determined by a registered Dieback interpreter), which exhibit multiple healthy indicator species, vegetation in Pristine to Very Good condition (Keighery scale 1-3), no disease pattern or chronology, and no significant risks from disease vectors or current land use.

3.3 Sampling

Soil and tissue samples of recently dead or dying disease indicator species were collected and lodged with the DPaW's Vegetation Health Services Laboratory (VHS) where diagnostic baiting was conducted. All sample point locations were recorded with a hand-held GPS. The following sampling strategy was applied when determining sample locations:

Initial standards sampling: Initial samples are taken to determine disease behaviour. The results inform the sampling strategy and enable testing of early hypotheses (e.g. are other factors causing the deaths of susceptible species such as *Armillaria luteobubalina* or drought).

Sampling to support infested diagnosis: Recently dead and dying indicator species are sampled to support an infested diagnosis.

Sampling to support an uninfested diagnosis: Recently dead and dying indicator species are sampled to support an uninfested diagnosis. Caution must be exercised when claiming that a negative result means that an area is uninfested, because false negative results can be recorded when inoculum levels are depleted from prolonged unfavourable environmental conditions for the pathogen.

All sampling strictly adheres to the following procedures:

- All tools used in sampling are thoroughly sterilised with a 70:30 mixture of methylated spirits and water before samples are taken. It must be ensured that the tools are dry prior to sampling so that the results are not compromised.
- The area around the base of the plant being sampled is cleared of leaf litter and debris so that this material is not included in the sample.
- The plant sampled is excavated to suitable depth to ensure that adequate plant tissue material can be obtained from the roots and cambium layer around the collar of the plant being sampled.
- Material from all around the plant is taken in addition to any obvious lesions to avoid missing any infected material. All the plant tissue material and a few handfuls of soil from around the roots and other places in the soil profile are placed in a polythene bag.
- Enough distilled water to moisten the soil is poured into the bag to ensure the survival of any inoculum that may be present in the sample.
- All relevant information pertaining to the plant sampled and sample location is recorded on the Sample Information Sheet.
- Two aluminium tags with the date, project name, sample number, species sampled and the name of the interpreter are written. One tag is placed in the sample bag and the other is tied near the sample site which is also flagged with a day-glow orange flagging banner.
- The sample hole is backfilled to prevent fauna from becoming trapped.
- All tools are brushed off (to remove excess soil) and sterilised to prevent contamination of the next sample site and sample.

3.4 Mapping

Field evidence and observations were used to prepare the Dieback risk map (**Figure 2**) within the study area. The information used in mapping includes:

1. Sample results
2. Interpretability determined from vegetation condition and disease indicator present
3. Topography and drainage

3.5 Limitations

The DPaW's draft Dieback interpreters guidelines (DPaW 2013) discuss the limitations of linear assessment (P.88)

While a linear assessment uses the same methods as comprehensive transect assessments, it is often regarded as significantly more difficult to do, because the linear assessment corridor is easily taken out of context from wider landscape units. Phytophthora occurrence assessment boundaries may only briefly intersect linear corridors, giving little relative perspective to the wider landscape unit.

The following limitations were encountered during the assessment:

- The widespread impact of drought on the vegetation made Dieback interpretation more difficult.
- The impacts of canker species on susceptible vegetation, particularly *Banksia* species, made Dieback interpretation more difficult.
- Some areas were uninterpretable due to past disturbance caused by logging and grazing.
- Although the survey was conducted during the optimal time, negative sample results can be due to low inoculum levels for *Phytophthora cinnamomi* and therefore it is possible to obtain false negative results.

4 Results

In total, 11 soil and tissue samples were collected from recently dead and dying disease indicator species. The samples were baited at the VHS laboratory. In addition, a tissue sample was taken to test for canker and this returned a positive result for *Cytospora* sp. *Banksia* species including *Banksia attenuata*, *B. menziesii*, and *B. grandis* were the preferred species to sample because they are highly susceptible to the pathogen (Brandis 1983). The sample results are presented in **Table 4** below.

Table 4: Sample Results

Sample No.	Species	Easting GDA 94, Zone 50	Northing GDA 94, Zone 50	Result
CS01	<i>Banksia attenuata</i>	404805	6514443	<i>P. cinnamomi</i>
CS02	<i>Banksia grandis</i>	404874	6511350	Negative
CS03	<i>Banksia menziesii</i>	405328	6517342	Negative
CS04	<i>Banksia attenuata</i>	406281	6517239	Negative
CS05	<i>Banksia grandis</i>	406273	6516533	Negative
CS06	<i>Banksia menziesii</i> & <i>Banksia attenuata</i>	402347	6517398	<i>P. cinnamomi</i>
CS07	<i>Banksia attenuata</i>	402678	6514603	Negative
CS08	<i>Banksia attenuata</i>	403319	6514552	Negative
CS9	<i>Banksia grandis</i>	404215	6514542	<i>Cytospora</i> sp. (Canker)
CS10	<i>Banksia attenuata</i>	404459	6517350	Negative
CS11	<i>Xanthorrhoea preissii</i>	402356	6516852	Negative

The total study area in terms of the linear corridor that was assessed is 119.2ha. This is comprised of 19.4 ha of High Risk (16.3 %), 12.2 ha of Moderate Risk (10.2 %) and 87.6 ha (73.5 %) of Low risk vegetation (**Figure 2**).

5 Discussion

5.1 High Risk Areas

High risk areas are defined as areas where *Phytophthora cinnamomi* has been recovered and disease symptoms consistent with Dieback have been observed. Depending on disease expression symptoms may include:

- Multiple disease indicator species deaths
- Disease pattern and chronology
- Reduction in species richness and cover
- The presence of a disease vector (e.g. track, watercourse, evidence of animal vectors such as pigs)

The linear assessment identified three high risk areas within and adjacent to the study area:

1. The northern section of the power line track near Ippolo Road is infested with recently dead *Banksia attenuata* and *B. menziesii* returning a positive result for *P. cinnamomi* (sample CS08). The infestation runs down the slope along the power line but doesn't appear to extend further than 50 to 100m either side of the track. This section of the power line track poses a high risk of spreading Dieback through the site (**Plates 1 & 2**).
2. The unsealed road along the western boundary of the unnamed DPaW reserve to the west of the study area boundary is infested with two historical results for *P. cinnamomi* (VHS 2014). This unsealed road poses a high risk of vectoring disease along Ippolo Road and into the study area.
3. A section of vegetation on the northern side of the creek located to the south of site boundary is infested. A recently dead *Banksia attenuata* returned a positive result for *P. cinnamomi* (Sample CS01). It is believed that the disease has been vectored into the riparian zone of the creek by feral pigs (**Plate 3**) because there was no distinct disease pattern along the watercourse. The track crossing the creek into the southern boundary of study area poses a high risk as a disease vector.

5.2 Moderate Risk Areas

Two of the moderate risk areas have past disturbances, including logging and grazing, which have resulted altered vegetation structure and some disease indicator species deaths, but have not yielded positive results for *P. cinnamomi* (**Plate 4**). The other moderate risk area is along the power line track downslope of a confirmed infestation. Although this area did not yield a positive result for *P. cinnamomi* there were multiple disease indicator species deaths and additional sampling may recover a positive result

5.3 Low Risk Areas

Low risk areas are areas that have been determined to be uninfested by a DPaW registered Dieback Interpreter. While an uninfested diagnosis can be supported by negative sample results for *P. cinnamomi*, an area cannot be determined to be uninfested on sample results alone (**Plate 5**). Observable factors which can be used in making an uninfested diagnosis include the following:

- Multiple healthy disease indicator species.
- Vegetation condition is rated as 1-3 on the Keighery vegetation condition scale.
- No evidence of disease pattern or chronology.
- Indicator species deaths can be attributed to other factors i.e. drought, canker or *Armillaria*.

5.4 Other Potential Impacts to Vegetation

There may be other factors that caused the observed deaths of disease indicator species, including drought, other *Phytophthora* species, pathogenic fungi and *Armillaria luteobubalina* (*Armillaria* or Australian Honey Fungus).

5.4.1 Other *Phytophthora* species

Phytophthora arenaria is thought to be a native Australian species of *Phytophthora*, however its centre of diversity is still to be determined (C, Crane. Pers. Comm 16/12/2014). The website 'Phytophthora Database' describes the characteristics of *P. arenaria* as follows:

Phytophthora arenaria A. Rea, M. Stukely & T. Jung has been isolated in Western Australia from kwongan heath-land stands since the early 1980s (Burgess et al. 2009, Rea et al. 2011), but was misidentified as *P. citricola*. With the exception of one isolate from Bunbury (south-west coast) *P. arenaria* has been isolated exclusively from the northern sand plains. Most isolates were associated with dead or dying *Banksia* or *Eucalyptus* species; however, isolates were also recovered in association with asymptomatic *Banksia* and *Eucalyptus* species. The first isolation of this taxon was from soil in native kwongan vegetation near Kalbarri in 1986. *Phytophthora arenaria* has thick oospore walls and physiological characteristics that appear to be adaptations favouring survival in the harsh kwongan ecosystem suggesting that this species may be endemic to Western Australia. However, the most closely related species is *P. alticola* a species described from South Africa and the origin of both species requires further examination (<http://www.phytophthoradb.org>).

Another species, *Phytophthora multivora*, which has often been misdiagnosed for *P. citricola*, can persist in alkaline soil (Scott et al. 2009) which is suppressive to *P. cinnamomi*. The ability of *P. multivora* to survive in alkaline soils has implications for hygiene management because using limestone as a sterilising road-base material, as it has been previously used due to its antagonism to *P. cinnamomi*, may not be effective for managing *P. multivora* spread.

5.4.2 Other Pathogenic Fungi

The impact of cankers caused by pathogenic fungus on Proteaceous species was examined by Crane and Burgess (2013). The study examined the impact that aerial cankers are having on coastal vegetation between Esperance and Cervantes and demonstrated pathogenicity in seven *Banksia* spp. over a wide geographic range. The pathogenic fungus was identified as a new genus and species within the *Cryphonectriaceae* (*Diaporthales*) and is described as *Luteocirrhus shearii* gen. sp. nov. The fungus causes the death of single branches; however, it can lead to multiple branch deaths or cause complete crown dieback as occurred with some of the *Banksia baxteri* and *B. verticillata* sampled (Crane and Burgess 2013).

A tissue sample taken from a recently dead *Banksia grandis* was tested for the presence of canker at VHS. *Cytospora* sp. was recovered from the sample which is likely to indicate an inability of the plant to contain the fungi because this canker species can also be present on healthy plants (**Appendix 1**). *Banksia* species including *Banksia attenuata*, *B. grandis*, *B. prionotes* and *B. menziesii* displaying symptoms consistent with those described by Crane and Burgess, but not characteristic of *P. cinnamomi* disease expression, were observed throughout the study area. Canker impacts were observed throughout the study area and were generally discernible from Dieback symptoms by the death of single branches or lesions emanating above the trunk collar (**Plates 6, 7 & 8**).

5.4.3 Drought

Impacts to vegetation as a result of prolonged drought were differentiated from impacts caused by *P. cinnamomi* by the following characteristics:

- No disease pattern or chronology in the surrounding vegetation.
- The plant had senesced gradually rather than succumbing quickly as is usually the case with deaths attributed to *P. cinnamomi*.

- No visible lesions or mycelium on the roots of the dead or dying plant.
- Re-shooting or epicormic growth visible on dying plants (**Plates 9 & 10**).

The presence of single or multiple dead branches with the remainder of the plant appearing to be healthy may be attributed to drought or pathogenic fungi.

5.4.4 *Armillaria* (Australian Honey Fungus)

Armillaria luteobubalina (Armillaria or Australian Honey Fungus) is a species of mushroom which causes Armillaria root-rot in affected plants. The fungus is widespread in Jarrah (*Eucalyptus marginata*) and Karri (*E. diversicolor*) forests of the southwest of WA, but has also been recorded in coastal vegetation between Cape Arid (120 km east of Esperance) to Cervantes (160 km north-west of Perth) (Shearer *et al* 1997). *Armillaria* is dispersed by spores produced by the mushroom and also reproduces vegetatively through the roots of affected plants. It affects many of the same plant genera as *Phytophthora* in particular members of the Myrtaceae and Proteaceae plant families, such as *Eucalyptus* and *Banksia* species. *Armillaria* forms a quite visible white or yellow leathery mycelial sheath which is visible beneath the bark in the roots or lower stem. Other observable factors that can be applied in the diagnosis of *Armillaria* infection include:

- Clusters of fruiting bodies around or near the base of the plant
- A pungent mushroom smell
- An inverted V shaped scar at the base of the plant
- Yellow-white stringy rot under the bark in the roots and base of affected plants (DEC, 2012)

While some of the mycelium observed may be as a result of *Armillaria*, the assessment occurred at the wrong time of the year to observe fruiting bodies and therefore confirm the presence of the fungus. It is possible that *Armillaria luteobubalina* is present within the study area and contributing to the death of the vegetation.

6 Conclusion and Recommendations

Tracks, water courses and hard-hooved feral animals are considered to be the most likely vectors of disease in the study area. Therefore a linear Dieback assessment was considered an appropriate method for assessing the risk and likelihood of Dieback presence within and adjacent to the study area. The linear assessment determined that the majority of the study area is uninfested and therefore presents a low risk of spreading Dieback into areas outside the study corridor. While it is likely that the majority of the 983 ha site is uninfested, caution should be used when extrapolating the disease status and/or risk to vegetation that has not been assessed outside the study area.

Terratree makes the following recommendations in relation to the linear *Phytophthora* Dieback assessment of the study area:

- A comprehensive Dieback assessment of the site should be completed in accordance with *Manual for detecting and mapping Phytophthora Dieback disease* (Procedures for DPaW managed lands) (DPaW 2013).
- Protectable areas should be clearly demarcated and signposted.
- Additional samples from moderate risk areas should be taken.
- A Dieback management plan, including an access management strategy, should be developed for the site.

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8 Glossary of Terms

Assessment – (*Phytophthora* occurrence) any combination of activities including, detection, diagnosis (interpretation), mapping and demarcation of *Phytophthora* Dieback disease in natural ecosystems.

Assessment Area – An area where *Phytophthora* occurrence assessment is possible, or will be possible in the short to medium term. This area may be larger or smaller than the proponent's project area.

Disease - The combination of a pathogen, host and correct environmental conditions, which results in disease symptoms or death of a host.

Environment - The sum of all external factors which act on an individual organism during its lifetime.

Excluded Area – An area of high disturbance in which native vegetation is unlikely to recover.

Host - means the plant which is invaded by a pathogen and from which the pathogen derives its energy.

Indicator species – Plant species that are more susceptible to *Phytophthora* disease and reliably show symptoms earlier than other species.

Infection – The invasion of a host organism's bodily tissue by disease causing organisms. In relation to Dieback this refers to an individual plant and not the population.

Infested – The state of being invaded or overrun by pests or parasites. In relation to Dieback it refers to a population of plants and not individual plants.

Inoculum – Cells, tissue, or viruses that are used to inoculate a new culture

Pathogen – Any organism or factor causing disease within a host

Pathogenic – Causing or capable of causing disease

***Phytophthora* Dieback** – A term referring to the disease symptoms caused by *Phytophthora* species in susceptible vegetation.

Susceptible – Likely to be influenced or able to be harmed by particular pathogen

Sporulation - a type of reproduction that occurs in fungi, algae, and protozoa and involves the formation of spores by the spontaneous division of a cell into four or more daughter cells, each of which contains a part of the original nucleus.

Symptom – A phenomenon that arises from, and accompanies a particular disease or disorder and serves as an indication of it

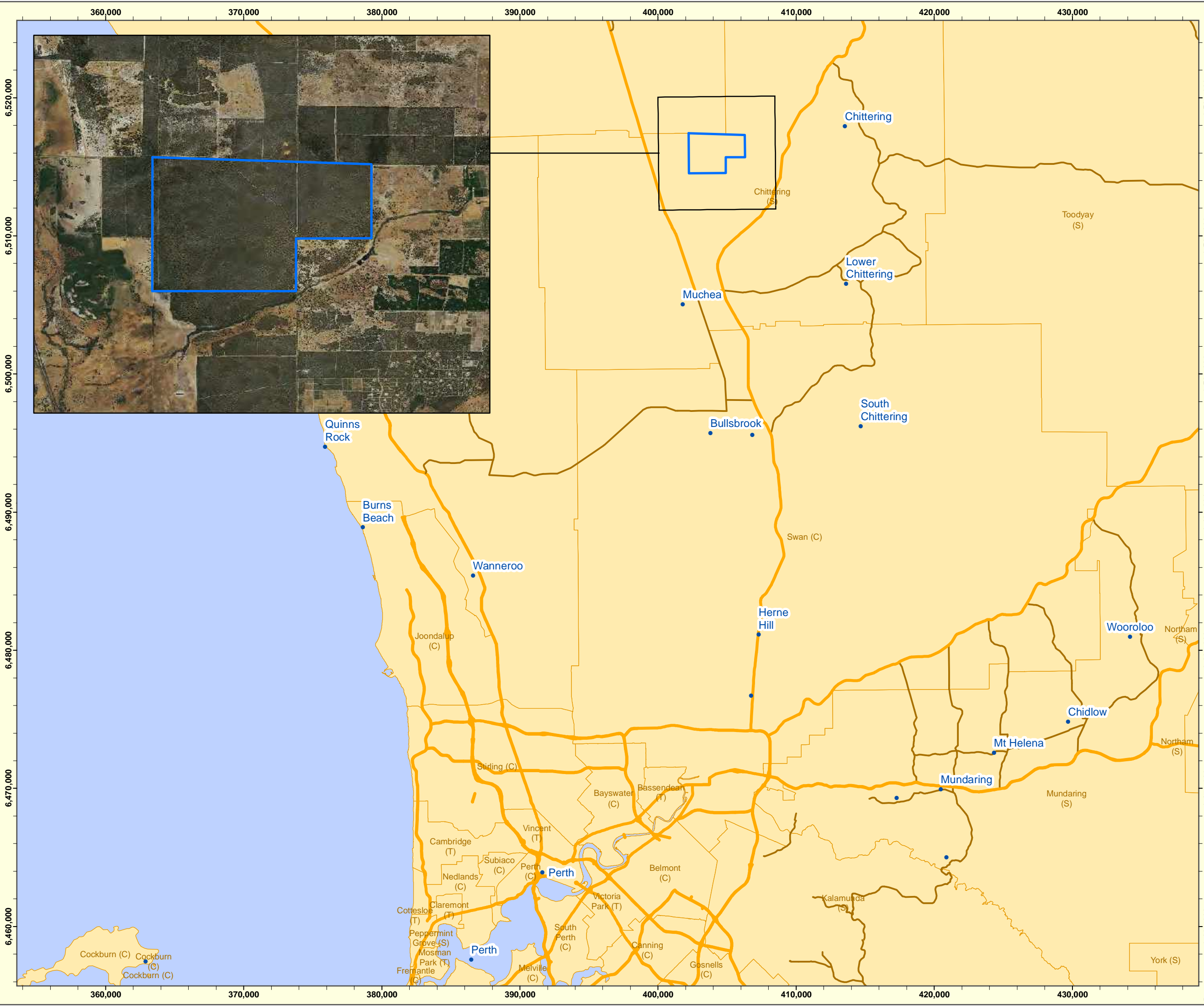
Uninfested – An area that does not contain infected plants or show visible signs of disease

Uninterpretable – a natural area where there are inadequate visible symptoms present to make a diagnosis

Unmappable – A naturally vegetated area that has had disturbance and from which is likely to recover in the short term

Unprotectable – A disease free area that is likely to become infested within a given time

Figures

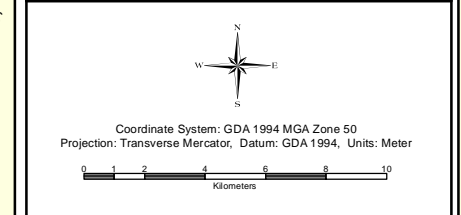


LEGEND

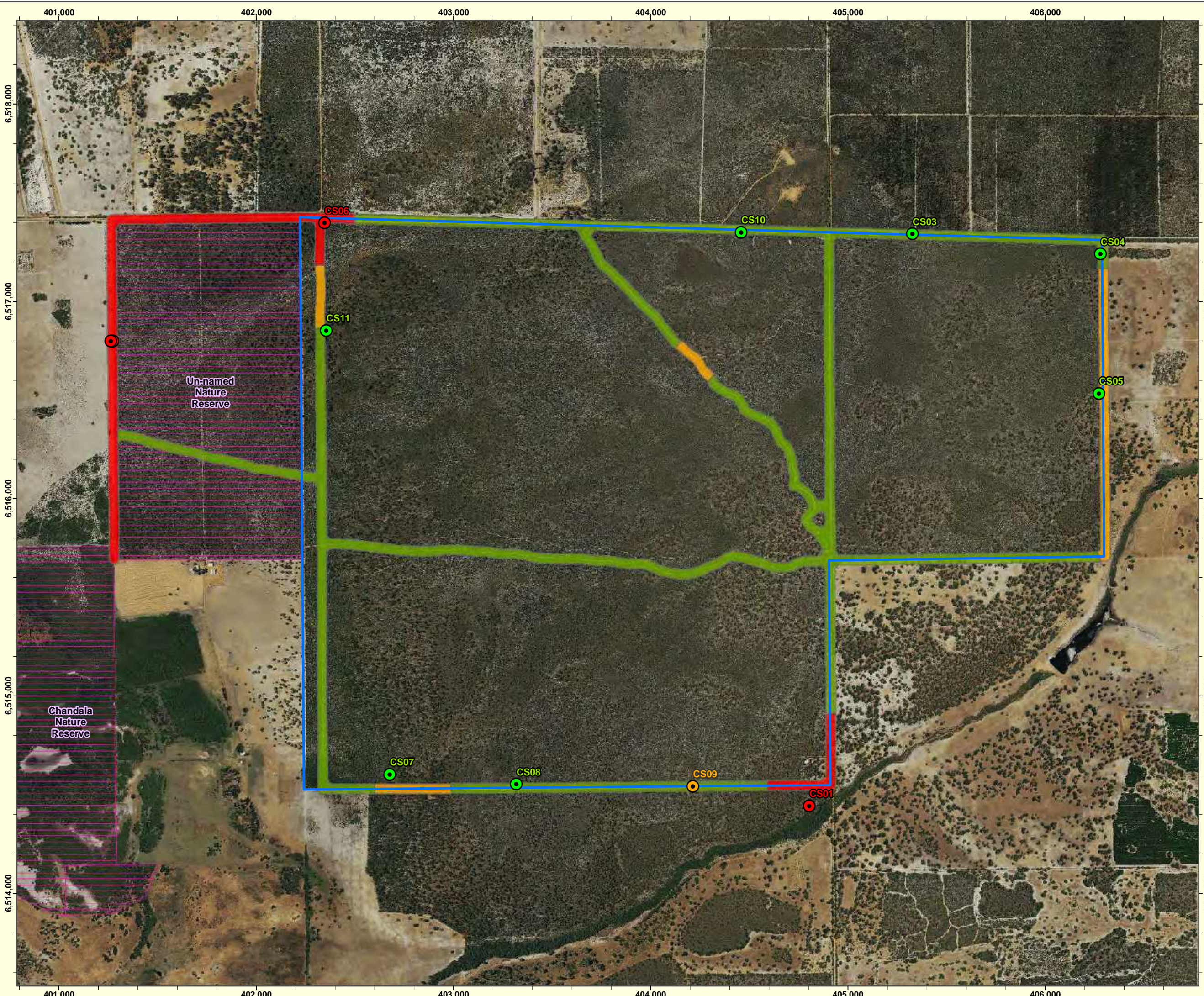
- Site boundary
- Towns
- Road (Primary Distributor)
- Road (Regional Distributor)



SITE LOCALITY
Chittering Dieback
Reconnaissance Survey



Scale @ A3: 1:250,000	Figure 01
Date: 22/09/2014	
Revision: Rev A	
Project No: TS14013	
Prepared: R Cullen	
Checked: J Botterill	
Reviewed: N King	



LEGEND

- Site boundary
- DPaW managed lands

Dieback sample results

- Cytospora* sp. (canker)
- P. cinnamomi*
- Negative

Dieback risk assessment

- High
- Moderate
- Low



LINEAR DIEBACK RISK ASSESSMENT AND SAMPLE RESULTS
Chittering Dieback
Reconnaissance Survey

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

Scale @ A3: 1:17,500	Figure 02
Date: 22/09/2014	
Revision: Rev C	
Project No: TS14013	
Prepared: R Cullen	
Checked: J Botterill	
Reviewed: N King	

9 Plates



Plate 1: High risk vegetation: Infested *Banksia* woodland with multiple indicator species deaths, disease pattern and chronology



Plate 2: Dead *Banksia attenuata* adjacent to disease vector (power line access track)



Plate 3: Evidence of feral pig activity, a likely vector for the positive *P. cinnamomi* sample



Plate 4: Medium risk vegetation - Area at risk due to historical disturbance due to logging, nearby areas of Infested vegetation and indicator species deaths.



Plate 5: Low risk vegetation - Uninfested woodland with low levels of disturbance and intact vegetation in Excellent condition



Plate 6: *Banksia grandis* exhibiting canker impacts



Plate 7: *Banksia* trunk exhibiting canker lesions on the cambium layer



Plate 8: *Banksia attenuata* exhibiting partial death due to canker



Plate 9: *Banksia* woodland exhibiting drought impacts



Plate 10: *Banksia attenuata* re-shooting after drought impact

10 Appendices

Appendix 1: Vegetation Health Services Laboratory report on positive identification of *Cytospora* sp. (canker) in CS11

Appendix 2: Sample Results from the Vegetation Health Services laboratory

PLANT DISEASE SAMPLE INFORMATION SHEET

CLIENT NAME Terratree Joe Grehan joeg@terratree.com.au

SAMPLE *Banksia grandis* canker CS 11 (canker) Fig. 1.

DIAGNOSIS A *Cytospora* sp. (Fig 2 & 3) was isolated and most likely indicates some inability of the plant to contain the fungi which can also be present on healthy plants.



Fig. 1 sample

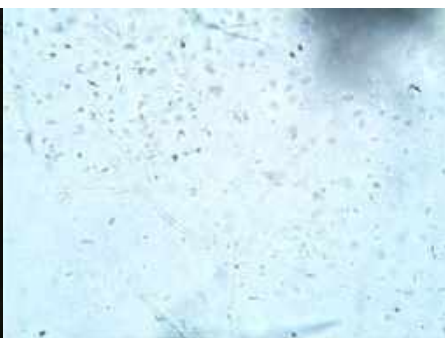


Fig. 2 Curved conidia



Fig.3 Alantoid conidia

THE PATHOGEN *Cytospora* sp. along with other genera in the Valsaceae, are commonly isolated from stem and twig cankers of *Eucalyptus*, *Hakea* and *Banksia* sp. of south-western Australia (Shearer 1994) They have a worldwide reputation as pathogens and cause extensive damage to tree crops. However in south-western Australia they often exist as benign endophytes (present in host tissues asymptotically) or wound pathogens causing disease only when the host is compromised in some way. Trees affected by drought, insect attack, defoliation by fungi, sunscald, herbicides or mechanical injury are predisposed to infection and disease development.

SYMPTOMS Twig and branch death.

HOST RANGE Myrtaceae, Proteaceae and Ericaceae

DISTRIBUTION Ubiquitous across the south-west but can have local high inoculum levels in infection pockets.

CONTROL Really need to trial this first to look at host/pathogen/fungicide response. Unsure? Is it warranted?

LABORATORY SAMPLES CC1721 not retained

SITE CS 11 Chittering

Boulder

MAP REFERENCE E 404215 N 6514542 Zone 50

19/9/2014

Colin Crane

Manager Vegetation Health Service

Department of Parks and Wildlife

Science Division

PH. (08) 9334 0482

Fax.(08) 9334 0327

Email: colin.crane@dpaw.wa.gov.au

Shearer BL (1994) The major plant pathogens occurring in native ecosystems of south-western Australia, *Journal of the Royal Society of Western Australia* 77, 113-122.

VEGETATION HEALTH SERVICE - PHYTOPHTHORA SAMPLE INFORMATION SHEET

SEND TO: Vegetation Health Service, Science Division - D.E.C, 17 Dick Perry Ave KENSINGTON 6151 Phone: (08) 9334 0317 Fax: (08) 9334 0114

CONTACT DETAILS of sender

Name Joe Graham Terratree
 Fax No. 011 9335 4228 Phone No. 0411 200 3658
 DEC Office or Company Name Terratree Pty Ltd

GDA
 (1)
 GDA 94

Job Type (Please indicate)
 D.E.C. (C) Alcoa (A)
 Recoup (R) FPC
 Private (P) Other _____

VHS USE ONLY
 Date processed 29/9/14
 Date faxed 12/9/14

VHS Identification Number (VHS USE ONLY)	Sample Date	Sample label (Give location, eg. Forest Block or Shire, etc. and sample number)	Plant species sampled	Site Impact (2)	Zone 50 or 51	Map Reference (3)	Land Tenure (4)	RESULT s/s root (5)	RESULT bait (5)
VHS31279	27/8/14	CS01 (chitting)	<i>Banksia attenuata</i>	M	50	E 404805 N 6514443	P		CIN
VHS31288	27/8/14	CS02 "	<i>Banksia grandis</i>	M	50	E 404874 N 6511350	P		NEG
VHS31281	27/8/14	CS03 "	<i>Banksia menziesii</i>	M	50	E 405325 N 6512242	P		NEG
VHS31282	27/8/14	CS04 "	<i>Banksia attenuata</i>	M	50	E 404251 N 6512232	P		NEG
VHS31283	27/8/14	CS05 "	<i>Banksia grandis</i>	H	50	E 400273 N 6516532	P		NEG
VHS31284	27/8/14	CS06 "	<i>B. menziesii</i>	L	50	E 401375 N 6516788	P		SUB
VHS31285	28/8/14	CS07 "	<i>B. menziesii</i>	NA	50	E 401251 N 6517193	P		AS FOR 31284
VHS31286	28/8/14	CS08 "	<i>B. menziesii</i> + <i>B. attenuata</i>	H	50	E 402347 N 6517395	P		CIN

NOTES:

1. Please tick this box if your map references are supplied in the GDA 94 standard. If not, please specify the datum used.
2. Site Impact - Low, Moderate, or High (as in the Dieback Interpreter's Manual).
3. An MGA map reference with prefixes must be supplied for all samples.
4. Land Tenure - State Forest (SF), National Park (NP), Reserve (R), Westrail (W), Private (P), Gravel Pit (GP), or other. (Other - describe in comments below).
5. Result codes used - CIN = *Phytophthora cinnamomi*, MUL = *P. multivora*, CRY = *P. cryptogea*, PI = *P. inundata*, ARE = *P. areolaris*, ELO = *P. elongata*, THE = *P. thomophila*, PM = *P. megasperma*, PN = *P. nicotianae*, CON = *P. constricta*, NEG = negative, SUB = subcultured for further tests

Please Note: a). NEG results cannot be used to represent a total absence of *Phytophthora* in the sampled area. b). Information from your samples will be incorporated into the VHS database.

COMMENTS:

VEGETATION HEALTH SERVICE - PHYTOPHTHORA SAMPLE INFORMATION SHEET

SEND TO: Vegetation Health Service, Science Division - D.E.C, 17 Dick Perry Ave KENSINGTON 6151 Phone: (08) 9334 0317 Fax: (08) 9334 0114





CONTACT DETAILS of sender

Name Joe Graham
 Fax No. Mob 0402003658 Phone No. 93354228
 DEC Office or Company Name Terratree Pty Ltd

GDA
 (1)
 GDA 94

Job Type (Please indicate)
 D.E.C. (C) Alcoa (A)
 Recoup (R) FPC
 Private (P) Other _____

VHS USE ONLY
 Date received 30/3/14
 Date sampled 12/9/14

VHS Identification Number (VHS USE ONLY)	Sample Date	Sample label (Give location, eg. Forest Block or Shire, etc. and sample number)	Plant species sampled	Site Impact (2)	Zone 50 or 51	Map Reference (3)	Land Tenure (4)	RESULT s/s root (5)	RESULT bait (5)
 VHS31287	28/8/14	CS09 (Whitening)	<i>Banksia attenuata</i>	M	50	E 402678 N 6574203	P		NEG
 VHS31288	28/8/14	CS10 "	<i>B. attenuata</i>	L	50	E 403319 N 6574352	P		NEG
	28/8/14	CS11 "	CANKER Sample <i>B. grandis</i>	M	50	E 404215 N 6574342	P		
 VHS31289	28/8/14	CS12 "	<i>B. attenuata</i>	L	50	E 404459 N 6577350	P		NEG
 VHS31290		CS13 "	<i>Xanthorrhoea preissii</i>	M	50	E 402356 N 6576352	P		NEG
						E ----- N -----			
						E ----- N -----			
						E ----- N -----			

NOTES:

1. Please tick this box if your map references are supplied in the GDA 94 standard. If not, please specify the datum used
2. Site impact - Low, Moderate, or High (as in the Dieback Interpreter's Manual).
3. An MGA map reference with prefixes must be supplied for all samples.
4. Land Tenure - State Forest (SF), National Park (NP), Reserve (R), Westrail (W), Private (P), Gravel Pit (GP), or other. (Other - describe in comments below).
5. Result codes used - CIN = *Phytophthora cinnamomi*, MUL = *P. multivora*, CRY = *P. cryptogea*, PI = *P. inundata*, ARE = *P. aranaria*, ELO = *P. elongata*, THE = *P. thermophila*, PM = *P. megasperma*, PN = *P. nicotianae*, CON = *P. constricta*, NEG = negative, SUB = subcultured for further tests

Please Note: a). NEG results cannot be used to represent a total absence of *Phytophthora* in the sampled area. b). Information from your samples will be incorporated into the VHS database.

COMMENTS:



APPENDIX D

Conservation
Significant Flora
Known to Occur or
Potentially Occur
Within the Study
Area

Species ¹	Conservation code ²			Habit ³	Habitat ³	Flowering period ³	Likelihood of occurrence
	EPBC Act	WC Act	DPAW				
<i>Acacia anomala</i>	VU	VU		Slender, rush-like shrub	Lateritic soils. Slopes.	Aug to Sep	Possible
<i>Acacia cummingiana</i>			3	Sprawling, straggly, rush-like shrub	Grey or yellow sand, lateritic gravel. Sandplains, lateritic breakaways.	May to Jun/ Aug	Likely
<i>Acacia drummondii</i> subsp. <i>affinis</i>			3	Erect shrub	Lateritic gravelly soils.	Jul to Aug	Likely
<i>Acacia pulchella</i> var. <i>reflexa</i> acuminate bracteole variant (R.J. Cumming 882)			3	Shrub, 0.3-1 m high	Sandy loam or sandy clay over laterite. Woodland.	Jul to Sep	Possible
<i>Adenanthos cygnorum</i> subsp. <i>chamaephyton</i>			3	Prostrate, mat-forming, non-lignotuberous shrub	Grey sand, lateritic gravel.	Jul/Sep to Dec/Jan	Possible
<i>Andersonia gracilis</i>	EN	VU		Slender erect or open straggly shrub	White/grey sand, sandy clay, gravelly loam. Winter-wet areas, near swamps.	Sep to Nov	Unlikely
<i>Anigozanthos viridis</i> subsp. <i>terraspectans</i>	VU	VU		Rhizomatous, perennial, herb	Grey sand, clay loam. Winter-wet depressions.	Aug to Sep	Unlikely
<i>Caladenia huegelii</i>	EN	CR		Tuberous, perennial, herb	Grey or brown sand, clay loam.	Sep to Oct	Possible
<i>Caustis</i> sp. Gigas (A.S. George 9318)			2	Erect, open sedge	Flat, dry white sand.	Aug to Nov	Likely
<i>Centrolepis caespitosa</i>	EN		4	Tufted annual, herb	White sand, clay. Salt flats, wet areas.	Oct to Dec	Unlikely
<i>Chamaescilla gibsonii</i>			3	Clumped tuberous, herb	Clay to sandy clay. Winter-wet flats, shallow water-filled claypans.	Sep	Unlikely

Species ¹	Conservation code ²			Habit ³	Habitat ³	Flowering period ³	Likelihood of occurrence
	EPBC Act	WC Act	DPAW				
<i>Chamelaucium</i> sp. Gingin (N.G. Marchant 6)	EN	VU		Unknown	Unknown.	Unknown	Likely
<i>Conospermum densiflorum</i> subsp. <i>Unicephalatum</i>	EN	EN		Erect, much-branched shrub	Clay soils. Low-lying areas.	Sep to Nov	Unlikely
<i>Cyathochaeta teretifolia</i>			3	Rhizomatous, clumped, robust perennial, grass-like or herb (sedge),	Grey sand, sandy clay. Swamps, creek.	Unknown	Unlikely
<i>Darwinia foetida</i>	CR	EN		Unknown	Unknown.	Unknown	Unlikely
<i>Diuris micrantha</i>	VU	VU		Tuberous, perennial, herb	Brown loamy clay. Winter-wet swamps, in shallow water.	Sep to Oct	Unlikely
<i>Diuris purdiei</i>	EN	EN		Tuberous, perennial, herb	Grey-black sand, moist. Winter-wet swamps.	Sep to Oct	Unlikely
<i>Drakaea elastica</i>	EN	CR		Tuberous, perennial, herb	White or grey sand. Low-lying situations adjoining winter-wet swamps.	Oct to Nov	Unlikely
<i>Drosera occidentalis</i> Morrison subsp. <i>occidentalis</i>				Fibrous-rooted, rosetted perennial, herb	Sandy & clayey soils. Swamps & wet depressions.	Nov to Dec	Unlikely
<i>Drosera sewelliae</i>			1	Fibrous-rooted, rosetted perennial, herb	Laterite & silica sand soils.	Oct	Possible
<i>Eleocharis keigheryi</i>	VU	VU		Rhizomatous, clumped perennial, grass-like or herb (sedge),	Clay, sandy loam. Emergent in freshwater: creeks, claypans.	Aug to Nov	Unlikely
<i>Eucalyptus balanites</i>	EN	CR		Mallee	Sandy soils with lateritic gravel	Oct to Dec	Unlikely

Species ¹	Conservation code ²			Habit ³	Habitat ³	Flowering period ³	Likelihood of occurrence
	EPBC Act	WC Act	DPAW				
<i>Eucalyptus leprophloia</i>	EN	EN		Mallee	White or grey sand over laterite. Valley slopes.	Aug to Oct	Unlikely
<i>Gastrolobium nudum</i>			2	Spreading, twiggy shrub	Red-brown clay, brown loam, gravel, laterite, granite. Flats, slopes, hilltops, ridges, valleys, breakaways.	Feb	Possible
<i>Grevillea candolleana</i>			2	Spreading shrub	Laterite, lateritic loam. Hillsides.	Aug to Sep	Possible
<i>Grevillea corrugata</i>	EN	VU		Shrub, 1.5-2.5 m high	Gravelly loam. Roadsides.	Aug to Sep	Unlikely
<i>Grevillea curviloba</i> subsp. <i>curviloba</i>	EN	CR		Prostrate to erect shrub	Grey sand. Winter-wet heath.	Oct	Possible
<i>Grevillea curviloba</i> subsp. <i>incurva</i>	EN	EN		Prostrate to erect shrub	Sand, sandy loam. Winter-wet heath.	Aug to Sep	Possible
<i>Grevillea evanescens</i>			1	Erect, robust shrub	Brown Spearwood sand.	Unknown	Possible
<i>Hibbertia glomerata</i> subsp. <i>ginginensis</i>			1	Erect shrub	Sand, brown clay, laterite. Near roadsides.	Jul to Sep	Possible
<i>Hibbertia helianthemoides</i>			4	Spreading to erect, low or prostrate shrub	Clayey sand over sandstone or loam over quartzite. Hills and scree slopes.	Jul/Sep to Oct	Unlikely
<i>Hypocalymma sylvestre</i>		CR		Spreading shrub	Yellow-brown sandy loam. Woodland on lateritic hilltop.	Aug	Unlikely
<i>Hypolaena robusta</i>			4	Dioecious rhizomatous, perennial, herb	White sand. Sandplains.	Sep to Oct	Likely

Species ¹	Conservation code ²			Habit ³	Habitat ³	Flowering period ³	Likelihood of occurrence
	EPBC Act	WC Act	DPAW				
<i>Isotropis cuneifolia</i> subsp. <i>glabra</i> Keighery			2	Prostrate to ascending, spreading perennial, herb or shrub	Sand, clay loam. Winter-wet flats.	Sep	Unlikely
<i>Lepidosperma rostratum</i>	EN	EN		Rhizomatous, tufted perennial, grass-like or herb (sedge)	Peaty sand, clay.	Unknown	Unlikely
<i>Leucopogon squarrosus</i> subsp. <i>trigynus</i>			2	Unknown	Unknown.	Unknown	Unlikely
<i>Meionectes tenuifolia</i>			3	Unknown	Unknown.	Unknown	Unlikely
<i>Myriophyllum echinatum</i>			3	Erect annual, herb	Clay. Winter-wet flats.	Nov	Unlikely
<i>Oxymyrrhine coronata</i>			4	Unknown	Unknown.	Unknown	Unlikely
<i>Persoonia rudis</i>			3	Erect, often spreading shrub	White, grey or yellow sand, often over laterite.	Sep to Dec/Jan	Possible
<i>Pithocarpa corymbulosa</i>			3	Erect to scrambling perennial, herb	Gravelly or sandy loam. Amongst granite outcrops.	Jan to Apr	Unlikely
<i>Platysace ramosissima</i>			3	Perennial, herb	Sandy soils.	Oct to Nov	Possible
<i>Ptychosema pusillum</i>	VU	VU		Perennial, herb	Sand. Rises	Aug to Oct	Possible
<i>Schoenus griffinianus</i>			3	Small, tufted perennial, grass-like or herb (sedge),	White sand.	Sep to Oct	Likely
<i>Stylidium cymiferum</i>			3	Rosetted perennial, herb	Brown loam over laterite. Uplands, Wandoo woodland.	Oct to Nov	Unlikely
<i>Stylidium longitubum</i>			3	Erect annual (ephemeral), herb	Sandy clay, clay. Seasonal wetlands.	Oct to Dec	Likely

Species ¹	Conservation code ²			Habit ³	Habitat ³	Flowering period ³	Likelihood of occurrence
	EPBC Act	WC Act	DPAW				
<i>Stylidium squamellosum</i>			2	Caespitose perennial, herb	Brown to red-brown clay loam. Winter-wet habitats and depressions, open woodland, shrubland.	Oct to Nov	Unlikely
<i>Synaphea grandis</i>			4	Tufted shrub	Laterite.	Oct to Nov	Possible
<i>Tetraria</i> sp. Chandala (G.J. Keighery 17055)			2	Unknown	Unknown.	Unknown	Likely
<i>Tetratheca pilifera</i>			3	Spreading shrub	Gravelly soils.	Aug to Oct	Unlikely
<i>Thelymitra stellata</i>	EN	EN		Tuberous, perennial, herb	Sand, gravel, lateritic loam.	Oct to Nov	Unlikely
<i>Trichocline</i> sp. Treeton (B.J. Keighery & N. Gibson 564)			2	Tuberous, perennial, herb	Sand over limestone, sandy clay over ironstone. Seasonally wet flats.	Unknown	Unlikely
<i>Verticordia lindleyi</i> subsp. <i>lindleyi</i>			4	Erect shrub	Sand, sandy clay. Winter-wet depressions.	May/Nov to Dec/Jan	Unlikely
<i>Verticordia rutilastra</i>			3	Shrub	Sand & lateritic gravel. Hills.	Sep to Nov	Likely
<i>Verticordia serrata</i> var. <i>linearis</i>			3	Shrub, to 1 m high	White sand, gravel. Open woodland.	Sep to Oct	Likely

1. See Section 4.1 for a comprehensive list of databases and reports reviewed to obtain the list of conservation significant flora.

2. See Appendix D for the descriptions of the conservation codes.

3. Descriptions and flowering periods obtained from DPAW (2014).



APPENDIX E

State and Federal Conservation Code Descriptions



1 STATE CONSERVATION CODES

1.1 Flora and fauna

T: Threatened species

Specially protected under the *Wildlife Conservation Act 1950*, listed under Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora (which may also be referred to as Declared Rare Flora).

Species 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.

X: Presumed extinct species

Specially protected under the *Wildlife Conservation Act 1950*, listed under Schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice for Presumed Extinct Fauna and Wildlife Conservation (Rare Flora) Notice for Presumed Extinct Flora (which may also be referred to as Declared Rare Flora).

Species which have been adequately searched for and there is no reasonable doubt that the last individual has died, and have been gazetted as such.

IA: Migratory birds protected under an international agreement

Specially protected under the *Wildlife Conservation Act 1950*, listed under Schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice.

Birds that are subject to an agreement between governments of Australia and Japan, China and The Republic of Korea relating to the protection of migratory birds and birds in danger of extinction.

S: Other specially protected fauna

Specially protected under the *Wildlife Conservation Act 1950*, listed under Schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice.

Threatened Fauna and Flora are further recognised by the Department of Parks and Wildlife according to their level of threat using IUCN Red List criteria. The ranking are:

CR Critically Endangered - considered to be facing an extremely high risk of extinction in the wild.


EN Endangered – considered to be facing a very high risk of extinction in the wild.

VU Vulnerable – considered to be facing a high risk of extinction in the wild.

Species that have not yet been adequately surveyed to be listed under Schedule 1 or 2 are added to the Priority Flora and Priority Fauna Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora or fauna. Species that are adequately known, are rare but not threatened, or meet criteria for Near Threatened, or that have been recently removed from the threatened list for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring. Conservation Dependent species are placed in Priority 5.

1: Priority One: Poorly-known species

Species that are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, rail reserves and Main



Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes.

2: Priority Two: Poorly-known species

Species that are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, unallocated Crown land, water reserves, etc. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes.

3: Priority Three: Poorly-known species

Species that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them.

4: Priority Four: Rare, Near Threatened and other species in need of monitoring

- (a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands.
- (b) Near Threatened. Species that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.
- (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

5: Priority Five: Conservation dependent species

Species that are not threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

1.2 Ecological Communities

Presumed Totally Destroyed (PD)

An ecological community that has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future.

An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant and either of the following applies (A or B):

- A) Records within the last 50 years have not been confirmed despite thorough searches of known or likely habitats or
- B) All occurrences recorded within the last 50 years have since been destroyed



Critically Endangered (CR)

An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated.

An ecological community will be listed as Critically Endangered when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This will be determined on the basis of the best available information, by it meeting any one or more of the following criteria (A, B or C):


- A) The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% and either or both of the following apply (i or ii):
 - i) geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 10 years);
 - ii) modification throughout its range is continuing such that in the immediate future (within approximately 10 years) the community is unlikely to be capable of being substantially rehabilitated.
- B) Current distribution is limited, and one or more of the following apply (i, ii or iii):
 - i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 10 years);
 - ii) there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes;
 - iii) there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes.
- C) The ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 10 years).

Endangered (EN)

An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future.

An ecological community will be listed as Endangered when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B, or C):

- A) The geographic range, and/or total area occupied, and/or number of discrete occurrences have been reduced by at least 70% since European settlement and either or both of the following apply (i or ii):
 - i) the estimated geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short term future (within approximately 20 years);
 - ii) modification throughout its range is continuing such that in the short term future (within approximately 20 years) the community is unlikely to be capable of being substantially restored or rehabilitated.

- 
- B) Current distribution is limited, and one or more of the following apply (i, ii or iii):
 - i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short term future (within approximately 20 years);
 - ii) there are few occurrences, each of which is small and/or isolated and all or most occurrences are very vulnerable to known threatening processes;
 - iii) there may be many occurrences but total area is small and all or most occurrences are small and/or isolated and very vulnerable to known threatening processes.
 - C) The ecological community exists only as very modified occurrences that may be capable of being substantially restored or rehabilitated if such work begins in the short-term future (within approximately 20 years).

Vulnerable (VU)

An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range.

An ecological community will be listed as Vulnerable when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction or significant modification in the medium to long-term future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B or C):

- A) The ecological community exists largely as modified occurrences that are likely to be capable of being substantially restored or rehabilitated.
- B) The ecological community may already be modified and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations.
- C) The ecological community may be still widespread but is believed likely to move into a category of higher threat in the medium to long term future because of existing or impending threatening processes.

Possible Threatened ecological communities that do not meet survey criteria or that are not adequately defined are added to the Priority Ecological Community List under priorities 1, 2 and 3. These three categories are ranked in order of priority for survey and/or definition of the community, and evaluation of conservation status, so that consideration can be given to their declaration as Threatened ecological communities. Ecological communities that are adequately known, and are rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list, are placed in Priority 4. These ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5.

Priority One: Poorly-known ecological communities

Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤ 5 occurrences or a total area of ≤ 100 ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.



Priority Two: Poorly-known ecological communities

Communities that are known from few occurrences with a restricted distribution (generally ≤ 10 occurrences or a total area of ≤ 200 ha). At least some occurrences are not believed to be under immediate threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.

Priority Three: Poorly known ecological communities

- (i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or:
- (ii) Communities known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or;
- (iii) Communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes.

Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.

Priority Four: Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring.

- (i) Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands.
- (ii) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.
- (iii) Ecological communities that have been removed from the list of threatened communities during the past five years.

Priority Five: Conservation Dependent ecological communities

Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

2 FEDERAL CONSERVATION CODES

2.1 Flora and fauna

Extinct

A native species is eligible to be included in the extinct category at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.



Extinct in the wild

A native species is eligible to be included in the extinct in the wild category at a particular time if, at that time:

- (a) it is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or
- (b) it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.

Critically endangered

A native species is eligible to be included in the critically endangered category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.

Endangered

A native species is eligible to be included in the endangered category at a particular time if, at that time:

- (a) it is not critically endangered; and
- (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.

Vulnerable

A native species is eligible to be included in the vulnerable category at a particular time if, at that time:

- (a) it is not critically endangered or endangered; and
- (b) it is facing a high risk of extinction in the wild in the medium term future, as determined in accordance with the prescribed criteria.

Conservation dependent

A native species is eligible to be included in the conservation dependent category at a particular time if, at that time:

- (a) the species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered; or
- (b) the following subparagraphs are satisfied:
 - (i) the species is a species of fish;
 - (ii) the species is the focus of a plan of management that provides for management actions necessary to stop the decline of, and support the recovery of, the species so that its chances of long term survival in nature are maximised;
 - (iii) the plan of management is in force under a law of the Commonwealth or of a State or Territory;
 - (iv) cessation of the plan of management would adversely affect the conservation status of the species.

2.2 Ecological communities

Critically endangered

An ecological community is eligible to be included in the critically endangered category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.



Endangered

An ecological community is eligible to be included in the endangered category at a particular time if, at that time:

- (a) it is not critically endangered; and
- (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.

Vulnerable

An ecological community is eligible to be included in the vulnerable category at a particular time if, at that time:

- (a) it is not critically endangered nor endangered; and
- (b) it is facing a high risk of extinction in the wild in the medium term future, as determined in accordance with the prescribed criteria.



APPENDIX F

Relevé Floristic Data

RELEVÉ DATA

Site: COR01
Described: CvdB & LD **Date:** 10/07/2014 **Type:** Releve
MGA Zone: 50 404219mE; 6517177mN
Habitat: Mid to upper north facing slope of a laterite rise
Soil: Black brown sandy loam with laterite
Rock Type: Laterite
Vegetation: *Eucalyptus marginata* and *Corymbia calophylla* mid sparse woodland over *Xanthorrhoea preissii* and *Allocasuarina humilis* mid open shrubland over *Hibbertia hypericoides*, *Conostephium pendulum* and *Hakea stenocarpa* low open shrubland
Condition: Excellent
Fire Age: >5 years
Notes Leaf Litter (%): 5
Rock Size (cm): 1-15
Exposed Rock (%): 17
Rock Cover (%): 22



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Acacia drummondii</i> subsp. <i>drummondii</i>		
<i>Allocasuarina humilis</i>	1	1.5
<i>Astroloma pallidum</i>		
<i>Astroloma stomarrhena</i>		
<i>Banksia bipinnatifida</i> subsp. <i>multifida</i>		
<i>Banksia bipinnatifida</i> subsp. <i>multifida</i>		
<i>Calectasia narragara</i>		
<i>Calothamnus sanguineus</i>		
<i>Conostephium pendulum</i>	1	0.5
<i>Corymbia calophylla</i>	1	10
<i>Daviesia physodes</i>		
<i>Daviesia physodes</i>		
<i>Eucalyptus marginata</i>	9	11
<i>Gonocarpus cordiger</i>		
<i>Grevillea pilulifera</i>		
<i>Hakea lissocarpa</i> (forma)	1	0.7
<i>Hakea stenocarpa</i>		
<i>Hibbertia hypericoides</i>	5	0.3
<i>Jacksonia floribunda</i>		
<i>Lepidosperma pubisquameum</i> (flat form)		
<i>Mesomelaena tetragona</i>		
<i>Patersonia occidentalis</i> var. <i>occidentalis</i>		
<i>Petrophile divaricata</i>		
<i>Synaphea spinulosa</i> subsp. <i>spinulosa</i>		
<i>Xanthorrhoea preissii</i>	12	1.8

Site: COR02
Described: CvdB & LD **Date:** 8/07/2014 **Type:** Relve
MGA Zone: 50 405595mE; 6516948mN
Habitat: Consolidated dune rise
Soil: Grey white coarse grained sand
Rock Type: N/A
Vegetation: *Eucalyptus marginata* mid sparse woodland over *Xanthorrhoea preissii* mid sparse shrubland over *Hibbertia hypericoides* and *Melaleuca systema* low heath shrubland over *Lepidosperma pubisquameum* (flat form) and *Mesomelaena pseudostygia* low sparse sedgeland over *Lyginia imberbis* low isolated rushes
Condition: Excellent
Fire Age: >5 years
Notes: Leaf Litter (%): 12



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Bossiaea eriocarpa</i>		
<i>Calytrix flavescens</i>		
<i>Calytrix variabilis</i>		
<i>Conostephium pendulum</i>		0.2
<i>Daviesia physodes</i>		
<i>Eucalyptus marginata</i>	6	13
<i>Gladiolus caryophyllaceus</i>		0.1
<i>Gompholobium tomentosum</i>		
<i>Hakea ruscifolia</i>		
<i>Hibbertia hypericoides</i>	15	0.3
<i>Hibbertia racemosa</i>		
<i>Hyalochlamys globifera</i>		
<i>Isopogon linearis</i>		
<i>Jacksonia floribunda</i>		
<i>Lepidosperma pubisquameum</i> (flat form)	1	0.3
<i>Lepidosperma squamatum</i>		
<i>Leucopogon conostephioides</i>		
<i>Leucopogon gracillimus</i>		
<i>Lomandra hermaphrodita</i>		
<i>Lyginia imberbis</i>	<1	0.3
<i>Melaleuca systema</i>	3	0.3
<i>Mesomelaena pseudostygia</i>	1	0.3
<i>Nuytsia floribunda</i>		
<i>Patersonia occidentalis</i> var. <i>occidentalis</i>		
<i>Persoonia saccata</i>		
<i>Stirlingia latifolia</i>		
<i>Xanthorrhoea preissii</i>	7	2

Site: COR03
Described: CvdB & LD **Date:** 8/07/2014 **Type:** Releve
MGA Zone: 50 405202mE; 6516708mN
Habitat: Upper plain on a consolidated dune rise
Soil: Yellow grey brown coarse-grained sand
Rock Type: N/A
Vegetation: *Banksia attenuata* and *B. menziesii* tall sparse shrubland over *Allocasuarina humilis*, *Daviesia divaricata* subsp. *divaricata* and *Xanthorrhoea preissii* mid heath shrubland over *Eremaea pauciflora* var. *pauciflora* and *Stirlingia latifolia* low open shrubland over *Mesomelaena pseudostygia* low sparse shrubland
Condition: Excellent
Fire Age: >5 years
Notes: Leaf Litter (%): 10



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Allocasuarina humilis</i>	37	1.5
<i>Banksia attenuata</i>	5	3.5
<i>Banksia dallanneyi</i> var. <i>dallanneyi</i>		
<i>Banksia menziesii</i>	3	3.5
<i>Bossiaea eriocarpa</i>		
<i>Calectasia narragara</i>		
<i>Calytrix flavescens</i>		
<i>Calytrix sylvana</i>		
<i>Calytrix variabilis</i>		
<i>Conospermum stoechadis</i>		
<i>Conostephium pendulum</i>		
<i>Conostylis aurea</i>		
<i>Daviesia divaricata</i> subsp. <i>divaricata</i>	1	2
<i>Daviesia triflora</i>		
<i>Drosera</i> ? <i>erythrorhiza</i>		
<i>Drosera pallida</i>		Creeper
<i>Eremaea pauciflora</i> var. <i>pauciflora</i>	4	0.5
<i>Hypocalymma xanthopetalum</i>		
<i>Jacksonia floribunda</i>		
<i>Lomandra sericea</i>		
<i>Lysinema pentapetalum</i>		
<i>Melaleuca systema</i>		
<i>Mesomelaena pseudostygia</i>	2	0.4
<i>Patersonia occidentalis</i> var. <i>occidentalis</i>		
<i>Petrophile macrostachya</i>		
<i>Stirlingia latifolia</i>	1	0.8
<i>Stylidium</i> sp.		
<i>Synaphea spinulosa</i> subsp. <i>spinulosa</i>		
<i>Xanthorrhoea preissii</i>	1	1.4

Site: COR04
Described: CvdB & LD **Date:** 8/07/2014 **Type:** Releve
MGA Zone: 50 406021mE; 6516192mN
Habitat: Upper plain of a consolidated dune rise
Soil: White brown coarse-grained sand
Rock Type: N/A
Vegetation: *Eucalyptus marginata* mid sparse woodland over *Banksia attenuata*, *B. grandis* and *Nuytsia floribunda* tall sparse shrubland over *Jacksonia floribunda* and *Adenanthos cygnorum* subsp. *cygnorum* mid open shrubland over *Eremaea pauciflora* var. *pauciflora*, *Hibbertia hypericoides* and *Melaleuca systema* low heath shrubland over *Mesomelaena pseudostygia* low sparse sedgeland
Condition: Excellent
Fire Age: >5 years
Notes: Leaf Litter (%): 12



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Adenanthos cygnorum</i> subsp. <i>cygnorum</i>	1	1.8
<i>Alexgeorgea nitens</i>		0.3
<i>Banksia attenuata</i>	4	4.5
<i>Banksia grandis</i>	1	4
<i>Bossiaea eriocarpa</i>		0.4
<i>Calytrix variabilis</i>		0.4
<i>Cassytha pomiformis</i>		Creeper
<i>Conostephium pendulum</i>		0.2
<i>Conostylis teretifolia</i> subsp. <i>teretifolia</i>		0.1
<i>Daviesia divaricata</i> subsp. <i>divaricata</i>		2
<i>Daviesia triflora</i>		0.4
<i>Drosera</i> ? <i>erythrorhiza</i>		Prostrate
<i>Eremaea pauciflora</i> var. <i>pauciflora</i>	1	0.5
<i>Eucalyptus marginata</i>	2	11
<i>Gladiolus caryophyllaceus</i>		0.1
<i>Hakea ruscifolia</i>		0.5
<i>Hibbertia hypericoides</i>	1	0.4
<i>Hibbertia racemosa</i>		0.3
<i>Isopogon linearis</i>		0.4
<i>Jacksonia floribunda</i>	1	1.1
<i>Lepidosperma pubisquameum</i> (flat form)		0.3
<i>Leucopogon conostephioides</i>		0.3
<i>Lyginia imberbis</i>		0.3
<i>Lysinema ciliatum</i>		0.6
<i>Melaleuca systema</i>	1	0.2
<i>Mesomelaena pseudostygia</i>	1	0.4
<i>Nuytsia floribunda</i>	1	4.5
<i>Patersonia occidentalis</i> var. <i>occidentalis</i>		0.4
<i>Persoonia saccata</i>		0.3
<i>Scholtzia involucrata</i>		0.3
<i>Stirlingia latifolia</i>		0.4
<i>Synaphea spinulosa</i> subsp. <i>spinulosa</i>		0.4

Site: COR05
Described: CvdB & LD **Date:** 8/07/2014 **Type:** Releve
MGA Zone: 50 406161mE; 6515925mN
Habitat: Upper to mid slope, Moderate slope facing East Southeast
Soil: Brown coarse-grained sandy loam with a laterite subsurface
Rock Type: Laterite
Vegetation: *Eucalyptus marginata* and *Corymbia calophylla* mid woodland over *Xanthorrhoea preissii* mid sparse shrubland over *Hibbertia hypericoides* low open shrubland over *Mesomelaena tetragona* low sparse sedgeland
Condition: Excellent
Fire Age: >5 years
Notes: Leaf Litter (%): 15
 Rock Size (cm): 1-10
 Exposed Rock (%): <1
 Rock Cover (%): <2



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Acacia applanata</i>		0.2
<i>Astroloma pallidum</i>		0.1
<i>Babingtonia camphorosmae</i>		0.3
<i>Banksia bipinnatifida</i> subsp. <i>multifida</i>		0.3
<i>Banksia dallanneyi</i> var. <i>dallanneyi</i>		0.3
<i>Burchardia congesta</i>		0.3
<i>Conostephium pendulum</i>		0.2
<i>Conostylis teretifolia</i> subsp. <i>teretifolia</i>		0.1
<i>Corymbia calophylla</i>	5	12
<i>Daviesia physodes</i>		0.4
<i>Daviesia preissii</i>		0.4
<i>Drosera</i> ? <i>erythrorhiza</i>		
<i>Drosera pallida</i>		Creeper
<i>Eucalyptus marginata</i>	10	12
<i>Gladiolus caryophyllaceus</i>		0.1
<i>Gompholobium marginatum</i>		0.2
<i>Grevillea pilulifera</i>		0.2
<i>Hakea lissocarpha</i> (forma)		0.4
<i>Hibbertia hypericoides</i>	25	0.3
<i>Lagenophora huegelii</i>		
<i>Lepidosperma</i> sp. Northern Sandplains (R. Barrett)		0.1
<i>Lomandra preissii</i>		0.3
<i>Mesomelaena tetragona</i>	2	0.3
Orchidaceae sp.		
<i>Styphelia tenuiflora</i>		0.4
<i>Xanthorrhoea preissii</i>	3	1

Site: COR06
Described: CvdB & LD **Date:** 8/07/2014 **Type:** Releve
MGA Zone: 50 404958mE; 6516136mN
Habitat: Plain on top of a consolidated dune rise
Soil: Grey brown coarse-grained sand
Rock Type: N/A
Vegetation: *Eucalyptus marginata* low sparse woodland over *Banksia attenuata*, *B. menziesii* and *Adenanthos cygnorum* subsp. *cygnorum* tall open shrubland over *Jacksonia floribunda* mid isolated shrubs over *Hibbertia hypericoides* and *Stirlingia latifolia* low open shrubland over *Hypolaena exsulca* low sparse sedges over *Lyginia imberbis* and *Alexgeorgea nitens* low sparse rushland
Condition: Excellent
Fire Age: >5 years
Notes: Leaf Litter (%): 10



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Adenanthos cygnorum</i> subsp. <i>cygnorum</i>	2	4
<i>Alexgeorgea nitens</i>	1	0.1
<i>Astroloma xerophyllum</i>		0.5
<i>Banksia attenuata</i>	16	4.5
<i>Banksia menziesii</i>	2	4.0
<i>Bossiaea eriocarpa</i>		0.2
<i>Calytrix flavescens</i>		0.3
<i>Calytrix variabilis</i>		0.6
<i>Cassytha pomiformis</i>		Creeper
<i>Conospermum crassinervium</i>		0.3
<i>Conostylis teretifolia</i> subsp. <i>teretifolia</i>		0.1
<i>Drosera</i> ? <i>erythrorhiza</i>		0.1
<i>Drosera pallida</i>		creeper
<i>Eremaea pauciflora</i> var. <i>pauciflora</i>	10	0.5
<i>Eucalyptus marginata</i>	1	7.5
<i>Hibbertia hypericoides</i>	1	0.4
<i>Hibbertia subvaginata</i>		0.5
<i>Hypolaena exsulca</i>	1	0.5
<i>Isopogon linearis</i>		0.4
<i>Jacksonia floribunda</i>	0.25	1.2
<i>Leucopogon conostephioides</i>		0.3
<i>Lyginia imberbis</i>	1	0.2
<i>Melaleuca systema</i>		0.3
<i>Mesomelaena tetragona</i>		0.2
<i>Patersonia occidentalis</i> var. <i>occidentalis</i>		0.3
<i>Scholtzia involucrata</i>		0.2
<i>Stirlingia latifolia</i>	1	0.4

Site: COR07
Described: CvdB & LD **Date:** 9/07/2014 **Type:** Releve
MGA Zone: 50 404569mE; 6515568mN
Habitat: Consolidated low dune
Soil: Yellow grey coarse grey sand
Rock Type: N/A
Vegetation: *Eucalyptus marginata* and *Corymbia calophylla* mid sparse woodland over *Xanthorrhoea preissii* and *Calothamnus sanguineus* mid sparse shrubland over *Hibbertia hypericoides*, *Conostephium pendulum* and *Stirlingia latifolia* low heath shrubland over *Mesomelaena pseudostygia* low sparse sedgeland
Condition: Excellent
Fire Age: >5 years
Notes: Leaf Litter (%): 7



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Banksia dallanneyi</i> var. <i>dallanneyi</i>		
<i>Calothamnus sanguineus</i>	1	1
<i>Calytrix variabilis</i>		
<i>Cassytha pomiformis</i>		Creeper
<i>Conostephium pendulum</i>	1	0.5
<i>Corymbia calophylla</i>	1	10
<i>Daviesia physodes</i>		
<i>Drosera pallida</i>		Creeper
<i>Eucalyptus marginata</i>	8	14
<i>Gladiolus caryophyllaceus</i>		
<i>Gompholobium marginatum</i>		
<i>Hibbertia hypericoides</i>	6	0.5
<i>Hibbertia racemosa</i>		
<i>Isopogon linearis</i>		
<i>Kunzea glabrescens</i>		
<i>Lepidosperma pubisquameum</i> (flat form)		
<i>Lepidosperma squamatum</i>		
<i>Macrozamia riedlei</i>		
<i>Mesomelaena pseudostygia</i>	3	0.4
<i>Olearia lehmanniana</i>		0.2
<i>Patersonia occidentalis</i> var. <i>occidentalis</i>		
<i>Stirlingia latifolia</i>	1	0.4
<i>Stylidium</i> sp.		Prostrate
<i>Styphelia tenuiflora</i>		
<i>Xanthorrhoea preissii</i>	3	1.5
<i>Xanthosia huegelii</i>		0.1

Site: COR08
Described: CvdB & LD **Date:** 9/07/2014 **Type:** Releve
MGA Zone: 50 404538mE; 6515087mN
Habitat: Top of a consolidated dune
Soil: Yellow brown coarse sand
Rock Type: N/A
Vegetation: *Eucalyptus todtiana* mid sparse mallee woodland over *Banksia attenuata* tall sparse shrubland over *Allocasuarina humilis* and *Xanthorrhoea preissii* mid sparse shrubland over *Hibbertia hypericoides*, *Calothamnus sanguineus* and *Eremaea pauciflora* var. *pauciflora* low open shrubland
Condition: Excellent - Pristine
Fire Age: >5 years
Notes: Leaf Litter (%): 10



SPECIES LIST

Name	Cover	Height
<i>Acacia extensa</i>		
<i>Acacia sessilis</i>		
<i>Allocasuarina humilis</i>		
<i>Astroloma pallidum</i>		
<i>Banksia attenuata</i>		
<i>Banksia dallanneyi</i> var. <i>dallanneyi</i>		
<i>Bossiaea eriocarpa</i>		
<i>Burchardia congesta</i>		
<i>Calothamnus sanguineus</i>		
<i>Cassytha pomiformis</i>		Creeper
<i>Conostephium pendulum</i>		
<i>Daviesia triflora</i>		
<i>Drosera</i> ? <i>erythrorhiza</i>		
<i>Eremaea pauciflora</i> var. <i>pauciflora</i>		
<i>Eucalyptus todtiana</i>		
<i>Gladiolus caryophyllaceus</i>		
<i>Hakea lissocarpha</i> (forma)		
<i>Hibbertia hypericoides</i>		
<i>Hibbertia racemosa</i>		
<i>Isopogon linearis</i>		
<i>Leptomeria cunninghamii</i>		
<i>Lyginia imberbis</i>		
<i>Mesomelaena pseudostygia</i>		
<i>Nuytsia floribunda</i>		
<i>Patersonia occidentalis</i> var. <i>occidentalis</i>		
<i>Persoonia saccata</i>		
<i>Petrophile macrostachya</i>		
<i>Scholtzia involucrata</i>		
<i>Synaphea spinulosa</i> subsp. <i>spinulosa</i>		
<i>Xanthorrhoea preissii</i>		

Site: COR09
Described: CvdB & LD **Date:** 9/07/2014 **Type:** Releve
MGA Zone: 50 404642mE; 6514639mN
Habitat: Middle to upper slope, moderate slope facing south
Soil: Brown coarse sandy loam
Rock Type: laterite
Vegetation: *Eucalyptus marginata* mid sparse woodland over *Xanthorrhoea preissii* mid sparse shrubland over *Hibbertia hypericoides* low open shrubland over *Lepidosperma pubisquameum* (flat form) and *Mesomelaena tetragona* low sparse sedgeland
Condition: Excellent
Fire Age: >5 years
Notes Leaf Litter (%): 30
 Rock Size (cm): 5-10
 Exposed Rock (%): <1
 Rock Cover (%): 5



SPECIES LIST

Name	Cover	Height
<i>Acacia nervosa</i>		
<i>Astroloma pallidum</i>		
<i>Banksia bipinnatifida</i> subsp. <i>multifida</i>		
<i>Banksia dallanneyi</i> var. <i>dallanneyi</i>		
<i>Bossiaea eriocarpa</i>		
<i>Conostephium pendulum</i>		
<i>Conostylis teretifolia</i> subsp. <i>teretifolia</i>		
<i>Daviesia preissii</i>		
<i>Drosera</i> ? <i>erythrorhiza</i>		
<i>Drosera pallida</i>		
<i>Eucalyptus marginata</i>	9	11
<i>Gompholobium marginatum</i>		
<i>Grevillea pilulifera</i>		
<i>Grevillea pilulifera</i>		
<i>Hakea lissocarpha</i> (forma)		
<i>Hakea trifurcata</i>		
<i>Hibbertia hypericoides</i>	6	0.3
<i>Hibbertia racemosa</i>		
<i>Lepidosperma pubisquameum</i> (flat form)	1	0.3
<i>Lepidosperma</i> sp. Northern Sandplains (R. Barrett)		
<i>Leucopogon gracillimus</i>		
<i>Leucopogon gracillimus</i>		
<i>Lomandra sericea</i>		
<i>Mesomelaena tetragona</i>	1	0.3
<i>Petrophile striata</i>		
<i>Stylidium</i> sp.		
<i>Synaphea spinulosa</i> subsp. <i>spinulosa</i>		
Unknown sp.		
<i>Xanthorrhoea preissii</i>	5	1.5

Site: COR10
Described: CvdB & LD **Date:** 9/07/2014 **Type:** Releve
MGA Zone: 50 403976mE; 6514919mN
Habitat: Mid consolidated dune
Soil: White grey coarse grained sand
Rock Type: N/A
Vegetation: *Eucalyptus todtiana* mid sparse mallee woodland over *Nuytsia floribunda* low sparse woodland over *Banksia attenuata* and *Adenanthos cygnorum* tall sparse shrubland over *Beaufortia elegans* and *Xanthorrhoea preissii* mid sparse shrubland over *Calothamnus sanguineus* and *Hibbertia hypericoides* low sparse shrubland
Condition: Excellent
Fire Age: >5 years
Notes: Leaf Litter (%): 5



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Acacia extensa</i>		
<i>Acacia pulchella</i> var. <i>pulchella</i>		
<i>Adenanthos cygnorum</i>	1	4
<i>Banksia attenuata</i>	2	4
<i>Beaufortia elegans</i>	5	1.4
<i>Bossiaea eriocarpa</i>		
<i>Calothamnus sanguineus</i>	3	0.9
<i>Calytrix variabilis</i>		
<i>Cassytha pomiformis</i>		
<i>Conostephium pendulum</i>		
<i>Conostylis teretifolia</i> subsp. <i>teretifolia</i>		
<i>Daviesia triflora</i>		
<i>Drosera</i> ? <i>erythrorhiza</i>		
<i>Eremaea pauciflora</i> var. <i>pauciflora</i>		
<i>Eucalyptus todtiana</i>	4	6
<i>Hibbertia hypericoides</i>	1	0.5
<i>Hibbertia racemosa</i>		
<i>Hibbertia subvaginata</i>		
<i>Hypolaena robusta</i>		
<i>Isopogon linearis</i>		
<i>Jacksonia floribunda</i>		
<i>Leucopogon conostephioides</i>		
<i>Leucopogon gracillimus</i>		
<i>Lomandra sericea</i>		
<i>Lyginia imberbis</i>		
<i>Nuytsia floribunda</i>	1	6
<i>Patersonia occidentalis</i> var. <i>occidentalis</i>		
<i>Persoonia saccata</i>		
<i>Scholtzia involucrata</i>		
<i>Synaphea spinulosa</i> subsp. <i>spinulosa</i>		
<i>Xanthorrhoea preissii</i>	3	2

Site: COR11
Described: CvdB & LD **Date:** 9/07/2014 **Type:** Releve
MGA Zone: 50 403705mE; 6515359mN
Habitat: Consolidated dune, small depression in mid slope
Soil: Yellow brown coarse-grained sandy loam
Rock Type: N/A
Vegetation: *Banksia attenuata* and *B. menziesii* tall sparse shrubland over *Allocasuarina humilis* and *Xanthorrhoea preissii* mid sparse shrubland over *Eremaea pauciflora* var. *pauciflora*, *Hibbertia hypericoides* and *Melaleuca systema* low sparse shrubland over *Mesomelaena pseudostygia* low sparse sedgeland
Condition: Excellent - Pristine
Fire Age: >5 years
Notes: Leaf Litter (%): 8



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Acacia sessilis</i>		
<i>Allocasuarina humilis</i>	1	1.5
<i>Banksia attenuata</i>	7	5
<i>Banksia dallanneyi</i> var. <i>dallanneyi</i>		
<i>Banksia menziesii</i>	1	5
<i>Calothamnus sanguineus</i>		
<i>Calytrix flavescens</i>		
<i>Cryptandra scoparia</i>		
<i>Daviesia divaricata</i> subsp. <i>divaricata</i>		
<i>Drosera</i> ? <i>erythrorhiza</i>		
<i>Drosera pallida</i>		Creeper
<i>Eremaea pauciflora</i> var. <i>pauciflora</i>	8	0.4
<i>Hakea lissocarpha</i> (forma)		
<i>Hibbertia hypericoides</i>	2	0.3
<i>Isopogon linearis</i>		
<i>Jacksonia floribunda</i>		
<i>Lepidobolus preissianus</i>		
<i>Leptospermum spinescens</i>		
<i>Melaleuca systema</i>	2	0.4
<i>Mesomelaena pseudostygia</i>	21	0.3
<i>Nuytsia floribunda</i>		
<i>Petrophile macrostachya</i>		
<i>Scholtzia involucrata</i>		
<i>Stylidium cygnorum</i>		
<i>Xanthorrhoea preissii</i>	1	1.5

Site: COR12
Described: CvdB & LD **Date:** 10/07/2014 **Type:** Releve
MGA Zone: 50 403022mE; 6515040mN
Habitat: Mid to upper west facing slope
Soil: Dark brown coarse-grained sandy loam, rocky
Rock Type: Laterite
Vegetation: *Eucalyptus marginata* and *Corymbia calophylla* mid sparse woodland over *Xanthorrhoea preissii* mid open shrubland over *Hibbertia hypericoides*, *Acacia celastrifolia* and *Hakea lissocarpha* low sparse shrubland
Condition: Very Good - Excellent
Fire Age: >5 years
Notes: Leaf Litter (%): 18
 Rock Size (cm): 1-15
 Exposed Rock (%): 1
 Rock Cover (%): 4



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Acacia applanata</i>		
<i>Acacia celastrifolia</i>	1	1
<i>Acacia preissiana</i>		
<i>Corymbia calophylla</i>	1	10
<i>Drosera pallida</i>		Creeper
<i>Eucalyptus marginata</i>	3	12
<i>Gompholobium marginatum</i>		
<i>Gonocarpus cordiger</i>		
<i>Grevillea pilulifera</i>		
<i>Hakea lissocarpha</i> (forma)	1	0.4
<i>Hakea stenocarpa</i>		
<i>Hibbertia hypericoides</i>	2	0.7
<i>Hibbertia racemosa</i>		
<i>Hypochaeris glabra</i>		
<i>Lomandra sericea</i>		
<i>Macrozamia riedlei</i>		
<i>Patersonia occidentalis</i> var. <i>occidentalis</i>		
<i>Petrophile striata</i>		
<i>Phyllanthus calycinus</i>		
<i>Synaphea spinulosa</i> subsp. <i>spinulosa</i>		
<i>Xanthorrhoea preissii</i>	12	2

Site: COR13
Described: CvdB & LD **Date:** 10/07/2014 **Type:** Releve
MGA Zone: 50 403244mE; 6514681mN
Habitat: Top of a rocky rise
Soil: Black brown coarse loamy sand
Rock Type: laterite
Vegetation: *Corymbia calophylla* and *Nuytsia floribunda* mid sparse woodland over *Banksia sessilis* var. *sessilis* tall sparse shrubland over *Xanthorrhoea preissii* mid open shrubland over *Calothamnus sanguineus* and *Hibbertia hypericoides* low open shrubland
Condition: Very Good - Excellent
Fire Age: >5 years
Notes: Leaf Litter (%): 21
 Rock Size (cm): 1-11
 Exposed Rock (%): 2
 Rock Cover (%): 3



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Acacia extensa</i>		
<i>Acacia preissiana</i>		
<i>Banksia dallanneyi</i> var. <i>dallanneyi</i>		
<i>Banksia sessilis</i> var. <i>sessilis</i>	3	4.5
<i>Boronia ramosa</i> subsp. <i>anethifolia</i>		
<i>Bossiaea eriocarpa</i>		
<i>Calothamnus sanguineus</i>	9	0.6
<i>Calytrix variabilis</i>		
<i>Cassytha pomiformis</i>		Creeper
<i>Corymbia calophylla</i>	3	11
<i>Desmodcladus flexuosus</i>		
<i>Drosera pallida</i>		Creeper
<i>Gompholobium marginatum</i>		
<i>Hakea lissocarpha</i> (forma)		
<i>Hakea ruscifolia</i>		
<i>Hibbertia hibbertioides</i>		
<i>Hibbertia hypericoides</i>	2	0.3
<i>Isopogon linearis</i>		
<i>Lepidosperma pubisquameum</i> (flat form)		
<i>Lomandra sericea</i>		
<i>Nuytsia floribunda</i>	1	8
<i>Patersonia occidentalis</i> var. <i>occidentalis</i>		
<i>Petrophile striata</i>		
<i>Phyllanthus calycinus</i>		
<i>Stirlingia latifolia</i>		
<i>Stylidium cygnorum</i>		
<i>Synaphea spinulosa</i> subsp. <i>spinulosa</i>		
<i>Xanthorrhoea preissii</i>	5	2

Site: COR14
Described: CvdB & LD **Date:** 9/07/2014 **Type:** Releve
MGA Zone: 50 402445mE; 6514595mN
Habitat: Depression on mid slope of a consolidated dune
Soil: Brown grey white coarse-grained sand
Rock Type: N/A
Vegetation: *Banksia attenuata* mid sparse woodland over *Kunzea glabrescens* and *Banksia menziesii* tall shrubland over *Macrozamia riedlei* and *Xanthorrhoea preissii* mid sparse shrubland over various sparse herbs
Condition: Very Good
Fire Age: >5 years
Notes: Leaf Litter (%):



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Acacia huegelii</i>		
<i>Banksia attenuata</i>	10	12
<i>Banksia menziesii</i>	1	3.5
<i>Conostephium preissii</i>		
<i>Desmocladius flexuosus</i>		
<i>Dianella revoluta</i>		
<i>Drosera ? erythrorhiza</i>		
<i>Eremaea pauciflora</i> var. <i>pauciflora</i>		
<i>Eucalyptus tottiana</i>	1	10
<i>Kunzea glabrescens</i>	25	4
<i>Macrozamia riedlei</i>	2	1.7
<i>Pterostylis sanguinea</i>		
<i>Xanthorrhoea preissii</i>	1	2

Site: COR15
Described: CvdB & LD **Date:** 9/07/2014 **Type:** Releve
MGA Zone: 50 402651mE; 6515634mN
Habitat: Mid slope of a consolidated dune facing west
Soil: Grey brown coarse sand
Rock Type: N/A
Vegetation: *Corymbia calophylla* and *Eucalyptus marginata* mid sparse woodland over *Banksia attenuata* and *B. menziesii* tall sparse shrubland over *Xanthorrhoea preissii* and *Macrozamia riedlei* mid sparse shrubland over *Hibbertia hypericoides*, *Conostephium pendulum* and *Stirlingia latifolia* low open shrubland over *Mesomelaena pseudostygia* low sparse sedgeland
Condition: Very Good - Excellent
Fire Age: >5 years
Notes: Leaf Litter (%): 30



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Acacia pulchella</i> var. <i>pulchella</i>		
<i>Allocasuarina humilis</i>		
<i>Banksia attenuata</i>	3	7
<i>Banksia dallanneyi</i> var. <i>dallanneyi</i>		
<i>Banksia menziesii</i>	1	4
<i>Conostephium pendulum</i>		
<i>Corymbia calophylla</i>	7	15
<i>Desmocladius flexuosus</i>		
<i>Drosera pallida</i>		
<i>Eremaea pauciflora</i> var. <i>pauciflora</i>		
<i>Eucalyptus marginata</i>	2	15
<i>Hakea lissocarpha</i> (forma)		
<i>Hibbertia hypericoides</i>	4	0.5
<i>Hovea trisperma</i>		
<i>Hypochaeris glabra</i>		
<i>Isopogon linearis</i>		
<i>Lagenophora huegelii</i>		
<i>Lyginia imberbis</i>		
<i>Macrozamia riedlei</i>	1	1.9
<i>Mesomelaena pseudostygia</i>	1	0.4
<i>Phyllanthus calycinus</i>		
<i>Stirlingia latifolia</i>	1	1
<i>Synaphea spinulosa</i> subsp. <i>spinulosa</i>		
<i>Xanthorrhoea preissii</i>	3	2

Site: COR16
Described: CvdB & LD **Date:** 10/07/2014 **Type:** Releve
MGA Zone: 50 403124mE; 6516352mN
Habitat: Upper consolidated dune
Soil: Yellow brown coarse-grained sand
Rock Type: N/A
Vegetation: *Eucalyptus todtiana* mid isolated mallee trees over *Banksia attenuata* and *Nuytsia floribunda* tall sparse woodland over *Xanthorrhoea preissii* tall sparse shrubland over *Allocasuarina humilis* mid open shrubland over *Hibbertia hypericoides*, *H. racemosa* and *Calothamnus sanguineus* low sparse shrubland over *Mesomelaena pseudostygia* low isolated sedges and *Lyginia imberbis* low isolated rushes
Condition: Excellent
Fire Age: >5 years
Notes: Leaf Litter (%): 10



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Acacia extensa</i>		
<i>Acacia sessilis</i>		
<i>Allocasuarina humilis</i>	20	1.9
<i>Banksia attenuata</i>	2	7
<i>Banksia dallanneyi</i> var. <i>dallanneyi</i>		
<i>Calothamnus sanguineus</i>	3	0.5
<i>Cassytha pomiformis</i>		
<i>Conostylis teretifolia</i> subsp. <i>teretifolia</i>		
<i>Drosera</i> ? <i>erythrorhiza</i>		
<i>Drosera pallida</i>		
<i>Eucalyptus todtiana</i>	1	7
<i>Hakea lissocarpha</i> (forma)		
<i>Hibbertia hypericoides</i>	5	0.4
<i>Hibbertia racemosa</i>	2	0.3
<i>Hibbertia subvaginata</i>		
<i>Isopogon linearis</i>		
<i>Isopogon linearis</i>		
<i>Lomandra sericea</i>		
<i>Lyginia imberbis</i>		
<i>Mesomelaena pseudostygia</i>	2	0.3
<i>Nuytsia floribunda</i>		5
<i>Petrophile macrostachya</i>		
<i>Stylidium cygnorum</i>		
<i>Synaphea spinulosa</i> subsp. <i>spinulosa</i>		
<i>Xanthorrhoea preissii</i>	1	2.6

Site: COR17
Described: CvdB & LD **Date:** 10/07/2014 **Type:** Releve
MGA Zone: 50 402519mE; 6516931mN
Habitat: Consolidated dune, upper to mid gently sloping Northwest facing slope
Soil: Brown white coarse-grained sand
Rock Type: N/A
Vegetation: *Corymbia calophylla* mid sparse woodland over *Xanthorrhoea preissii* and *Daviesia divaricata* subsp. *divaricata* tall sparse shrubland over *Hakea trifurcata* mid sparse shrubland over *Conostephium preissii* low sparse shrubland
Condition: Very Good
Fire Age: >5 years
Notes: Leaf Litter (%): 10



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Acacia celastrifolia</i>		
<i>Anigozanthos humilis</i>		
<i>Babingtonia camphorosmae</i>		
<i>Banksia dallanneyi</i>		
<i>Beaufortia elegans</i>		
<i>Bossiaea eriocarpa</i>		
<i>Calothamnus sanguineus</i>		
<i>Calytrix sylvana</i>		
<i>Cheilanthes austrotenuifolia</i>		
<i>Conostephium preissii</i>	1	0.9
<i>Corymbia calophylla</i>	7	12
<i>Daviesia divaricata</i> subsp. <i>divaricata</i>	1	5
<i>Daviesia physodes</i>		
<i>Hakea lissocarpha</i> (forma)	1	1.4
<i>Hakea trifurcata</i>	1	2
<i>Hypochaeris glabra</i>		
<i>Isopogon linearis</i>		
<i>Lechenaultia biloba</i>		
<i>Melaleuca systema</i>		
<i>Persoonia saccata</i>		
<i>Pimelea</i> sp. 1		
<i>Scholtzia involucrata</i>		
<i>Xanthorrhoea preissii</i>	7	3

Site: COR18
Described: CvdB & LD **Date:** 10/07/2014 **Type:** Releve
MGA Zone: 50 403130mE; 6517291mN
Habitat: Consolidated dune, lower north facing slope
Soil: Grey brown coarse-grained sand
Rock Type: N/A
Vegetation: *Banksia attenuata*, *B. menziesii* and *Nuytsia floribunda* mid woodland over *Xanthorrhoea preissii* and *Allocasuarina humilis* mid sparse shrubland over *Hibbertia subvaginata*, *Phlebocarya ciliata*, *Eremaea pauciflora* var. *pauciflora* and *Leucopogon conostephioides* low sparse shrubland
Condition: Excellent
Fire Age: >5 years
Notes: Leaf Litter (%): 24



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Acacia huegelii</i>		
<i>Allocasuarina humilis</i>		
<i>Banksia attenuata</i>	8	10
<i>Banksia menziesii</i>	4	8
<i>Bossiaea eriocarpa</i>		
<i>Calytrix sylvana</i>		
<i>Daviesia triflora</i>		
<i>Eremaea pauciflora</i> var. <i>pauciflora</i>		
<i>Hibbertia subvaginata</i>	1	0.3
<i>Isopogon linearis</i>		
<i>Lepidosperma pubisquameum</i> (flat form)		
<i>Leucopogon conostephioides</i>	12	0.3
<i>Lyginia imberbis</i>		
<i>Melaleuca systema</i>		
<i>Nuytsia floribunda</i>	1	12
<i>Phlebocarya ciliata</i>	1	0.4
<i>Stirlingia latifolia</i>		
<i>Synaphea spinulosa</i> subsp. <i>spinulosa</i>		
<i>Xanthorrhoea preissii</i>	2	1.5

Site: COR19
Described: CvdB & LD **Date:** 10/07/2014 **Type:** Releve
MGA Zone: 50 403985mE; 6516766mN
Habitat: Mid slope of a consolidated dune
Soil: Grey brown coarse-grained sandy loam
Rock Type: N/A
Vegetation: *Banksia attenuata* and *B. menziesii* low sparse woodland over *Adenanthos cygnorum* subsp. *cygnorum* tall open shrubland over *Xanthorrhoea preissii* and *Beaufortia elegans* mid sparse shrubland over *Hibbertia hypericoides*, *Scholtzia involucrata* and *Calothamnus sanguineus* low sparse shrubland over *Mesomelaena pseudostygia* low sparse sedgeland
Condition: Excellent
Fire Age: >5 years
Notes: Leaf Litter (%): 15



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Adenanthos cygnorum</i> subsp. <i>cygnorum</i>	14	3.5
<i>Allocasuarina humilis</i>		
<i>Banksia attenuata</i>	2	6
<i>Banksia menziesii</i>	1	5.5
<i>Beaufortia elegans</i>	1.5	1.3
<i>Calothamnus sanguineus</i>	1	0.8
<i>Calytrix flavescens</i>		
<i>Calytrix sylvana</i>		
<i>Calytrix variabilis</i>		
<i>Conospermum crassinervium</i>		
<i>Conospermum stoechadis</i>		
<i>Daviesia triflora</i>		0.6
<i>Drosera ? erythrorhiza</i>		
<i>Drosera pallida</i>		
<i>Hibbertia hypericoides</i>	3	
<i>Hibbertia racemosa</i>		
<i>Hibbertia racemosa</i>		
<i>Hibbertia subvaginata</i>		
<i>Hypocalymma xanthopetalum</i>		
<i>Hypolaena robusta</i>		
<i>Isopogon linearis</i>	1	0.4
<i>Jacksonia floribunda</i>		3.2
<i>Lyginia imberbis</i>	1	0.4
<i>Mesomelaena pseudostygia</i>	1	0.4
<i>Scholtzia involucrata</i>	2	0.6
<i>Stirlingia latifolia</i>	1	0.7
<i>Stylidium cygnorum</i>		
<i>Synaphea spinulosa</i> subsp. <i>spinulosa</i>		0.4
<i>Xanthorrhoea preissii</i>		6

Site: COR20
Described: CvdB & LD **Date:** 10/07/2014 **Type:** Relevé
MGA Zone: 50 404709mE; 6516428mN
Habitat: Consolidated dune, upper slope
Soil: Yellow brown coarse-grained sand
Rock Type: N/A
Vegetation: *Corymbia calophylla* mid Isolated trees over *Banksia attenuata* tall sparse shrubland over *Allocasuarina humilis* and *Xanthorrhoea preissii* mid sparse shrubland over *Eremaea pauciflora* var. *pauciflora*, *Calothamnus sanguineus* and *Stirlingia latifolia* low open shrubland over *Mesomelaena pseudostygia* low sparse sedgeland
Condition: Excellent
Fire Age: >5 years
Notes: Leaf Litter (%): 5



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Acacia sessilis</i>		
<i>Allocasuarina humilis</i>	2	1.8
<i>Banksia attenuata</i>	1	4
<i>Banksia dallanneyi</i> var. <i>dallanneyi</i>		
<i>Banksia menziesii</i>	1	4.5
<i>Calothamnus sanguineus</i>	2	0.5
<i>Calytrix sylvana</i>		
<i>Conostephium pendulum</i>		
<i>Conostylis teretifolia</i> subsp. <i>teretifolia</i>		
<i>Corymbia calophylla</i>	1	14
<i>Daviesia physodes</i>		
<i>Drosera</i> ? <i>erythrorhiza</i>		
<i>Eremaea pauciflora</i> var. <i>pauciflora</i>	9	0.6
<i>Gladiolus caryophyllaceus</i>		
<i>Hakea ruscifolia</i>		
<i>Hibbertia hypericoides</i>		
<i>Hibbertia racemosa</i>		
<i>Hypocalymma xanthopetalum</i>		
<i>Leptospermum spinescens</i>		
<i>Lomandra purpurea</i>		
<i>Lomandra sericea</i>		
<i>Mesomelaena pseudostygia</i>	3	0.3
<i>Nuytsia floribunda</i>		
<i>Patersonia occidentalis</i> var. <i>occidentalis</i>		
<i>Stirlingia latifolia</i>	1	0.7
<i>Xanthorrhoea preissii</i>	1	2

Site: COR21
Described: CvdB & LD **Date:** 9/07/2014 **Type:** Releve
MGA Zone: 50 404111mE; 6515797mN
Habitat: Low consolidated dune
Soil: Grey white coarse sand
Rock Type: N/A
Vegetation: *Eucalyptus marginata* mid sparse woodland over *Xanthorrhoea preissii* mid sparse shrubland over *Hibbertia hypericoides*, *Calothamnus sanguineus* and *Conostephium pendulum* low sparse heath shrubland over *Lepidosperma pubisquameum* (flat form), *Lepidosperma squamatum* and *Mesomelaena pseudostygia* low sparse sedgeland
Condition: Excellent
Fire Age: >5 years
Notes: Leaf Litter (%): 20



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Acacia applanata</i>		
<i>Banksia dallanneyi</i> var. <i>dallanneyi</i>		
<i>Bossiaea eriocarpa</i>		
<i>Burchardia congesta</i>		
<i>Calothamnus sanguineus</i>	1	0.5
<i>Calytrix sylvana</i>		
<i>Calytrix variabilis</i>		
<i>Cassytha pomiformis</i>		
<i>Conostephium pendulum</i>	1	0.4
<i>Conostylis teretifolia</i> subsp. <i>teretifolia</i>		
<i>Drosera</i> ? <i>erythrorhiza</i>		
<i>Eucalyptus marginata</i>	8	12
<i>Gompholobium marginatum</i>		
<i>Haemadorum</i> sp.		
<i>Hibbertia hypericoides</i>	8	0.3
<i>Hibbertia racemosa</i>		
<i>Isopogon linearis</i>		
<i>Lagenophora huegelii</i>		
<i>Lepidosperma pubisquameum</i> (flat form)	1	0.2
<i>Lepidosperma squamatum</i>	+	
<i>Leucopogon gracillimus</i>		
<i>Lomandra hermaphrodita</i>		
<i>Lomandra sericea</i>		
<i>Macrozamia riedlei</i>		
<i>Mesomelaena pseudostygia</i>	1	0.3
<i>Nuytsia floribunda</i>		
<i>Patersonia occidentalis</i> var. <i>occidentalis</i>		
<i>Stirlingia latifolia</i>		
<i>Styphelia tenuiflora</i>		
<i>Synaphea spinulosa</i> subsp. <i>spinulosa</i>		
<i>Xanthorrhoea preissii</i>	3	2
<i>Xanthosia huegelii</i>		

Site: COR22
Described: CvdB & LD **Date:** 10/07/2014 **Type:** Releve
MGA Zone: 50 403666mE; 6516114mN
Habitat: Consolidated dune, very gently sloping north
Soil: Brown white coarse-grained sand
Rock Type: N/A
Vegetation: *Eucalyptus todtiana* mid isolated mallee trees over *Banksia attenuata*, *B. menziesii* and *Adenanthos cygnorum* subsp. *cygnorum* tall sparse shrubland over *Allocasuarina humilis* and *Xanthorrhoea preissii* mid open shrubland over *Hibbertia hypericoides*, *Calothamnus sanguineus* and *Conostephium pendulum* low open shrubland
Condition: Excellent
Fire Age: >5 years
Notes: Leaf Litter (%): 8



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Adenanthos cygnorum</i> subsp. <i>cygnorum</i>	+	4
<i>Allocasuarina humilis</i>	2	1.6
<i>Banksia attenuata</i>	3	5
<i>Banksia dallanneyi</i> var. <i>dallanneyi</i>		
<i>Banksia menziesii</i>	1	4.5
<i>Calothamnus sanguineus</i>	3	1
<i>Calytrix flavescens</i>		
<i>Calytrix variabilis</i>		
<i>Cassytha pomiformis</i>		
<i>Conostephium pendulum</i>	+	0.4
<i>Conostylis teretifolia</i> subsp. <i>teretifolia</i>		
<i>Daviesia nudiflora</i> subsp. <i>nudiflora</i>		
<i>Daviesia physodes</i>		
<i>Drosera</i> ? <i>erythrorhiza</i>		
<i>Drosera pallida</i>		
<i>Eucalyptus todtiana</i>	1	8
<i>Gladiolus caryophyllaceus</i>		
<i>Hibbertia hypericoides</i>	10	0.4
<i>Hibbertia racemosa</i>		
<i>Hibbertia subvaginata</i>		
<i>Isopogon linearis</i>		
<i>Jacksonia floribunda</i>		
<i>Leucopogon conostephioides</i>		
<i>Lyginia imberbis</i>		
<i>Melaleuca systema</i>		
<i>Mesomelaena pseudostygia</i>		0.3
<i>Nuytsia floribunda</i>		
<i>Patersonia occidentalis</i> var. <i>occidentalis</i>		
<i>Scholtzia involucrata</i>		
<i>Stirlingia latifolia</i>	1	0.6
<i>Synaphea spinulosa</i> subsp. <i>spinulosa</i>		
<i>Xanthorrhoea preissii</i>	2	1.5

Site: COR23
Described: CvdB & LD **Date:** 10/07/2014 **Type:** Releve
MGA Zone: 50 403043mE; 6515985mN
Habitat: Upper consolidated dune
Soil: Yellow brown coarse-grained sand
Rock Type: N/A
Vegetation: *Eucalyptus todtiana* mid isolated mallee trees over *Nuytsia floribunda* low isolated trees over *Banksia attenuata* and *B. menziesii* tall sparse shrubland over *Allocasuarina humilis* and *Xanthorrhoea preissii* mid open shrubland over *Hibbertia hypericoides* and *Calothamnus sanguineus* low open shrubland over *Mesomelaena pseudostygia* low sparse sedgeland
Condition: Excellent
Fire Age: >5 years
Notes: Leaf Litter (%):



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Acacia pulchella</i> var. <i>pulchella</i>		
<i>Acacia sessilis</i>		
<i>Allocasuarina humilis</i>	10	1.7
<i>Banksia attenuata</i>	3	7
<i>Banksia dallanneyi</i> var. <i>dallanneyi</i>		
<i>Banksia menziesii</i>		5
<i>Calothamnus sanguineus</i>		
<i>Calytrix variabilis</i>		
<i>Cassytha pomiformis</i>		
<i>Conostephium pendulum</i>		
<i>Daviesia nudiflora</i> subsp. <i>nudiflora</i>		
<i>Drosera</i> ? <i>erythrorhiza</i>		
<i>Drosera pallida</i>		
<i>Eucalyptus todtiana</i>	1	8
<i>Gladiolus caryophyllaceus</i>		
<i>Gompholobium marginatum</i>		
<i>Grevillea pilulifera</i>		
<i>Hakea lissocarpha</i> (forma)		
<i>Hakea ruscifolia</i>		
<i>Hibbertia hypericoides</i>	3	0.3
<i>Hibbertia racemosa</i>		
<i>Isopogon linearis</i>		
<i>Jacksonia floribunda</i>		
<i>Lomandra sericea</i>		
<i>Lyginia imberbis</i>		
<i>Lysinema pentapetalum</i>		
<i>Mesomelaena pseudostygia</i>	2	0.3
<i>Nuytsia floribunda</i>		6
<i>Petrophile macrostachya</i>		
<i>Pimelea imbricata</i> var. <i>piligera</i>		
<i>Xanthorrhoea preissii</i>	2	1.9

Site: COR24
Described: CvdB & LD **Date:** 17/07/2014 **Type:** Releve
MGA Zone: 50 402604mE; 6516405mN
Habitat: Consolidated dune
Soil: Black/grey coarse grained sand
Rock Type: N/A
Vegetation: *Eucalyptus todtiana* mid isolated mallee trees over *Banksia attenuata*, *B. menziesii* and *Adenanthos cygnorum* subsp. *cygnorum* tall open shrubland over *Beaufortia elegans* and *Jacksonia floribunda* mid sparse shrubland over *Scholtzia involucrata*, *Leucopogon conostephioides* and *Eremaea pauciflora* var. *pauciflora* low open shrubland over *Mesomelaena pseudostygia* low isolated sedges over *Lyginia imberbis* low isolated rushes
Condition: Excellent
Fire Age: >5 years
Notes: None



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Acacia pulchella</i> var. <i>glaberrima</i>		0.50
<i>Adenanthos cygnorum</i> subsp. <i>cygnorum</i>	1	4
<i>Alexgeorgea nitens</i>		0.10
<i>Astroloma xerophyllum</i>		0.60
<i>Banksia attenuata</i>	8	5
<i>Banksia menziesii</i>	2	5
<i>Beaufortia elegans</i>	1	1.7
<i>Boronia ramosa</i> subsp. <i>ramosa</i>		0.40
<i>Calytrix flavescens</i>		.20
<i>Calytrix variabilis</i>		0.40
<i>Cassytha pomiformis</i>		Creeper
<i>Conospermum crassinervium</i>		1
<i>Eremaea pauciflora</i> var. <i>pauciflora</i>	1	0.80
<i>Eucalyptus todtiana</i>	1	6
<i>Gompholobium tomentosum</i>		0.20
<i>Hibbertia hypericoides</i>		0.30
<i>Hibbertia racemosa</i>		
<i>Hibbertia subvaginata</i>		0.20
<i>Isopogon linearis</i>		0.40
<i>Jacksonia floribunda</i>	+	2
<i>Leucopogon conostephioides</i>	2	0.50
<i>Lyginia imberbis</i>	1	0.50
<i>Mesomelaena pseudostygia</i>	+	0.30
<i>Nuytsia floribunda</i>		0.50
<i>Scholtzia involucrata</i>	7	0.50
<i>Stirlingia latifolia</i>		1.4
<i>Stylidium cygnorum</i>		0.10
<i>Xanthorrhoea preissii</i>		1.3

Site: COR25
Described: CvdB & LD **Date:** 17/07/2014 **Type:** Releve
MGA Zone: 50 405045mE; 6517238mN
Habitat: Consolidated dune. Upper crest
Soil: Grey/white coarse grain sand
Rock Type: N/A
Vegetation: *Eucalyptus marginata* mid woodland over *Banksia attenuata* and *B. menziesii* tall sparse shrubland over *Eremaea pauciflora* var. *pauciflora*, *Hibbertia hypericoides* and *Daviesia triflora* low open shrubland over *Mesomelaena pseudostygia* low isolated sedges over *Lyginia imberbis* low isolated rushes
Condition: Excellent
Fire Age: > 5 years
Notes: None



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Astroloma xerophyllum</i>		0.60
<i>Banksia attenuata</i>	5	4
<i>Banksia dallanneyi</i> var. <i>dallanneyi</i>		0.10
<i>Banksia menziesii</i>	2	3.5
<i>Burchardia congesta</i>		0.40
<i>Calytrix flavescens</i>		0.30
<i>Conostephium pendulum</i>		0.40
<i>Conostylis teretifolia</i> subsp. <i>teretifolia</i>		0.10
<i>Daviesia physodes</i>		0.50
<i>Daviesia triflora</i>	2	0.40
<i>Drosera</i> ? <i>erythrorhiza</i>		Prostrate
<i>Eremaea pauciflora</i> var. <i>pauciflora</i>	5	0.60
<i>Eucalyptus marginata</i>	3	12
<i>Hibbertia hypericoides</i>	5	0.50
<i>Hibbertia hypericoides</i>		0.20
<i>Hibbertia racemosa</i>		0.20
<i>Hypolaena exsulca</i>		0.30
<i>Isopogon linearis</i>		0.50
<i>Jacksonia floribunda</i>		1.8
<i>Lyginia imberbis</i>	1	0.40
<i>Melaleuca systema</i>		0.40
<i>Mesomelaena pseudostygia</i>	1	0.40
<i>Patersonia occidentalis</i> var. <i>occidentalis</i>		0.30
<i>Stirlingia latifolia</i>		0.40
<i>Synaphea spinulosa</i> subsp. <i>spinulosa</i>		0.20
<i>Xanthorrhoea preissii</i>		1.5

Site: COR26
Described: CvdB & LD **Date:** 17/07/2014 **Type:** Releve
MGA Zone: 50 405772mE; 6517198mN
Habitat: Swale-consolidated dune. Low slope gently towards the south
Soil: Yellow/brown coarse grain sand
Rock Type: N/A

Vegetation: *Banksia attenuata*, *B. menziesii* and *Nuytsia floribunda* tall sparse shrubland over *Xanthorrhoea preissii* mid sparse shrubland over *Allocasuarina humilis*, *Eremaea pauciflora* var. *pauciflora* and *Melaleuca systema* low open shrubland over *Mesomelaena pseudostygia* and *Schoenus efoliatus* low sparse sedgeland

Condition: Excellent

Fire Age: >5 years

Notes: Dead Banksia - Dieback?



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Alexgeorgea nitens</i>		0.10
<i>Allocasuarina humilis</i>	12	1
<i>Austrodanthonia</i> sp.		0.50
<i>Banksia attenuata</i>	1	3
<i>Banksia dallanneyi</i> var. <i>dallanneyi</i>		0.10
<i>Banksia menziesii</i>	+	3
<i>Bossiaea eriocarpa</i>		0.10
<i>Calectasia narragara</i>		0.20
<i>Caustis dioica</i>		0.30
<i>Conostephium pendulum</i>		0.30
<i>Daviesia physodes</i>		0.30
<i>Daviesia triflora</i>		0.40
<i>Eremaea pauciflora</i> var. <i>pauciflora</i>	10	0.60
<i>Gladiolus caryophyllaceus</i>		0.30
<i>Hibbertia hypericoides</i>		0.30
<i>Hovea trisperma</i> var. <i>trisperma</i>		0.20
<i>Isopogon linearis</i>		0.10
<i>Leptospermum spinescens</i>		0.40
<i>Lyginia imberbis</i>		0.30
<i>Melaleuca systema</i>	2	0.50
<i>Mesomelaena pseudostygia</i>	1	0.30
<i>Nuytsia floribunda</i>	+	4.5
<i>Patersonia occidentalis</i> var. <i>occidentalis</i>		0.30
<i>Pimelea imbricata</i> var. <i>piligera</i>		0.20
<i>Schoenus efoliatus</i>	2	0.40
<i>Synaphea spinulosa</i> subsp. <i>spinulosa</i>		0.20
<i>Xanthorrhoea preissii</i>	1	2

Site: COR27
Described: CvdB & LD **Date:** 17/07/2014 **Type:** Releve
MGA Zone: 50 406089mE; 6516591mN
Habitat: Consolidated dune, mid slope gently sloping to south-east
Soil: Black/grey coarse grain sand
Rock Type: N/A

Vegetation: *Allocasuarina humilis*, *Banksia attenuata* and *B. menziesii* tall sparse shrubland over *Allocasuarina humilis* and *Xanthorrhoea preissii* mid sparse shrubland over *Eremaea pauciflora* var. *pauciflora* and *Melaleuca systema* low open shrubland over *Mesomelaena pseudostygia* low sparse sedgeland

Condition: Excellent

Fire Age: > 5 years

Notes: Dieback?



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Allocasuarina humilis</i>	8	1.8
<i>Amphipogon turbinatus</i>		0.20
<i>Banksia attenuata</i>	1	4
<i>Banksia dallanneyi</i> var. <i>dallanneyi</i>		0.10
<i>Banksia menziesii</i>	1	4
<i>Bossiaea eriocarpa</i>		0.40
<i>Conospermum stoechadis</i>		0.50
<i>Conostephium pendulum</i>		0.40
<i>Daviesia physodes</i>		0.50
<i>Daviesia triflora</i>		0.40
<i>Eremaea pauciflora</i> var. <i>pauciflora</i>	15	0.70
<i>Hibbertia racemosa</i>		0.30
<i>Hovea trisperma</i> var. <i>trisperma</i>		0.30
<i>Isopogon linearis</i>		0.20
<i>Jacksonia floribunda</i>		1.3
<i>Lepidosperma</i> sp. Inland Scabrid (R. Barrett)		0.60
<i>Leucopogon gracillimus</i>		0.40
<i>Lomandra sericea</i>		0.30
<i>Lyginia imberbis</i>		0.30
<i>Melaleuca systema</i>	2	0.40
<i>Mesomelaena pseudostygia</i>	2	0.30
<i>Nuytsia floribunda</i>	+	7
<i>Patersonia occidentalis</i> var. <i>occidentalis</i>		0.40
<i>Petrophile macrostachya</i>		0.80
<i>Stirlingia latifolia</i>		0.60
<i>Xanthorrhoea preissii</i>	3	2

Site: COR28
Described: CvdB & LD **Date:** 17/07/2014 **Type:** Releve
MGA Zone: 50 405613mE; 6515861mN
Habitat: Consolidated dune, upper to mid gentle slope to south - east
Soil: Yellow / brown coarse –grained sand
Rock Type: NIL
Vegetation: *Corymbia calophylla* mid isolated trees over *Eucalyptus todtiana* mid isolated mallee trees over *Banksia attenuata*, *B. menziesii* and *Daviesia divaricata* subsp. *divaricata* tall sparse shrubland over *Eremaea pauciflora* var. *pauciflora*, *Calothamnus sanguineus* and *Hibbertia hypericoides* low sparse heath shrubland over *Mesomelaena pseudostygia* low sparse sedgeland
Condition: Excellent
Fire Age: > 5 years
Notes: none



SPECIES LIST

Name	Cover	Height
<i>Allocasuarina humilis</i>		1.2
<i>Banksia attenuata</i>	+	3
<i>Banksia dallanneyi</i> var. <i>dallanneyi</i>		0.20
<i>Banksia menziesii</i>	+	3
<i>Calothamnus sanguineus</i>	2	0.40
<i>Calytrix sylvana</i>		0.50
<i>Calytrix variabilis</i>		0.40
<i>Conospermum stoechadis</i>		0.50
<i>Conostephium pendulum</i>		0.50
<i>Conostylis teretifolia</i> subsp. <i>teretifolia</i>		0.10
<i>Corymbia calophylla</i>	+	11
<i>Daviesia divaricata</i> subsp. <i>divaricata</i>	+	3
<i>Daviesia physodes</i>		0.80
<i>Daviesia triflora</i>		0.30
<i>Drosera</i> ? <i>erythrorhiza</i>		Prostrate
<i>Eremaea pauciflora</i> var. <i>pauciflora</i>	15	0.60
<i>Eucalyptus todtiana</i>	1	7
<i>Grevillea pilulifera</i>		0.20
<i>Hakea ruscifolia</i>		2
<i>Hibbertia hypericoides</i>	2	0.40
<i>Hibbertia racemosa</i>		0.30
<i>Isopogon linearis</i>		0.40
<i>Jacksonia floribunda</i>		1.8
<i>Leucopogon racemosus</i>		0.40
<i>Lomandra purpurea</i>		0.30
<i>Lyginia imberbis</i>		0.40
<i>Lysinema pentapetalum</i>		0.40
<i>Melaleuca systema</i>		0.30
<i>Mesomelaena pseudostygia</i>	2	0.30
<i>Nuytsia floribunda</i>		4
<i>Patersonia occidentalis</i> var. <i>occidentalis</i>		0.30
<i>Stirlingia latifolia</i>		0.70
<i>Synaphea spinulosa</i> subsp. <i>spinulosa</i>		0.50
<i>Xanthorrhoea preissii</i>		2

Site: COR29
Described: CvdB & LD **Date:** 17/07/2014 **Type:** Releve
MGA Zone: 50 404188mE; 6516321mN
Habitat: Consolidated dune. Upper slope to south-east
Soil: Yellow/brown coarse-grained sand
Rock Type: N/A
Vegetation: *Eucalyptus todtiana* mid isolated mallee trees over *Banksia attenuata*, *B. menziesii* and *Nuytsia floribunda* tall sparse shrubland over *Allocasuarina humilis*, *Xanthorrhoea preissii* and *Jacksonia floribunda* mid open shrubland over *Eremaea pauciflora* var. *pauciflora*, *Hibbertia hypericoides* and *Melaleuca systema* low sparse shrubland over *Mesomelaena pseudostygia* low sparse sedgeland.
Condition: Excellent
Fire Age: > 5 years
Notes: None



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Allocasuarina humilis</i>	20	1.8
<i>Amphipogon turbinatus</i>		0.40
<i>Anigozanthos</i> sp.		0.10
<i>Banksia attenuata</i>	1	6
<i>Banksia dallanneyi</i> var. <i>dallanneyi</i>		0.20
<i>Banksia menziesii</i>	1	5
<i>Bossiaea eriocarpa</i>		0.20
<i>Calectasia narragara</i>		0.40
<i>Calytrix flavescens</i>		0.30
<i>Conospermum stoechadis</i>		0.60
<i>Conostephium pendulum</i>		0.40
<i>Daviesia nudiflora</i> subsp. <i>nudiflora</i>		0.60
<i>Daviesia physodes</i>		0.50
<i>Daviesia preissii</i>		0.60
<i>Drosera</i> ? <i>erythrorhiza</i>		Pro
<i>Eremaea pauciflora</i> var. <i>pauciflora</i>	4	0.60
<i>Eucalyptus todtiana</i>	+	7
<i>Hakea ruscifolia</i>		1.1
<i>Hibbertia hypericoides</i>	2	0.30
<i>Hibbertia racemosa</i>		0.20
<i>Isopogon linearis</i>		0.30
<i>Jacksonia floribunda</i>	+	2
<i>Lomandra sericea</i>		0.20
<i>Melaleuca systema</i>	1	0.40
<i>Mesomelaena pseudostygia</i>	2	0.30
<i>Nuytsia floribunda</i>	1	6
<i>Patersonia occidentalis</i> var. <i>occidentalis</i>		0.20
<i>Petrophile macrostachya</i>		0.60
<i>Stirlingia latifolia</i>		0.60
<i>Synaphea spinulosa</i> subsp. <i>spinulosa</i>		0.30
<i>Xanthorrhoea preissii</i>	1	1.8

Site: COR30
Described: CvdB & LD **Date:** 17/07/2014 **Type:** Releve
MGA Zone: 50 402497mE; 6517323mN
Habitat: Swale. Low swale, depression
Soil: Grey/brown coarse-grained organic sand
Rock Type: NIL
Vegetation: *Banksia attenuata* and *B. menziesii* low woodland over *Melaleuca preissiana* and *Adenanthos cygnorum* subsp. *cygnorum* tall sparse shrubland over *Calytrix angulata* and *Xanthorrhoea preissii* mid sparse shrubland over *Leucopogon conostephioides* and *Hibbertia subvaginata* low sparse shrubland
Condition: Excellent
Fire Age: > 5 years
Notes: None



SPECIES LIST

Name	Cover (%)	Height (m)
<i>Adenanthos cygnorum</i> subsp. <i>cygnorum</i>	2	5
<i>Allocasuarina humilis</i>		1.8
<i>Banksia attenuata</i>	20	9
<i>Banksia menziesii</i>	1	6
<i>Bossiaea eriocarpa</i>		0.30
<i>Calytrix angulata</i>		1.4
<i>Calytrix angulata</i>	5	1.6
<i>Conospermum crassinervium</i>		1.1
<i>Conostephium pendulum</i>		0.50
<i>Drosera ? erythrorhiza</i>		Pros
<i>Eremaea pauciflora</i> var. <i>pauciflora</i>		1.3
<i>Gladiolus caryophyllaceus</i>		0.30
<i>Hibbertia subvaginata</i>	+	0.30
<i>Isopogon linearis</i>		0.40
<i>Leucopogon conostephioides</i>	1	0.40
<i>Lyginia imberbis</i>		0.30
<i>Macrozamia riedlei</i>		1.4
<i>Melaleuca preissiana</i>	1	6
<i>Nuytsia floribunda</i>		0.50
<i>Phlebocarya ciliata</i>		0.30
<i>Phlebocarya ciliata</i>		0.50
<i>Scholtzia involucreta</i>		0.10
<i>Stylidium cygnorum</i>		0.10
<i>Xanthorrhoea preissii</i>	1	1.5



APPENDIX G

Vascular Plant Taxa Recorded



VASCULAR PLANT TAXA RECORDED

29 PTERIDACEAE

Cheilanthes austrotenuifolia

42 ZAMIACEAE

Macrozamia riedlei

80 LAURACEAE

Cassytha pomiformis

82 ARACEAE

* *Zantedeschia aethiopica* (Declared Pest)

109 COLCHICACEAE

Burchardia congesta

115 ORCHIDACEAE

Leporella fimbriata

Orchidaceae sp.

Pterostylis sanguinea

Pterostylis vittata

124 IRIDACEAE

* *Gladiolus caryophyllaceus*

Patersonia occidentalis var. *occidentalis*

126 XANTHORRHOEACEAE

Xanthorrhoea preissii

128 ASPARAGACEAE

Laxmannia sessiliflora

Lomandra hermaphrodita

Lomandra preissii

Lomandra purpurea

Lomandra sericea


130 HEMEROCALLIDACEAE

Dianella revoluta

138 HAEMODORACEAE

Anigozanthos humilis

Anigozanthos sp.



Conostylis aculeata subsp. *cygnorum*
Conostylis aurea
Conostylis teretifolia subsp. *teretifolia*
Haemodorum sp.
Phlebocarya ciliata

147 DASYPOGONACEAE

Calectasia narragara

156 CYPERACEAE

Caustis dioica
Lepidosperma pubisquameum (flat form)
Lepidosperma sp. Inland Scabrid (R. Barrett)
Lepidosperma sp. Northern Sandplains (R. Barrett)
Lepidosperma squamatum
Mesomelaena pseudostygia
Mesomelaena tetragona
Schoenus efoliatus

157 ANARTHRIACEAE

Lyginia imberbis

159 RESTIONACEAE


Alexgeorgea nitens
Desmocladius flexuosus
Hypolaena exsulca
Hypolaena robusta (Priority 4)
Lepidobolus preissianus

163 POACEAE

Amphipogon turbinatus
Austrodanthonia sp.
* *Briza maxima*

175 PROTEACEAE

Adenanthos cygnorum
Adenanthos cygnorum subsp. *cygnorum*
Banksia attenuata
Banksia bipinnatifida subsp. *multifida*
Banksia dallanneyi
Banksia dallanneyi var. *dallanneyi*
Banksia grandis
Banksia menziesii
Banksia sessilis var. *sessilis*
Conospermum crassinervium
Conospermum stoechadis
Grevillea pilulifera



Grevillea synapheae subsp. *synapheae*
Hakea amplexicaulis
Hakea costata
Hakea lissocarpha (forma)
Hakea prostrata
Hakea ruscifolia
Hakea stenocarpa
Hakea trifurcata
Isopogon linearis
Persoonia saccata
Petrophile divaricata
Petrophile macrostachya
Petrophile serruriae
Petrophile striata
Stirlingia latifolia
Synaphea spinulosa subsp. *spinulosa*

181 DILLENIACEAE


Hibbertia hibernioides
Hibbertia hypericoides
Hibbertia racemosa
Hibbertia subvaginata

196 HALORAGACEAE

Gonocarpus cordiger

201 FABACEAE

Acacia applanata
Acacia celastriifolia
Acacia drummondii subsp. *drummondii*
Acacia extensa
Acacia huegelii
Acacia nervosa
Acacia preissiana
Acacia pulchella var. *glaberrima*
Acacia pulchella var. *pulchella*
Acacia sessilis
Bossiaea eriocarpa
Daviesia divaricata subsp. *divaricata*
Daviesia incrassata subsp. *incrassata*
Daviesia nudiflora subsp. *nudiflora*
Daviesia physodes
Daviesia preissii
Daviesia triflora
Gompholobium marginatum
Gompholobium tomentosum
Hovea trisperma



Hovea trisperma var. *trisperma*

Jacksonia floribunda

Jacksonia sternbergiana

Kennedia prostrata

* *Lupinus* sp.

208 **RHAMNACEAE**

Cryptandra scoparia

217 **CASUARINACEAE**

Allocasuarina humilis

247 **PHYLLANTHACEAE**

Phyllanthus calycinus

261 **VIOLACEAE**

Hybanthus calycinus

281 **MYRTACEAE**

Babingtonia camphorosmae

Beaufortia elegans

Calothamnus sanguineus

Calytrix angulata

Calytrix flavescens

Calytrix sylvana

Calytrix variabilis

Chamelaucium sp. Gingin (N.G. Marchant 6) (**Threatened**)

Corymbia calophylla

Eremaea pauciflora var. *pauciflora*

Eucalyptus marginata

Eucalyptus todtiana

Hypocalymma xanthopetalum

Kunzea glabrescens

Leptospermum spinescens

Melaleuca preissiana

Melaleuca systema

Scholtzia involucrata

Verticordia nitens

300 **RUTACEAE**


Boronia ramosa subsp. *anethifolia*

Boronia ramosa subsp. *ramosa*

311 **THYMELAEACEAE**

Pimelea imbricata var. *piligera*

Pimelea sp. 1



Pimelea sp.2

332 BRASSICACEAE

* *Brassica tournefortii*

338 SANTALACEAE

Leptomeria cunninghamii

339 LORANTHACEAE

Amyema miquelii

Nuytsia floribunda

346 DROSERACEAE

Drosera ? erythrorhiza

Drosera pallida

403 ERICACEAE

Andersonia lehmanniana subsp. *lehmanniana*

Astroloma pallidum

Astroloma stomarrhena

Astroloma xerophyllum

Conostephium pendulum

Conostephium preissii

Leucopogon conostephioides

Leucopogon gracillimus

Leucopogon racemulosus

Lysinema ciliatum

Lysinema pentapetalum

Styphelia tenuiflora

452 STYLIDIACEAE

Stylidium cygnorum

Stylidium sp.

458 GOODENIACEAE

Lechenaultia biloba

460 ASTERACEAE

* *Hypochaeris glabra*

Lagenophora huegelii

Olearia lehmanniana

474 APIACEAE

Xanthosia huegelii






APPENDIX H

Fauna Habitat Assessment Data

Appendix H
Habitat Assessments

Site		HA1	HA2	HA3	HA4	HA5	HA6
Coordinates	Eastings	406165	405432	405160	405741	404966	405619
	Northings	6515785	6515940	6516520	6516293	6517284	6517059
Describer		JT	JT	JT	JT	JT	JT
Date		08-Jul-14	08-Jul-14	08-Jul-14	08-Jul-14	08-Jul-14	08-Jul-14
Seasonal Conditions		Raining weather conditions	Raining weather conditions	Raining weather conditions	Raining weather conditions	Raining weather conditions	Raining weather conditions
Habitat	Type	Eucalypt Woodland	Eucalypt Woodland	Eucalypt Woodland	Eucalypt Woodland	Eucalypt Woodland	Eucalypt Woodland
	Quality	High habitat quality	High habitat quality	High habitat quality	High habitat quality	High habitat quality	High habitat quality
Tree Denisty		27 p/ha - Jarrah - DBH 500-100mm - Height 6-9 m	30 p/ha - Jarrah - DBH 600-1200mm - Height 6-9m	35 p/ha - Jarrah- DBH 600-1000mm - Height 7-9m	16 p/ha - Jarrah - DBH 500-1000mm - Height 7-10m	12 p/ha - Jarrah - DBH 500-900mm - Height 6-8m	15 p/ha - Jarrah - DBH 500-900mm - Height 6-9m
Litter Cover		> 50%	> 50%	> 50%	> 50%	> 50%	> 50%
Fire Age (years)		> 5	> 5	> 5	> 5	> 5	> 5
Disturbance Levels		low	low	low	low	low	low
Photo Number							


Site		HA7	HA8	HA9	HA10	HA11	HA12
Coordinates	Eastings	406105	404333	404335	404275	404658	404000
	Northings	6517107	6517198	6517202	6516847	6515703	6515715
Describer		JT	JT	JT	JT	JT	JT
Date		08-Jul-14	09-Jul-14	09-Jul-14	09-Jul-14	09-Jul-14	09-Jul-14
Seasonal Conditions		Raining weather conditions	Fine weather conditions	Fine weather conditions	Fine weather conditions	Fine weather conditions	Fine weather conditions
Habitat	Type	Eucalypt Woodland	Eucalypt Woodland	Eucalypt Woodland	Eucalypt Woodland	Eucalypt Woodland	Eucalypt Woodland
	Quality	High habitat quality	High habitat quality	High habitat quality	High habitat quality	High habitat quality	High habitat quality
Tree Denisty		26 p/ha - Jarrah - DBH 500-1000mm - Height 6-9m	13 p/ha - Jarrah - DBH 600-1000mm - Height 7-10m	21 p/ha - Jarrah - DBH 500-900mm - Height 6-9m	22 p/ha - Jarrah /Marri - DBH 600-1400 - Height 7-12m	23 p/ha - Jarrha/Marri - DBH 600-1000mm - Height 7-9m	8 p/ha - Jarrah - DBH 500-900mm - Height 6-8m
Litter Cover		> 50%	> 50%	> 50%	> 50%	> 50%	> 50%
Fire Age (years)		> 5	> 5	> 5	> 5	> 5	> 5
Disturbance Levels		low	low	low	low	low	low
Photo Number							

Appendix H
Habitat Assessment

Site		HA13	HA14	HA15	HA16	HA17	HA18
Coordinates	Eastings	402784	402353	402517	403251	404433	403595
	Northings	651715	6516674	6516918	6517153	6515552	6515122
Describer		JT	JT	JT	JT	JT	JT
Date		09-Jul-14	09-Jul-14	09-Jul-14	09-Jul-14	10-Jul-14	10-Jul-14
Seasonal Conditions		Fine weather conditions	Fine weather conditions	Fine weather conditions	Fine weather conditions	Fine weather conditions	Fine weather conditions
Habitat	Type	Eucalypt Woodland	Eucalypt Woodland	Eucalypt Woodland	Eucalypt Woodland	Eucalypt Woodland	Eucalypt Woodland
	Quality	High habitat quality	High habitat quality	High habitat quality	High habitat quality	High habitat quality	High habitat quality
Tree Denisty		22 p/ha - Jarrah/Marri - DBH 600-1000mm - Height 7-10m	11 p/ha - Marri/Jarrah - DBH 500-900mm - Height 7-9m	18 p/ha - Marri - DBH 500-1000mm - Height 7-10m	16 p/ha - Jarrah/Marri - DBH 500-900mm - Height 6-8m	20p/ha - Jarrah - DBH 500-900mm - Height 6-8m	11 p/ha - Jarrah/Marri - DBH 500-1000mm - Height 7-10m
Litter Cover		> 50%	> 50%	> 50%	> 50%	> 50%	> 50%
Fire Age (years)		> 5	> 5	> 5	> 5	> 5	> 5
Disturbance Levels		low	low	low	low	low	low
Photo Number							

Site		HA19	HA20	HA21	HA22	HA23	Dampland
Coordinates	Eastings	403088	403088	402649	402913	404778	402280
	Northings	6515273	6515275	6414895	6514657	6514842	6514574
Describer		JT	JT	JT	JT	JT	JT
Date		09-Jul-14	10-Jul-14	10-Jul-14	10-Jul-14	10-Jul-14	10-Jul-14
Seasonal Conditions		Fine weather conditions	Fine weather conditions	Fine weather conditions	Fine weather conditions	Fine weather conditions	Fine weather conditions
Habitat	Type	Eucalypt Woodland	Eucalypt Woodland	Eucalypt Woodland	Eucalypt Woodland	Eucalypt Woodland	Damlands
	Quality	High habitat quality	High habitat quality	High habitat quality	High habitat quality	High habitat quality	Moderate quality
Tree Denisty		23 p/ha - Jarrah/Marri - DBH 600-1000mm - 8-10m	24 p/ha - Jarrah/Marri - DBH 500-1000mm - Height 7-9m	21p/ha - Jarrah/Marri - DBH 600-1100mm - Height 8-11m	10 p/ha - Marri - DBH 500-1000mm - 7-9m	16 p/ha - Jarrah - DBH 600-1000mm - Height 7-10m	N/A
Litter Cover		> 50%	> 50%	> 50%	> 50%	> 50%	> 50%
Fire Age (years)		> 5	> 5	> 5	> 5	> 5	> 5
Disturbance Levels		low	low	low	low	low	low
Photo Number							

Appendix H
Habitat Assessment

Site		BW1	BW2
Coordinates	Eastings	403327	402989
	Northings	6516329	6515567
Describer		JT	JT
Date		10-Jul-14	10-Jul-14
Seasonal Conditions		Fine weather conditions	Fine weather conditions
Habitat	Type	Banksia Woodland	Banksia Woodland
	Quality	Moderate habitat	Moderate habitat
Tree Denisty		N/A	N/A
Litter Cover		> 50%	> 50%
Fire Age (years)		> 5	> 5
Disturbance Levels		low	low
Photo Number			



APPENDIX I

Black Cockatoo Breeding Trees



APPENDIX J

Vertebrate Fauna Predicted to Occur within the Study Area

Appendix J
Previously recorded fauna

SPECIES	VERNACULAR	Conservation Status	EPBC Search	DPAW Search	NatureMap	Birddata	Tingay, 1994	Burbridge et al, 1996	ATA, 2007	GHD, 2014	Current Survey
Amphibians											
<i>Litoria adelaidensis</i>	Slender Tree Frog				X						
<i>Litoria moorei</i>	Motorbike Frog				X						
<i>Heleioporus eyrei</i>	Moaning Frog				X		X	X	X		
<i>Heleioporus psammophilus</i>	Sand Frog				X						
<i>Limnodynastes dorsalis</i>	Western Banjo Frog				X		X	X	X		
<i>Neobatrachus pelobatoides</i>	Humming Frog				X						
<i>Crinia georgiana</i>	Quacking Frog				X		X				X
<i>Crinia glauerti</i>	Clicking Frog				X		X				
<i>Crinia insignifera</i>	Squelching Froglet				X		X				
<i>Geocrinia leai</i>	Ticking Frog				X						
<i>Myobatrachus gouldii</i>	Turtle Frog							X	X	X	
<i>Pseudophryne guentheri</i>	Crawling Toadlet				X						
Reptiles											
<i>Ctenophorus adelaidensis</i>	Western Heath Dragon				X			X			
<i>Pogona minor</i>	Dwarf Bearded Dragon				X		X	X	X	X	
<i>Strophurus spinigerus</i>	Soft Spiny-tailed Gecko				X		X			X	
<i>Underwoodisaurus milii</i>	Southern Barking Gecko				X						
<i>Christinus marmoratus</i>	Marbled Gecko									X	
<i>Ctenadactylus ocellatus</i>								X			
<i>Gehyra variegata</i>					X						
<i>Hemidactylus frenatus</i>	Asian House Gecko	In	X								
<i>Aprasia pulchella</i>					X						
<i>Aprasia repens</i>	Sand-plain Worm Lizard				X			X		X	
<i>Delma fraseri</i>								X			
<i>Lialis burtonis</i>	Burton's Legless Lizard				X				X	X	
<i>Pygopus lepidopodus</i>	Common Scaly Foot				X			X			
<i>Pletholax gracilis</i>								X	X		
<i>Cryptoblepharus buchananii</i>	Buchanan's Snake-eyed Sink				X					X	X
<i>Cryptoblepharus plagioccephalus</i>					X		X	X	X		
<i>Ctenotus australis</i>	West Coast Long-tailed Ctenotus				X				X	X	
<i>Ctenotus fallens</i>								X	X	X	X
<i>Egernia napoleonis</i>					X		X				
<i>Hemiernis initialis</i>									X		
<i>Hemiernis quadrilineata</i>					X		X		X	X	
<i>Lerista christinae</i>					X						
<i>Lerista distinguenda</i>								X		X	
<i>Lerista elegans</i>					X		X		X	X	
<i>Lerista lineopunctulata</i>					X						
<i>Lerista praepedita</i>					X		X	X		X	
<i>Menetia greyii</i>	Common Dwarf Skink				X		X		X	X	
<i>Morethia lineoocelatta</i>										X	
<i>Morethia obscura</i>	Dusky Morethia				X			X	X	X	
<i>Tiliqua occipitalis</i>	Western Bluetongue								X	X	
<i>Tiliqua rugosa</i>	Bobtail Skink							X	X	X	
<i>Varanus gouldii</i>	Bungarra or Sand Monitor								X	X	
<i>Ramphotyphlops australis</i>					X				X	X	
<i>Ramphotyphlops braminus</i>	Flowerpot Blind Snake	In	X								

Appendix J
Previously recorded fauna

SPECIES	VERNACULAR	Conservation Status	EPBC Search	DPAW Search	NatureMap	Birddata	Tingay, 1994	Burbridge et al, 1996	ATA, 2007	GHD, 2014	Current Survey
<i>Ramphotypholops pinguis</i>										X	
<i>Ramphotypholops waitii</i>										X	
<i>Antaresia stimsoni</i>	Stimson's Python				X						
<i>Morelia spilota imbricata</i>	Western Carpet Python	S4								X	
<i>Brachyuropsis semifasciatus</i>	Southern Shovel-nosed Snake				X			X		X	X
<i>Echiopsis curta</i>	Bardick				X				X		
<i>Elapognathus coronatus</i>	Crowned Snake				X						
<i>Neelaps bimaculatus</i>	Black-naped Snake							X			
<i>Neelaps calonotos</i>	Black-striped Snake	P3		X	X			X			
<i>Notechis scutatus</i>	Tiger Snake				X		X	X			
<i>Parasuta gouldii</i>					X				X		
<i>Pseudonaja affinis</i>	Dugite							X	X	X	
<i>Simoselaps bertholdi</i>	Jan's Banded Snake				X				X	X	
Birds											
<i>Dromaius novaehollandiae</i>	Emu				X	X	X	X	X	X	X
<i>Coturnix pectoralis</i>	Stubble Quail				X	X					
<i>Coturnix ypsilophora</i>	Brown Quail					X				X	
<i>Phasianus colchicus</i>	Common Pheasant (Domestic Pheasant)	In				X					
<i>Elanus caeruleus</i>	Black-shouldered Kite				X		X	X			
<i>Hamirostra isura</i>	Square-tailed Kite					X					
<i>Haliastur sphenurus</i>	Whistling Kite				X	X		X		X	
<i>Accipiter fasciatus</i>	Brown Goshawk				X	X			X	X	
<i>Accipiter cirrocephalus</i>	Collared Sparrowhawk				X	X		X	X		
<i>Aquila morphnoides</i>	Little Eagle				X	X					X
<i>Aquila audax</i>	Wedge-tailed Eagle					X	X	X		X	
<i>Circus assimilis</i>	Spotted Harrier					X					
<i>Circus approximans</i>	Swamp Harrier				X	X					
<i>Falco berigora</i>	Brown Falcon				X	X		X			
<i>Falco cenchroides</i>	Australian Kestrel				X	X		X			
<i>Falco longipennis</i>	Australian Hobby				X	X		X		X	
<i>Falco peregrinus</i>	Peregrine Falcon	S4		X	X	X			X		
<i>Turnix varia</i>	Painted Button-quail					X			X		
<i>Turnix velox</i>	Little Button-quail				X	X					
<i>Burhinus grallarius</i>	Bush Stone curlew	P4				X					
<i>Vanellus tricolor</i>	Banded Lapwing					X					
<i>Columba livia</i>	Domestic Pigeon	In	X			X				X	
<i>Streptopelia senegalensis</i>	Laughing Turtle-Dove	In	X		X	X	X		X		
<i>Streptopelia chinensis</i>	Spotted Turtle-Dove	In	X			X					
<i>Phaps chalcoptera</i>	Common Bronzewing				X	X		X	X	X	
<i>Phaps elegans</i>	Brush Bronzewing	P4				X					
<i>Ocyphaps lophotes</i>	Crested Pigeon				X	X		X	X	X	X
<i>Calyptorhynchus banksii naso</i>	Forest Red-tailed Black Cockatoo	Vu,S1			X	X					
<i>Calyptorhynchus latirostris</i>	Carnaby's Cockatoo	En, S1	X	X	X	X		X	X	X	
<i>Calyptorhynchus baudinii</i>	Baudin's Cockatoo	Vu,S1		X	X	X					
<i>Cacatua roseicapilla</i>	Galah					X	X	X	X	X	X
<i>Cacatua tenuirostris</i>	Eastern Long-billed Corella				X	X					
<i>Cacatua pastinator</i>	Western Long-billed Corella				X	X	X				
<i>Cacatua sanguinea</i>	Little Corella				X	X			X	X	

Appendix J
Previously recorded fauna

SPECIES	VERNACULAR	Conservation Status	EPBC Search	DPAW Search	NatureMap	Birddata	Tingay, 1994	Burbridge et al, 1996	ATA, 2007	GHD, 2014	Current Survey
<i>Cacatua galerita</i>	Sulphur-crested Cockatoo				X	X					
<i>Nymphicus hollandicus</i>	Cockatiel					X					
<i>Trichoglossus haematodus</i>	Rainbow Lorikeet					X				X	
<i>Glossopsitta porphyrocephala</i>	Purple-crowned Lorikeet				X	X		X		X	
<i>Polytelis anthopeplus</i>	Regent Parrot					X					
<i>Platycercus zonarius</i>	Australian Ringneck (Ring-necked Parrot)				X	X	X	X	X	X	X
<i>Platycercus spurius</i>	Red-capped Parrot				X	X		X	X	X	X
<i>Platycercus icterotis</i>	Western Rosella				X	X					
<i>Neophema elegans</i>	Elegant Parrot								X		
<i>Neophema petrophila</i>	Rock Parrot					X					
<i>Melopsittacus undulatus</i>	Budgerigar				X						
<i>Cuculus pallidus</i>	Pallid Cuckoo				X	X		X			X
<i>Cacomantis flabelliformis</i>	Fan-tailed Cuckoo				X	X	X	X		X	
<i>Chrysococcyx osculans</i>	Black-eared Cuckoo										X
<i>Chrysococcyx basalis</i>	Horsfield's Bronze Cuckoo					X		X	X	X	X
<i>Chrysococcyx lucidus</i>	Shining Bronze Cuckoo				X	X	X	X			
<i>Ninox connivens</i>	Barking Owl	P2				X					
<i>Ninox novaeseelandiae</i>	Boobook Owl				X	X		X	X	X	X
<i>Tyto alba</i>	Barn Owl								X	X	
<i>Podargus strigoides</i>	Tawny Frogmouth				X	X		X	X	X	
<i>Aegotheles cristatus</i>	Australian Owlet-nightjar				X			X		X	
<i>Apus pacificus</i>	Fork-tailed Swift	S3	X			X					
<i>Dacelo novaeguineae</i>	Laughing Kookaburra				X	X	X	X	X	X	X
<i>Todiramphus sanctus</i>	Sacred Kingfisher				X	X		X	X	X	
<i>Merops ornatus</i>	Rainbow Bee-eater	S3	X	X	X	X	X	X	X	X	
<i>Climacteris rufa</i>	Rufous Treecreeper					X					
<i>Malurus splendens</i>	Splendid Fairy-wren				X	X	X	X	X	X	X
<i>Malurus lamberti</i>	Variiegated Fairy-wren				X	X					
<i>Malurus pulcherrimus</i>	Blue-breasted Fairy-wren				X	X					
<i>Malurus elegans</i>	Red-winged Fairy-wren					X					
<i>Malurus leucopterus</i>	White-winged Fairy-wren				X	X		X			
<i>Stipiturus malachurus</i>	Southern Emu-wren					X					
<i>Pardalotus punctatus</i>	Spotted Pardalote				X	X					
<i>Pardalotus striatus</i>	Striated Pardalote				X	X		X	X	X	X
<i>Sericornis frontalis</i>	White-browed Scrubwren				X	X					
<i>Calamanthus campestris</i>	Rufous Fieldwren					X					
<i>Smicronis brevirostris</i>	Weebill				X	X		X	X	X	
<i>Gerygone fusca</i>	Western Gerygone				X	X	X	X	X	X	X
<i>Acanthiza apicalis</i>	Broad-tailed Thornbill (Inland Thornbill)				X	X	X	X	X		X
<i>Acanthiza inornata</i>	Western Thornbill				X	X		X	X	X	
<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill				X	X		X		X	
<i>Lichmera indistincta</i>	Brown Honeyeater				X	X	X	X	X	X	X
<i>Lichenostomus virescens</i>	Singing Honeyeater					X		X		X	X
<i>Lichenostomus ornatus</i>	Yellow-plumed Honeyeater					X		X			
<i>Lichenostomus leucotis</i>	White-eared Honeyeater					X					
<i>Melithreptus brevirostris</i>	Brown-headed Honeyeater				X	X		X		X	
<i>Phylidonyris novaehollandiae</i>	New Holland Honeyeater				X	X		X			
<i>Phylidonyris nigra</i>	White-cheeked Honeyeater					X	X		X	X	

Appendix J
Previously recorded fauna

SPECIES	VERNACULAR	Conservation Status	EPBC Search	DPAW Search	NatureMap	Birddata	Tingay, 1994	Burbridge et al, 1996	ATA, 2007	GHD, 2014	Current Survey
<i>Phylidonyris albifrons</i>	White-fronted Honeyeater					X					
<i>Phylidonyris melanops</i>	Tawny-crowned Honeyeater					X		X			
<i>Acanthorhynchus superciliosus</i>	Western Spinebill				X	X	X	X	X		X
<i>Manorina flavigula</i>	Yellow-throated Miner				X	X		X			
<i>Acanthagenys rufogularis</i>	Spiny-cheeked Honeyeater					X					
<i>Anthochaera lunulata</i>	Western Little Wattlebird				X	X		X		X	
<i>Anthochaera carunculata</i>	Red Wattlebird				X	X	X	X	X	X	X
<i>Epthianura albifrons</i>	White-fronted Chat				X	X		X			
<i>Epthianura tricolor</i>	Crimson Chat					X					
<i>Microeca fascinans</i>	Jacky Winter					X				X	
<i>Petroica multicolor</i>	Scarlet Robin					X		X	X	X	X
<i>Petroica goodenovii</i>	Red-capped Robin				X	X		X			X
<i>Petroica cucullata</i>	Hooded Robin					X		X			
<i>Eopsaltria australis</i>	Yellow Robin					X				X	
<i>Eopsaltria georgiana</i>	White-breasted Robin					X					
<i>Daphoenositta chrysoptera</i>	Varied Sittella				X	X		X	X	X	X
<i>Oreoica gutturalis</i>	Crested Bellbird					X					
<i>Pachycephala pectoralis</i>	Golden Whistler				X	X		X		X	
<i>Pachycephala rufiventris</i>	Rufous Whistler				X	X	X	X	X	X	X
<i>Colluricincla harmonica</i>	Grey Shrike-thrush				X	X	X	X	X	X	X
<i>Rhipidura fuliginosa</i>	Grey Fantail				X	X	X	X	X	X	X
<i>Rhipidura leucophrys</i>	Willie Wagtail				X	X	X	X	X	X	
<i>Grallina cyanoleuca</i>	Magpie-lark				X	X	X	X		X	
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike				X	X	X		X	X	X
<i>Lalage tricolor</i>	White-winged Triller					X		X		X	
<i>Artamus personatus</i>	Masked Woodswallow					X					
<i>Artamus cinereus</i>	Black-faced Woodswallow				X	X		X			
<i>Artamus cyanopterus</i>	Dusky Woodswallow				X	X		X			X
<i>Cracticus torquatus</i>	Grey Butcherbird				X	X		X	X	X	X
<i>Cracticus nigrogularis</i>	Pied Butcherbird				X	X					
<i>Cracticus tibicen</i>	Australian Magpie				X	X		X	X	X	X
<i>Strepera versicolor</i>	Grey Currawong				X	X				X	
<i>Corvus coronoides</i>	Australian Raven				X	X		X	X	X	X
<i>Ptilonorhynchus maculatus</i>	Spotted Bowerbird					X					
<i>Sturnus vulgaris</i>	Common Starling	In	X								
<i>Acridotheres tristis</i>	Common Myna	In	X								
<i>Cheramoeca leucosternus</i>	White-backed Swallow					X		X			
<i>Hirundo neoxena</i>	Welcome Swallow				X	X		X		X	X
<i>Hirundo nigricans</i>	Tree Martin				X	X		X		X	
<i>Hirundo ariel</i>	Fairy Martin					X					X
<i>Zosterops lateralis</i>	Grey-breasted White-eye (Silvereye)				X	X	X	X	X	X	
<i>Acrocephalus australis</i>	Australian Reed Warbler				X	X	X				
<i>Megalurus gramineus</i>	Little Grassbird				X	X					
<i>Cincloramphus mathewsi</i>	Rufous Songlark				X	X		X			
<i>Cincloramphus cruralis</i>	Brown Songlark				X	X					
<i>Dicaeum hirundinaceum</i>	Mistletoebird				X			X		X	
<i>Passer domesticus</i>	House Sparrow	In	X								
<i>Passer montanus</i>	Eurasian Tree Sparrow	In	X								

Appendix J
Previously recorded fauna

SPECIES	VERNACULAR	Conservation Status	EPBC Search	DPAW Search	NatureMap	Birdata	Tingay, 1994	Burbridge et al, 1996	ATA, 2007	GHD, 2014	Current Survey
<i>Stagonopleura oculata</i>	Red-eared Firetail					X					
<i>Lonchura castaneothorax</i>	Chestnut-breasted Mannikin					X					
<i>Anthus australis</i>	Australian Pipit					X					
<i>Carduelis carduelis</i>	Goldfinch (European Goldfinch)	In	X			X					
Mammals											
<i>Tachyglossus aculeatus</i>	Echidna				X			X		X	
<i>Dasyurus geoffroii</i>	Western Quoll, Chuditch	Vu,S1	X	X	X						
<i>Sminthopsis griseoventer</i>	Grey-bellied Dunnart							X			
<i>Isoodon obesulus fusciventer</i>	Southern Brown Bandicoot	P5		X	X		X			X	
<i>Macropus fuliginosus</i>	Western Grey Kangaroo				X		X	X		X	X
<i>Macropus irma</i>	Western Brush Wallaby	P4						X			X
<i>Macropus robustus</i>	Euro, Biggada				X						
<i>Trichosurus vulpecula</i>	Common Brushtail Possum									X	
<i>Cercartetus concinnus</i>	Western Pygmy-possum, Mundarda				X						
<i>Tarsipes rostratus</i>	Honey Possum, Noolbenger						X	X	X		
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat				X			X		X	
<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat				X			X		X	
<i>Nyctophilus gouldi</i>	Gould's Long-eared Bat				X			X			
<i>Vespadelus regulus</i>	Southern Forest Bat							X			
<i>Tadarida australis</i>	White-striped Freetail-bat									X	
<i>Mus musculus</i>	House Mouse	In	X		X		X	X	X	X	
<i>Pseudomys albocinereus</i>	Ash-grey Mouse				X			X			
<i>Rattus norvegicus</i>	Brown Rat	In	X								
<i>Rattus rattus</i>	Black Rat	In	X		X		X			X	
<i>Funambulus pennanti</i>	Indian Palm Squirrel	In	X								
<i>Oryctolagus cuniculus</i>	Rabbit	In	X				X	X		X	
<i>Canis lupus</i>	Dog	In	X							X	
<i>Vulpes vulpes</i>	Red Fox	In	X				X	X		X	X
<i>Felis catus</i>	Cat	In	X		X			X		X	
<i>Sus scrofa</i>	Pig	In	X								
<i>Bos taurus</i>	European Cattle	In	X								
<i>Capra hircus</i>	Goat	In	X								
<i>Cervus elaphus</i>	Red Deer	In	X								

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Main Roads Western Australia

Hill River Offset Property
Biological Survey

September 2016

Executive summary

Introduction

Main Roads Western Australia is currently constructing Stage 1 of the Mitchell Freeway Extension. Stage 1 of the project was referred to the DotE under the EPBC Act and was determined to be a 'controlled action' due to the likely significant impacts on Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*). The impact is clearing of 88.7 ha of native vegetation that provides known and potential foraging, roosting and breeding habitat for Carnaby's Black Cockatoo.

Condition 3 of EPBC approval 2013/7091 stipulated that Main Roads must provide an offset property with suitable environmental values to be transferred to the Conservation and Parks Commission of Western Australian and managed by Department of Parks and Wildlife, to be reserved for conservation in perpetuity.

Main Roads has acquired an offset property (Lot 1, 1395 Banovich Road, Hill River), which is the subject of this report. A biological survey ('Ecological Values Assessment'), including a Black Cockatoo habitat assessment to determine the environmental values of the property was undertaken. The property (survey area) consists of 1,993 ha.

Key results

- Four vegetation types were considered to resemble conservation significant ecological communities, including:
 - VT01 is associated with the Lesueur-Coomallo Floristic Community D1 TEC, listed as Critically Endangered under the WC Act
 - VT03 is associated with the Lesueur-Coomallo Floristic Community M2 (*Melaleuca preissiana* woodland) Priority 1 PEC
 - VT04 is associated with the Lesueur-Coomallo Floristic Community DFGH Priority 1 PEC, in particular 'D' heath and woodlands on gravelly hills and slopes
 - VT02 is associated with the *Petrophile chrysantha* low heath on Lesueur dissected uplands (Gp200-170) Priority 2 PEC
- Fourteen vegetation types were described from the survey area. 1746.81 ha of native vegetation, ranging from Pristine to Completely Degraded condition
- The native vegetation within the survey area is considered significant vegetation as defined by the EPA and DPaW (2015) as the majority of the survey area is in a Pristine condition that is a refuge for a number of conservation significant flora that occur throughout the survey area in a variety of vegetation types
- The survey area contained a diverse range of flora with 344 taxa (including subspecies and varieties) representing 51 families and 149 genera recorded from the survey area
- Nine conservation significant flora were recorded from the survey area including:
 - *Hakea megalosperma* (listed as Vulnerable under both the EPBC Act and WC Act)
 - *Acacia retrorsa* (Priority 2)
 - *Grevillea delta* (Priority 2)
 - *Thelymitra variegata* (Priority 2)
 - *Hensmania stoniella* (Priority 3)

- *Lepidobolus quadratus* (Priority 3)
 - *Stylidium ?hymenocraspedum* (Priority 3)
 - *Stylidium ?torticarpum* (Priority 3)
 - *Hakea neurophylla* (Priority 4).
- The Likelihood of Occurrence assessment post-field survey concluded that seven taxa are known to occur, two are likely to occur, 152 may possibly occur and the remaining 29 taxa are unlikely or highly unlikely to occur within the survey area. The large number of conservation significant taxa that are considered possibly to occur is due to the survey area comprising of a varied landscape with a range of soils and landforms that align with the habitat considered suitable for the species
 - No introduced species listed as a Declared Pest under Section 22 of the BAM Act or as a Weed of National Significance were recorded within the survey area
 - Seven fauna habitat types were recorded during the field survey, which broadly aligned with the vegetation types and include, Wandoo Woodlands, Marri Woodland, *Eucalyptus todtiana*, *Banksia attenuata/menziesii* low Open Woodland, Minor Drainage lines and Seasonally Inundated Areas and Dams, Heathlands on Sandy Soils, Heathlands on Lateritic Soils and Scattered Trees of Wandoo and Marri in Paddock
 - One hundred and seven fauna species were recorded within or in close proximity to the survey area including 72 birds, 18 mammals (6 introduced), 12 reptiles and five frogs
 - The EPBC Act listed Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*), Endangered Schedule 1 and Priority 4 listed Western Brush Wallaby (*Macropus irma*) were recorded during the survey
 - The Likelihood of Occurrence assessment post-field survey concluded that six additional conservation significant fauna taxa may likely occur within the survey area and these are: Western Ground Parrot (*Pezoporus flaviventris*), Chuditch (*Dasyurus geoffroi*), Peregrine Falcon (*Falco peregrinus*), Woma Python (*Aspidites ramsayi* SW pop.), Southern Brown Bandicoot (*Isodon obesulus* subsp. *fusciventer*) and Black-striped Snake (*Neelaps calonotos*). Some of these species are considered rare in Western Australia, however few fauna studies have occurred in this region and their presence could not be excluded.

Summary of offset calculator inputs

The EPBC Act Offsets Assessment Guide has been used to determine the required offsets for impacts to Carnaby's Black Cockatoo for Stage 1 of the Mitchell Freeway Extension, Burns Beach to Hester Avenue, and the geotechnical trace lines. A summary of the inputs into the Offsets Calculator section of the EPBC Act Offsets Assessment Guide for the proposed offset site (the survey area) is provided in the table below.

The outcome accounts for greater than 100% (106.57%) direct offset for the impact of clearing 88.7 ha of Carnaby's Black Cockatoo habitat for Stage 1 of the project.

Summary of inputs into Offset Calculator

Offset calculator attribute	Input value
Proposed offset	Portion of Lot 1, 1395 Banovich Road, Hill River Area: 1993 ha including 1771.5 ha native vegetation and 27.5 ha of highly modified vegetation
Time horizon (years)	
Time over which loss is averted	20 years

Offset calculator attribute	Input value
Time until ecological benefit	10 years
Start area (ha)	564 ha
Start quality (scale of 1-10)	9
Future area and quality with and without offset (%)	
Risk of loss (%) without offset	15%
Future quality without offset (scale 1-10)	8
Risk of loss (%) with offset	2%
Future quality with offset (scale 1-10)	9
Confidence in result (%)	
Averted loss component input	80%
Change in habitat quality component input	80%
Output	
Net present value (adjusted hectares)	75.63

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Appendix B – Relevant legislation, conservation codes and background information

Appendix C – Desktop searches

Appendix D – Flora Data

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1. Introduction

1.1 Background

Main Roads Western Australia (Main Roads) is currently constructing Stage 1 of the Mitchell Freeway Extension (project). The ultimate works for the project have been divided into three stages, of which Stage 1 includes the works associated with the extension from Burns Beach Road to Hester Avenue and the connecting roads (Neerabup Road and Hester Avenue).

Stage 1 was referred to the Department of the Environment (DotE¹) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and was determined to be a 'controlled action' due to the likely significant impacts on Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*). The impact is clearing of 88.7 hectares (ha) of native vegetation that provides known and potential foraging, roosting and breeding habitat for Carnaby's Black Cockatoo.

Condition 3 of EPBC approval 2013/7091 stipulated that Main Roads must provide an offset property with suitable environmental values to be transferred to the Conservation and Parks Commission of Western Australian and managed by Department of Parks and Wildlife, to be reserved for conservation in perpetuity.

Main Roads acquired a potential offset property (Lot 1, 1395 Banovich Road, Hill River). A biological survey ('Ecological Values Assessment') including a Black Cockatoo habitat assessment was commissioned to determine the environmental values of the property. The property consists of 1,993 ha (survey area) of bushland in the locality of Hill River (near the town of Jurien), situated approximately 170 kilometres (km) from the project.

1.1 Purpose of this report

The purpose of the assessment was to delineate key flora, vegetation, fauna, soil values within the survey area. The outcomes of the assessment will be used to determine the suitability of the property being used as an offset for the project and for future Main Roads offsets.

1.2 Location

1.2.1 Study area

A study area was defined for the desktop based searches of the survey area and includes a 20 km buffer around the survey area.

1.2.2 Biological survey area

The survey area is located west of Banovich Road and north of Jurien Road, approximately 20 km east northeast of Jurien town site, in the Shire of Dandaragan. The location of the survey area is mapped in Figure 1, Appendix A.

1.3 Scope of works

The scope of works, as detailed in the Main Roads Consultants Brief was to undertake a desktop assessment and Level 1 flora, vegetation and fauna survey, including targeted Black Cockatoo habitat assessment for the project. The following actions were undertaken:

¹ The Department of the Environment is now the Department of the Environment and Energy (DotEE)

- Complete a desktop assessment of the study area prior to the field survey work to identify all biological features and constraints, which may be in, or nearby the survey area
- Identify and review any existing and relevant environmental reports
- Identify significant flora, vegetation/ecological communities, fauna, soil, groundwater and surface water values and potential sensitivity to impact
- Identify broad pre-European vegetation type(s) using Beard (various)
- Conduct a Level 1 field survey (to be done by an environmental specialist in accordance with regulatory expectation for years of experience in the relevant bioregion) to verify/ground truth the desktop assessment findings through targeted and comprehensive survey
- Undertake vegetation condition mapping using an appropriate condition scale for the bioregion (as per Environmental Protection Agency (EPA) and DPaW 2015)
- Undertake ecological community mapping to a scale appropriate for the bioregion and described according to the National Vegetation Information System (NVIS) structure and floristics
- Undertake targeted Black Cockatoo habitat assessment and mapping
- Undertake relevant environmental constraints mapping using GIS mapping software (e.g. ArcMap)
- Assess the project areas plant species diversity, density, composition, structure and weed cover, recording the percentage of each in 20 flora sampling quadrats.

The biological survey aspects that relate to flora were undertaken having regard to the EPA and DPaW (2015) Technical Guide and those aspects that relate to fauna were undertaken having regard to EPA Guidance Statement No.56 (EPA 2004) and the subsequent Technical Guide (EPA and Department of Environment and Conservation (DEC) 2010).

1.4 Relevant legislation, conservation codes and background information

In Western Australia some ecological communities, flora and fauna are protected under both Federal and State Government legislation. In addition, regulatory authorities also provide a range of guidance and information on expected standards and protocols for environmental surveys.

An overview of key legislation and guidelines, conservation codes and background information relevant to this biological survey is provided in Appendix B.

1.5 Report limitations and assumptions

This report has been prepared by GHD for Main Roads and may only be used and relied on by Main Roads for the purpose agreed between GHD and the Main Roads as set out in section 1.3 of this report.

GHD otherwise disclaims responsibility to any person other than Main Roads arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report (including species listings). GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Main Roads and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of access tracks, operational works, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

This report has assessed the flora and fauna within the survey area (Figure 1, Appendix A). Should the survey area change or be refined, further assessment may be required.

2. Methodology

2.1 Desktop assessment

Prior to the commencement of the field survey, a desktop assessment was undertaken to identify relevant environmental information pertaining to the study area and to assist in survey design. The search parameters used were a 20 km radius of a point at 30° 11' 31" S, 115° 14' 11" E. This included a review of:

- The DotEE Protected Matters Search Tool (PMST) to identify communities and species listed under the EPBC Act potentially occurring within the study area (DotEE 2016a) (Appendix C)
- The DPaW Threatened Ecological Communities (TECs) and Priority Ecological Communities (PECs) database (Reference Number: 14-0716EC) to determine the potential for TECs or PECs to be present within the study area
- The *NatureMap* database for flora and fauna species previously recorded within the study area (DPaW 2016) (Appendix C)
- The DPaW Threatened (Declared Rare) and Priority Flora (TPFL) database² (Reference Number: 02-0816FL), the DPaW Threatened and Priority Fauna database (Reference Number: FAUNA#5265), and the WA Herbarium database for Threatened flora and fauna species listed under the *Wildlife Conservation Act 1950* (WC Act) and listed as Priority by the DPaW, previously recorded within the study area
- Existing datasets including previous vegetation mapping of the survey area (Beard 1979), aerial photography, geology/soils and hydrology information to provide background information on the variability of the environment, likely vegetation units and fauna habitats and to identify areas with potential to contain TECs, PECs, and Threatened and Priority listed flora and fauna species.

2.2 Field survey

2.2.1 Vegetation and flora

As part of the biological survey, a Level 1 single season vegetation and flora assessment of the survey area was conducted by botanists Mathew Gannaway (SL011729) and Joshua Foster (SL011812) from the 1 to 5 August 2016. The field survey was undertaken to verify the results of the desktop assessment, identify and describe the dominant vegetation units where possible, assess vegetation condition and identify and record vascular flora taxa present at the time of survey. Searches for conservation significant ecological communities and flora taxa were also undertaken.

The survey methodology employed was undertaken with reference to the EPA and DPaW *Technical Guide – Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA and DPaW 2015).

Data collection

Field survey methods involved a combination of sampling quadrats located in identified vegetation units and traversing the survey area by foot. Twenty pegged quadrats (measuring 10 metres (m) x 10 m) were recorded in the survey area. To sample all the apparent vegetation

² DPAW would only supply data for a 5 km radius search of the survey area for the DPAW TPFL database search.

units across the survey area, the location of quadrats was made primarily on the basis of aerial photographic maps. The locations of TECs and PECs were previously recorded within the survey area were targeted. Additional sites were selected in situ, based on observations of vegetation units during the field assessment.

Field data for each quadrat were recorded on a pro-forma data sheet and included the parameters detailed in Table 1. Quadrat data are provided to Main Roads in Excel format.

Table 1 Data collected during the flora and vegetation field survey

Aspect	Measurement
Collection attributes	Personnel/recorder; date, quadrat dimensions, photograph of the quadrat.
Physical features	Aspect, soil attributes, ground surface cover, leaf and wood litter.
Location	Coordinates recorded in GDA94 datum using a hand-held Global Positioning System (GPS) tool to accuracy approximately ± 10 m. Location recorded at the north-west corner peg.
Vegetation condition	The vegetation condition of the survey area was assessed and mapped in accordance with the vegetation condition rating scale for the South West and Interzone Botanical Provinces (EPA and DPaW 2015).
Disturbance	Level and nature of disturbances (e.g. weed presence, fire and time since last fire, impacts from grazing, exploration activities).
Flora	List of dominant flora from each structural layer List of all species within the quadrat including average height, number and cover (using a modified Braun-Blanquet scale).

A flora inventory was compiled from taxa listed in described quadrats and from opportunistic floristic records throughout the survey area.

Vegetation units

Vegetation units were identified and boundaries delineated using a combination of aerial photography, topographical features and field data/observations.

Vegetation units were described based on structure, dominant taxa and cover characteristics as defined by quadrat data and field observations. Vegetation unit descriptions follow the National Vegetation Information System (NVIS) framework and are consistent with NVIS Level V (Association). At Level V, three (or occasionally more) taxa per stratum are used to describe the association (Executive Steering Committee for Australian Vegetation Information (ESCAVI) 2003).

Vegetation condition

The vegetation condition of the survey area was assessed and mapped in accordance with the vegetation condition rating scale for the South West and Interzone Botanical Provinces (EPA and DPaW 2015). The scale recognises the intactness of vegetation and consists of six rating levels as outlined in Appendix B.

Flora identification and nomenclature

Species well known to the survey botanists were identified in the field; all other species were collected and assigned a unique collection number to facilitate tracking. All plant specimens collected during the field assessment were dried and processed in accordance with the requirements of the WA Herbarium. Plant species were identified by the use of taxonomic literature, electronic keys and online electronic databases. Where necessary, plant taxonomists considered to be authorities on particular plant groups were consulted.

The conservation status of all recorded flora was compared against the current lists available on *FloraBase* (WA Herbarium 2016) and the EPBC Act List of Threatened Flora (DotEE 2016b).

Conservation significant flora that could not be confidently identified at the WA Herbarium by the field botanist were submitted to the WA Herbarium for formal identification (Accession Number: 6917).

Nomenclature used in this report follows that used by the WA Herbarium as reported on *FloraBase* (WA Herbarium 2016).

Surveys for conservation significant flora

Prior to the field survey, information from the desktop assessments (e.g. aerial photography, geology, soils and topography data, EPBC Act PMST, TPFL and *NatureMap*) was reviewed to determine conservation significant flora taxa potentially present within the survey area. Additionally, ecological information (e.g. habitat, associated flora taxa and phenology) was sourced from *FloraBase* (WA Herbarium 2016) and other relevant publications where available, to provide further details.

Potential habitats were searched for the presence of conservation significant flora. Locations within the survey area with differing hydrology, fire or disturbance history to the surrounding areas were also searched where identified.

When any known or potential Threatened, Priority or significant flora was located, the following data was collected: GPS location, height (m), number of plants and corresponding area of population, reproductive state and plant condition.

2.2.2 Fauna

Zoologists (Glen Gaikhorst and Craig Grabham) undertook a single season Level 1 fauna survey (reconnaissance survey) of the survey area from the 1 to 5 August 2016. The fauna survey was undertaken concurrently with the vegetation and flora assessment and with reference to the EPA Guidance Statement No. 56 *Terrestrial Fauna Survey for Environmental Impact Assessment in Western Australia* (EPA 2004). The purpose of the reconnaissance survey was to verify the accuracy of the desktop study, and delineate and characterise the fauna assemblages present in the survey area.

The majority of the survey area was traversed on foot and by vehicle over the course of five days to identify and describe the dominant fauna habitat types and their condition, assess habitat connectivity, identify and record fauna species within the survey area. A Likelihood of Occurrence assessment for conservation significant fauna and their habitats occurring within the survey area was also undertaken.

Habitat assessment

Fauna habitats were assessed in-situ and comprised visual assessment of the following:

- Habitat structure (e.g. vegetation type, presence/absence of structural layers such as ground cover and mid storey)
- Presence/absence of refuge including: density of ground covers, fallen timber, hollow-bearing trees and stags and rocks/boulder piles, and the type and extent of each refuge
- Presence/absence of waterways including type, extent and habitat quality within waterways
- Location of the habitat within the survey area in comparison to the habitat within the surrounding landscape

- Habitat connectivity and identification of wildlife corridors within and immediately adjacent to the survey area
- Current land use and disturbance history
- Identification and evaluation of key habitat features and types identified during the desktop assessment relevant to fauna of conservation significance
- Evaluation of the Likelihood of Occurrence of conservation significant fauna within the habitat (based on presence of suitable habitat and observations)
- A representative photograph of each habitat type.

Opportunistic fauna searches

Opportunistic fauna searches were also conducted across the survey area. The majority of opportunistic searches were undertaken at habitat assessment locations and focussed on the following:

- Searching the survey area for tracks, scats, bones, diggings and feeding areas for both native and feral fauna
- Searching through microhabitats including turning over rocks and ground debris (e.g. leaf litter) and examining tree hollows and hollow logs for reptile and other small vertebrate fauna
- Visual and aural surveys. This accounted for many bird species potentially utilising the survey area. The *Michael Morcombe eGuide to Australian Birds* – phone application (Morcombe 2014) and binoculars were used to assist visual observations. Pre-recorded calls (Morcombe 2014) were used to assist with aural identification of bird species
- A visual assessment of the water bodies to identify any fish species observed
- Recording GPS locations of any conservation significant fauna species.

Camera traps

Remote sensor cameras (15 x Reconyx-Hyperfire and 5 x ScoutGuard DTC 560K) were deployed for 15 nights each at 20 locations within the survey area. Cameras were positioned in areas where key habitat features were present or potential activity of species was recorded. Cameras were baited with cereal laced with peanut butter and honey to attract fauna. For each camera location the time and date deployed and recovered, a GPS coordinate, and brief habitat description were recorded (as seen in Table 2). Camera locations are displayed in Figure 5, Appendix A. Data from the cameras was downloaded to a computer and analysed for the presence of animals following the field survey.

Table 2 Camera trap locations and effort undertaken

Sites	Easting	Northing	Deployed	Collected	Total Nights	Comments
SG2	329377	6659242	3 Aug	19 Aug	15	Wandoo Woodland
SG7	329354	6659348	3 Aug	19 Aug	15	Wandoo Woodland
R16	331296	6660200	3Aug	19 Aug	15	Wandoo Woodland
R16b	331280	6660051	3 Aug	19 Aug	15	Wandoo Woodland
SG10	329356	6659374	3 Aug	19 Aug	15	Wandoo Woodland

Sites	Easting	Northing	Deployed	Collected	Total Nights	Comments
R20	331319	6656593	3 Aug	19 Aug	15	On dam edge
R8	331362	6656589	3 Aug	19 Aug	15	On dam edge
RA	331394	6656519	3 Aug	19 Aug	15	Wandoo Woodland
R14c	331441	6656539	3 Aug	19 Aug	15	Wandoo Woodland
R12	331464	6656549	3 Aug	19 Aug	15	Wandoo Woodland
R13b	331292	6660127	3 Aug	19 Aug	15	<i>Kingia</i> Heath on lateritic Ridge
SG6	329363	6659313	3 Aug	19 Aug	15	<i>Kingia</i> Heath on lateritic Ridge
R31	331285	6660101	3 Aug	19 Aug	15	<i>Kingia</i> Heath on lateritic Ridge
SG9	329361	6659278	3 Aug	19 Aug	15	<i>Kingia</i> Heath on lateritic Ridge
R6	331248	6659981	3 Aug	19 Aug	15	<i>Kingia</i> Heath on lateritic Ridge
R14	328641	6660175	3 Aug	19 Aug	15	Low Heath with <i>Banksia</i>
R3	328609	6660146	3 Aug	19 Aug	15	Low Heath with <i>Banksia</i>
R21	328579	6660119	3 Aug	19 Aug	15	Low Heath with <i>Banksia</i>
R27	328699	6660166	3 Aug	19 Aug	15	On isolated Rock Boulder
R15	328654	6660175	3 Aug	19 Aug	15	Low Heath with <i>Banksia</i>

Bat survey

Two Songmeter SM2BAT+ recorder (Wildlife Acoustics Inc., USA) and one Anabat Express recorder (Titley Scientific) was deployed at three locations. The three units were deployed for a combined total of 26 nights to record ultrasonic echolocation calls emitted by microchiropteran bats. Figure 5, Appendix A displays the detector locations within the survey area.

Data from the detector were downloaded to a computer and analysed for the presence of bat calls by Craig Grabham of GHD following the field survey (see Appendix E).

Fauna species identification

Fauna species were identified in the field using available field and electronic guides (e.g. Morcombe 2014). Where identification was not possible, photographs of specimens were collected to be later identified.

Nomenclature follows that used by the WA Museum (as shown on *NatureMap*), as it is deemed to contain the most up-to-date species information for WA, with the exception of birds, where Christidis and Boles (2008) was used.

Targeted survey for Black Cockatoo

The aim of the habitat assessment was to assess the presence, quality and extent of habitat for Carnaby's Black Cockatoo within the survey area based on their modelled distribution (Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC 2012a). Carnaby's Black Cockatoo is the only Black Cockatoo in this region with both Forest Red-tailed Black Cockatoo and Baudin's Black Cockatoo not modelled to be present (DSEWPaC 2012a). The survey involved visual and aural assessment of the survey area identifying breeding habitat (presence/absence of actual and potential breeding trees), foraging habitat, roosting areas, current activity and any other signs of use by Carnaby's Black Cockatoo. For the purpose of this assessment, the DSEWPaC (2012a) Black Cockatoo referral guideline was used to define breeding, foraging and night roosting habitat.

Information collected during the field survey included:

- Foraging habitat – the location and extent of suitable Black Cockatoo species foraging habitat was identified and mapped for the survey area, based on the vegetation associations and presence/absence of known foraging species. During the field surveys any direct or indirect evidence of foraging by Black Cockatoos was recorded via GPS
- Breeding habitat - suitable breeding habitat for Black Cockatoos is defined by DSEWPaC (2012a) as trees of species known to support breeding within the range of the species which either have a suitable nest hollow or are of a suitable diameter at breast height (DBH) to develop a nest hollow. For most tree species, suitable DBH is 500 millimetres (mm). For Salmon Gum and Wandoo, suitable DBH is 300 mm (DSEWPaC 2012a). Breeding habitat was identified and mapped according to the presence of suitable woodland habitat. Individual trees for the entire survey area were not mapped however 10 (50 x 50 m) plots were undertaken in Wandoo Woodland and four in Marri Woodland to ascertain tree densities within these habitats. For each breeding tree, details of the tree species, size and number of hollows observed, evidence of use and any other significant observations were recorded. On average, Carnaby's Black Cockatoos are known to nest in hollows with an entrance diameter greater than 200-300 mm (Johnstone and Storr 1998; Groom 2011). Therefore, during the field survey a suitable nesting hollow currently able to support breeding was defined as a tree hollow with an entrance diameter of 200 mm or greater
- Night roosting habitat - suitable roosting habitat is defined by DSEWPaC (2012a). Suitable roosting habitat was identified based on the presence of suitable tall trees, proximity of known roosting sites and the presence of suitable foraging habitat
- Opportunistic observations (both visual and aural) for the presence of Black Cockatoos within the survey area and surrounding areas were also noted during the survey.

This information was used to map and calculate the amount of foraging habitat, breeding, potential breeding habitat and night roosting sites within the survey area. Any area containing known foraging species or potential nesting trees was considered as habitat for Black Cockatoos.

2.3 Limitations

2.3.1 Desktop limitations

The EPBC Act PMST is based on bioclimatic modelling for the potential presence of species. As such, this does not represent actual records of the species within the area. The records from the DPaW searches of Threatened flora and fauna provide more accurate information for the general area. However, some collection, sighting or trapping records cannot be dated and often misrepresent the current range of Threatened species.

2.3.2 Field survey limitations

The EPA and DPaW (2015) Technical Guide and Guidance Statement No. 56 (EPA 2004) states that flora and fauna survey reports for environmental impact assessment in WA should contain a section describing the limitations of the survey methods used. The limitations and constraints associated with this field survey are discussed in Table 3.

Table 3 Survey limitations

Aspect	Constraint	Comment
Sources of information and availability of contextual information.	Nil	Adequate information is available for the survey area; this includes: <ul style="list-style-type: none"> Broad scale (1:250,000) vegetation mapping by Beard (1979) and digitised by Shepherd <i>et al.</i> (2002) Regional biogeography (Desmond and Chant 2001) Regional vegetation (Department of Conservation and Land Management (CALM) 1995; Bell <i>et al.</i> 1984).
Scope (what life forms were sampled etc.)	Nil	Vascular flora and terrestrial vertebrate fauna were sampled during the survey. Non-vascular flora, invertebrate and aquatic fauna were not assessed as part of survey, although opportunistic records were taken of invertebrate and aquatic fauna during the survey.
Proportion of flora collected and identified (based on sampling, timing and intensity) Proportion of fauna identified, recorded and/or collected	Moderate	<p>The vegetation and flora survey was a single season survey only and was undertaken in early August 2016. The optimal time to undertake flora and vegetation surveys in the Northern Sandplains region is in Spring from September to November (EPA and DPaW 2015). The majority of the conservation significant flora identified in the desktop assessment flower from September to October and therefore the survey timing was a little early with many of the observed species either budding or not in flower. The proportion of flora collected and identified was considered low for the region; with annuals representing only 6.12 % of species recorded. Orchids represented only 3.79 % of species while grasses and daisies combined also only represented 4.66 % of species.</p> <p>The fauna survey was undertaken in early August 2016 and was a reconnaissance survey only. The fauna assessment sampled those species that can be easily seen, heard or have distinctive signs, such as tracks, scats, diggings, etc. Twenty remote cameras were deployed for 15 days in Wandoo woodlands and healthlands to gather additional data on some nocturnal species. Many cryptic (e.g. invertebrate species) and localised nocturnal species would not have been identified during a reconnaissance survey and seasonal variation within species often requires targeted surveys at a particular time of the year.</p> <p>The fauna assessment was aimed at identifying habitat types and terrestrial vertebrate fauna utilising the survey area. No sampling for invertebrates or aquatic species occurred. Where terrestrial invertebrate fauna was recorded opportunistically, these findings were mentioned in this report. However, this report is limited to an assessment of terrestrial vertebrate fauna, as the information available on the identification, distribution and conservation status of invertebrates is generally less extensive than that of vertebrate species.</p>
Flora determination	Moderate	<p>Flora determination was undertaken by Mathew Gannaway and Joshua Foster in the field and by Mathew Gannaway at the WA Herbarium.</p> <p>Fifty-six taxa could only be identified to genus and nine taxa could only be identified to family due to lack of flowering and fruiting material required for identification. With no flowering or fruiting material, positive identification of these collections and their resemblance to conservation significant flora identified in the desktop assessment could not occur. Additionally, some species, particularly small herbs and annuals were unable to be identified due to only cotyledons present or insufficient material available for identification.</p>

Aspect	Constraint	Comment
		The taxonomy and conservation status of the WA flora is dynamic. This report was prepared with reliance on taxonomy and conservation status current at the time report development, but it should be noted this may change in response to ongoing research and review of International Union for Conservation of Nature criteria.
Completeness and further work which might be needed (e.g. was the relevant area fully surveyed)	Minor	The survey area is large (approximately 1993 ha) and was surveyed through the use of a vehicle, surveying only those areas accessible with vehicle tracks. Information gained from the survey was extrapolated across the sections of the survey area not easily accessed by vehicle to assist with determining the extent of vegetation and habitat types for the survey area. As the survey area is in a dynamic landscape with varied low heath formations that are not easily discernible from aerial imagery, extrapolation of the vegetation and habitat carries a small degree of uncertainty. In addition, the flora is very complex in the survey area with some species unable to be distinguished from similar species due to insufficient flowering and fruiting material. As the survey area is not proposed for clearing but rather for retention as conservation estate, lack of comprehensive coverage is not a true constraint for this project.
Mapping reliability	Nil	High resolution Environmental Systems Research Institute aerial imagery was available. Data were recorded in the field using hand-held GPS tools (e.g. Tablet using the Collector Application and Garmin GPS). Certain atmospheric factors and other sources of error can affect the accuracy of GPS receivers. The Garmin GPS units used for this survey are accurate to within +/-10 m on average. Therefore the data points consisting of coordinates recorded from the GPS may be imprecise.
Timing/weather/season/cycle	Moderate	The field survey was conducted in early August 2016. In the four months prior to the survey (April to July), Jurien Bay weather station (No. 0091316, Bureau of Meteorology (BoM) 2016) recorded a total of 401.7 millimetres (mm) of rainfall. This rainfall is well above the long term average (LTA) for the same period (April to July; 328.2 mm) (BoM 2016). While sufficient rainfall was received within the survey area, an assessment of the flowering times of conservation significant flora taxa shows that September to October is the optimum time to capture a majority of the conservation significant flora in flower (Appendix D) as plant flowering is linked to both rainfall and temperature. It was noted during the field survey that a majority of taxa had either just started to bud or showed no flowering or fruiting material, suggesting the survey was too early to capture flowering times for a majority of species. In addition, annuals only represented 6.12 % of species recorded.
Disturbances (e.g. fire, flood, accidental human intervention)	Minor	The majority of the survey area has been exposed to a mosaic of historical fire regimes with a variety of burn ages recorded. Most of the disturbances throughout the survey area were associated with historical coal drilling activity with a number of wells located throughout the northern part of the property, and associated vehicle tracks. Around the homestead and paddock area pasture species, in particular <i>*Arctotheca calendula</i> was prevalent. Feral pig activity was noted throughout the survey area, in particular along drainage lines.
Intensity (in retrospect, was the intensity adequate)	Moderate	The vascular flora of the survey area was sampled in accordance with the EPA and DPaW (2015) Technical Guide and terrestrial fauna sampled in accordance to EPA (2004a) as required by the scope of works. The survey area is large (approximately 1993 ha), which meant the survey area could only be covered efficiently through the use of a vehicle, surveying only those areas accessible with vehicle tracks. Certain areas of the

Aspect	Constraint	Comment
		survey area were unable to be accurately assessed due to insufficient vehicle tracks and time constraints limiting the ability to traverse the survey area on foot. Information gained from along the vehicles tracks were extrapolated across the areas not accessed by vehicle.
Resources	Nil	Adequate resources were employed during the field survey. Sixteen person days were spent undertaking the survey using two dedicated botanists and two zoologists (1 botanist and 1 zoologist for five days each and 1 botanist and 1 zoologist for 3 days each).
Access restrictions	Nil	No access problems were encountered during the survey. The survey area was accessed by vehicle and only time constraints limited the accessibility of the survey area on foot.
Experience levels	Nil	The ecologists who executed the survey were practitioners suitably qualified in their respective fields. Glen Gaikhorst (zoologist) is a Senior Ecologist with over 20 years' experience in undertaking ecological surveys, most of which is undertaking surveys in Western Australia, including projects in the Northern Sandplains. Craig Grabham (zoologist) is a Senior Ecologist with over 16 years' experience in undertaking ecological surveys, including 4 years' experience undertaking surveys in Western Australia. Joshua Foster is a Principal Ecologist (botanist) with over 18 years' experience in undertaking ecological surveys in Western Australia, including extensive experience in the Northern Sandplains. Mathew Gannaway is an Ecologist (botanist) with 8 years' experience in undertaking ecological surveys in Western Australia, including projects in the Northern Sandplains.

3. Desktop assessment

3.1 Climate

The survey area is located in the Northern Sandplains Region of WA and experiences a dry, warm Mediterranean climate with winter precipitation ranging from 300-500 mm with seven to eight dry months per year (Beard 1990).

The BoM Jurien Bay station (site number: 009131) is the nearest active weather station to the study area with continuous long-term data (approximately 20 km south west from the study area). Climatic data from this site indicates the mean maximum temperature of the area ranges from 19.5 degrees Celsius (°C) in July to 30.9 °C in February, and the mean minimum temperature of the area ranges from 9.3 °C in July to 18.0 °C in February. The LTA annual rainfall is 551.7 mm, with an average of 71.4 rain days per year (BoM 2016).

Rainfall and temperature data for Jurien Bay in the 12 months preceding the survey are summarised in Plate 1 (BoM 2016). In the four months prior to the survey (April to July), Jurien Bay weather station recorded a total of 401.7 mm of rainfall. This rainfall total is higher than the LTA for the same period (April to July; 328.4 mm) (BoM 2016). The weather conditions recorded during the field survey included (BoM 2016):

- Maximum temperature range: 18.0 °C - 21.5 °C
- Minimum temperature range: 5.0 °C - 13.0 °C
- Rainfall 2.7 mm.

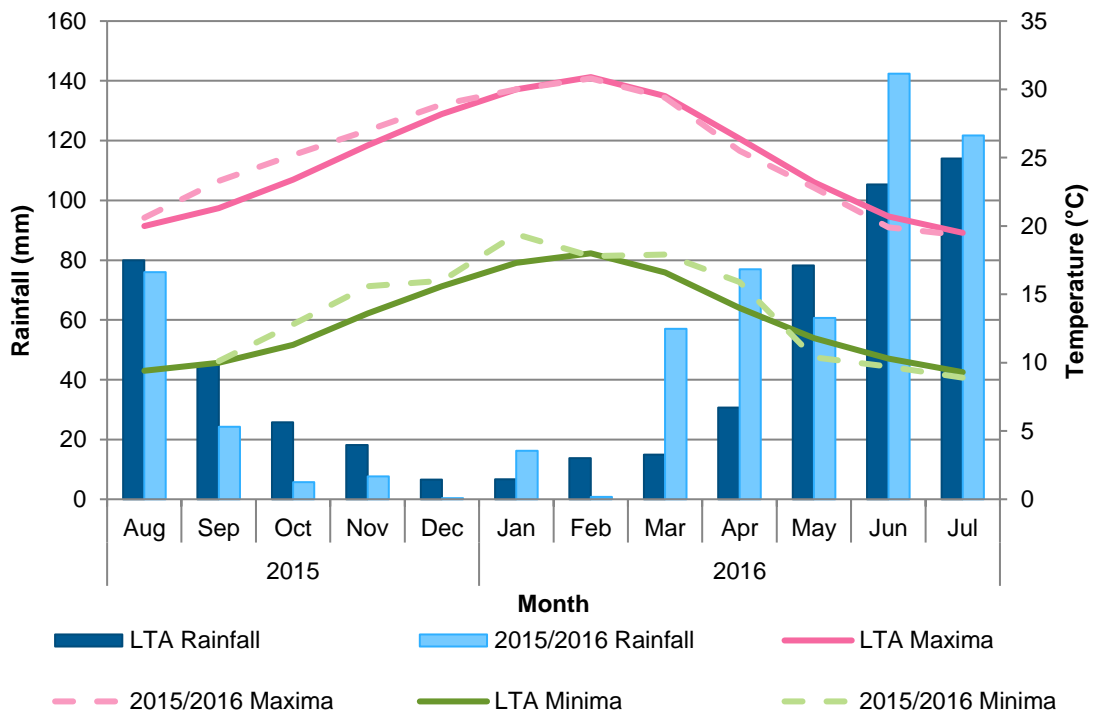


Plate 1 Rainfall and temperature data for Jurien Bay (BoM 2016)

3.2 Regional biogeography

The survey area is situated in the Southwest Botanical Province of WA (Beard 1990), within the Geraldton Sandplains Bioregion and Lesueur Sandplain Sub-region as described by the Interim Biogeographic Regionalisation of Australia (IBRA) (DotEE 2016c).

The Geraldton Sandplains Bioregion comprises the central and northern Perth Basin, the Pinjarra Orogen, and the south end of the Carnarvon Basin. Outcrops of Jurassic siltstones and sandstones can be heavily lateralised. Extensive proteaceous heaths and scrub-heaths often with emergent mallees, *Banksia* and *Actinostrobus*, occur on an undulating, lateritic sandplain mantling Permian to Cretaceous strata. These heaths are rich in endemics (CALM 2002).

The Lesueur Sandplain Subregion comprises coastal Aeolian and limestone soils, Jurassic siltstones and sandstones (often heavily lateralised) of the central Perth Basin. Alluvial soils are associated with drainage systems. There are extensive yellow sandplains in the south-eastern parts of the Subregion, especially where the Subregion overlaps the western edge of the Pilbara Craton. Shrub-heaths rich in endemics occur on a mosaic of lateritic mesas, sandplains, coastal sands and limestone soils (Desmond and Chant 2001).

3.3 Landforms and soils

The survey area is located within the Arrowsmith Zone of the Greenough Province. The Greenough Province is characterised by a lateritised plateau developed on Jurassic and Permian sediments and Proterozoic granites; dissected at fringes. There is a narrow coastal plain with Quaternary sands and calcarenite on the western margin. The Arrowsmith Zone is characterised by a dissected lateritic sandplain on Cretaceous and Jurassic sediments and is bounded in the east by the Dandaragan Scarp and in the south and west by the Gingin Scarp. The sandy and gravelly soils were formed in colluvium and the rock weathered in-situ (Schoknecht *et al.* 2004).

The Australian Soil Resource Information System (ASRIS) (2016) mapping indicates that one soil landscape type occurs within the survey area:

- Wd10 – Broad valleys and undulating interfluvial areas; some evenly sloping pediments with exposure of sandstone and shale. Chief soils are sandy acidic yellow mottled soils, containing much ironstone gravel in the A horizons and forming a complex pattern with lateritic sandy gravels. Associated are leached sands underlain by lateritic gravels, and mottled clays that occur about three feet in depth. Other soils include yellow duplex soils as well as podzol soils on the pediments; and red duplex soils in areas where country rock has been exposed.

3.4 Hydrology

A summary of the Department of Water (DoW) Geographic Data Atlas (DoW 2016) results for the survey area is provided in Table 4. The study area is located within the Jurien Groundwater Area and the Hill River and Tributaries Catchment Surface Water Area as listed under the *Rights in Water and Irrigation Act 1914* (RIWI Act). Murbinea Creek and associated minor tributaries flow through the western portion of the survey area (Figure 2; Appendix A).

Table 4 Department of Water geographic atlas queries for the survey area

Aspect	Details	Result
Groundwater areas	Groundwater areas proclaimed under the RIWI Act.	Jurien
Surface water areas	Surface water areas proclaimed under the RIWI Act.	Hill River and Tributaries Catchment
Irrigation district	Irrigation Districts proclaimed under the RIWI Act.	None present
Rivers	Rivers proclaimed under the RIWI Act.	None present
Public Drinking Water Source Areas (PDWSA)	PDWSAs is a collective term used for the description of Water Reserves, Catchment Areas and Underground Pollution Control Areas declared (gazetted) under the provisions of the <i>Metropolitan Water Supply, Sewage and Drainage Act 1909</i> or the <i>Country Area Water Supply Act 1947</i> .	None present
Waterway Management Areas	Areas proclaimed under the <i>Waterway Conservation Act 1976</i> .	None present

3.5 Land use

3.5.1 Conservation reserves and estate

There are a number of DPaW-managed conservation areas located within the study area including: Drovers Cave National Park, Beekeepers Nature Reserve, Hill River Nature Reserve, South Eneabba Nature Reserve and a number of smaller Crown reserves for the conservation of flora and fauna. The closest DPaW-managed conservation areas are located immediately adjacent to the survey area, including the Coomallo Nature Reserve (Class C) to the east and Lesueur National Park (Class A) to the north. No DPaW-managed conservation areas are located within the survey area.

3.5.2 Environmentally Sensitive Areas

A number of Environmentally Sensitive Areas (ESAs) are located within the study area, primarily associated with the presence of TECs and Threatened flora locations. Two ESAs located adjacent to the survey area include the Coomallo Nature Reserve located to the east and Lesueur National Park located to the north. A ESA associated with the TEC 'Lesueur-Coomallo Floristic Community D1' is located within the survey area (Figure 2, Appendix A).

3.5.3 Important bird areas

In a project managed by BirdLife Australia, thirteen Important Bird Areas (IBAs) have been designated specifically for Carnaby's Black Cockatoo (Dutson *et al.* 2009). IBAs are sites of global bird conservation importance and are considered a priority for bird conservation. The criteria used for the designation of IBAs for Carnaby's Black Cockatoo are sites supporting at least 20 breeding pairs, or 1% of the population regularly utilising an area in the non-breeding part of the range. Coomallo IBA is within 5 km of the survey area, with the actual Coomallo Reserve lying adjacent to the eastern boundary of the survey area. This IBA supports populations of Carnaby's Black Cockatoo (up to 40 breeding pairs), and is identified as an important breeding area for the species (Dutson *et al.* 2009). In addition to Carnaby's Black Cockatoo, the Coomallo IBA is known to maintain five other bird species recognised as globally important populations. These are the Western Long-billed Corella, Regent Parrot, Rufous Treecreeper, Blue-breasted Fairywren and Western Spinebill.

3.5.4 Pre-European vegetation associations and extent

Broad scale (1:250,000) pre-European vegetation mapping of the Geraldton Sandplains area was completed by Beard (1979) at an association level. The mapping indicates that three vegetation associations are present within the survey area:

- Medium woodland; marri & wandoo (association 4)
- Mosaic: Shrublands; hakea scrub-heath / Shrublands; dryandra heath (association 1031)
- Mosaic: Medium woodland; marri, wandoo, powder bark / Shrublands; dryandra heath (association 1032).

The pre-European mapping was adapted and digitised by Shepherd *et al.* (2002). The extents of the vegetation associations have been determined by the State-wide vegetation remaining extent calculations maintained by DPaW (latest update May 2016 – Government of Western Australia (GoWA) 2015). The current extent remaining of vegetation association 1032 is greater than 30 % of the pre-European extent at all scales (e.g. State, IBRA Bioregion, IBRA Sub-region and Local Government Area (LGA), and is therefore above the 30 % threshold level³.

Vegetation association 4 has less than 30 % of its pre-European extent remaining as the State level, however is greater than 30 % at the IBRA Bioregion, IBRA Sub-region and Local Government Area (LGA) level. Vegetation association 1031 has less than 30 % of its pre-European extent remaining as the LGA level, however is greater than 30 % at the State, IBRA Bioregion and IBRA Sub-region level. The extent remaining for each association is summarised in Table 5.

Table 5 Pre-European vegetation extents (Beard 1979, GoWA 2015)

Vegetation association	Scale	Pre-European extent (ha)	Current extent (ha)	Remaining (%)	% Current extent in all DPaW managed lands
4	State: Western Australia	1,054,279.89	293,916,.91	27.88	22.74
	IBRA Bioregion: Geraldton Sandplains	5,336.70	2,130.04	39.91	18.87
	IBRA Sub-region: Lesueur Sandplain	5,336.70	2,130.04	39.91	18.87
	LGA: Shire of Dandaragan	6,476.43	2,777.00	42.88	21.28
1031	State: Western Australia	269,490.91	88,606.02	32.88	42.30
	IBRA Bioregion: Geraldton Sandplains	241,349.97	83,154.99	34.45	44.13
	IBRA Sub-region: Lesueur Sandplain	241,349.97	83,154.99	34.45	44.13
	LGA: Shire of Dandaragan	230,488.23	67,978.55	29.49	52.13
1032	State: Western Australia	8,317.21	6,472.06	77.82	79.23

³ The 30 % threshold level is the level below which species loss appears to accelerate exponentially at an ecosystem level (EPA 2000).

Vegetation association	Scale	Pre-European extent (ha)	Current extent (ha)	Remaining (%)	% Current extent in all DPaW managed lands
	IBRA Bioregion: Geraldton Sandplains	8,317.21	6,472.06	77.82	79.23
	IBRA Sub-region: Lesueur Sandplain	8,317.21	6,472.06	77.82	79.23
	LGA: Shire of Dandaragan	3,075.84	2,653.17	86.26	78.06

3.6 Conservation significant ecological communities

A search of the EPBC Act PMST database did not identify any Commonwealth listed TECs within the study area. However, a search of the DPaW TEC database identified the presence of two TECs within the study area. The two TECs include:

- Lesueur-Coomallo Floristic Community A1.2, listed as Endangered under the WC Act. This community is described as species-rich heath with emergent *Hakea obliqua* on sand with faithful species of *Hakea obliqua* and *Beaufortia* aff. *elegans* and constant species of *Dasyogon bromeliifolius* and *Stirlingia latifolia* over well-drained grey sand over pale yellow sand on lateritic uplands. Associated species include *Allocasuarina humilis*, *Calothamnus sanguineous*, *Hibbertia hypericoides*, *Hypocalymma xanthopetalum* and *Schoenus subflavus*. This community is found north of the survey area, within Lesueur National Park
- Lesueur-Coomallo Floristic Community D1, listed as Critically Endangered under the WC Act. This community comprises a species-rich low heath, on moderately to well-drained lateritic gravels on lower slopes and low rises, dominated by *Allocasuarina microstachya* with *A. ramosissima*, *A. humilis*, *Baeckeke grandiflora*, *Borya nitida*, *Calytrix flavescens*, *Calothamnus sanguineous*, *Conostylis androstemma*, *Cryptandra pungens*, *Banksia armata*, *Gastrolobium polystachyum*, *Hakea auriculata*, *H. incrassata*, *H. aff. erinacea*, *Hibbertia hypericoides*, *Hypocalymma xanthopetalum*, *Melaleuca trichophylla*, *Petrophile chrysantha*, *Schoenus subflavus* and *Xanthorrhoea drummondii*. This community has previously been recorded within the survey area.

The database search also identified the presence of three PECs within the study area. The three PECs have all previously been recorded within the survey area and include:

- Lesueur-Coomallo Floristic Community DFGH (Priority 1) is described as mixed species-rich heath on lateritic gravel with *Hakea erinacea*, *Melaleuca platycalyx* and *Petrophile seminuda*: a fine scale mixture of four floristically-defined communities occurring on lateritic slopes. The four communities include 'D' Heath and woodlands on gravelly hills and slopes, 'F', 'G' and 'H' Heath on duplex soils, on benched slopes and broad valleys. Community 'D' comprises of five subtypes. D1: *Allocasuarina microstachya* Heath, D2: *Hakea undulata* Heath (Gravel type), D3: *Leucopogon* Heath, D4: *Darwinia neildiana* Heath and D5: *Petrophile chrysantha* Heath. Community 'F' comprises of *Hakea erinacea* Heath, Community 'G' of *Melaleuca platycalyx* Heath and 'H' of *Petrophile seminuda* heath
- Lesueur-Coomallo Floristic Community M2 (*Melaleuca preissiana* woodland) (Priority 1) is described as a *Melaleuca preissiana* woodland along sandy drainage lines with faithful

species of *Anigozanthos pulcherrimus* and constant species of *Chamaescilla corymbosa*, *Petrophile brevifolia* and *Xanthorrhoea reflexa*

- *Petrophile chrysantha* low heath on Lesueur dissected uplands (Gp200-170) (Priority 2) is described as a *Petrophile chrysantha* low heath on Lesueur dissected uplands. Associated species include *Banksia armata* and *Hakea undulata*.

3.7 Flora

3.7.1 Flora diversity

A search of the *NatureMap* database identified 1,595 plant taxa, representing 91 families and 371 genera, which have previously been recorded within the study area. This total comprised 1,506 native flora taxa and 89 naturalised (non-native) flora taxa. Dominant families include Myrtaceae (228 taxa), Proteaceae (185 taxa), Fabaceae (167 taxa) and Asteraceae (77 taxa). The *NatureMap* database search is provided in Appendix C.

3.7.2 Conservation significant flora

Desktop searches of the EPBC Act PMST database, *NatureMap* database, and the DPaW TPFL and WA Herbarium databases identified the presence/potential presence of 190 conservation significant flora taxa within the study area.

The desktop searches recorded:

- 36 taxa listed as Threatened under either the EPBC Act and/or the WC Act
- 14 Priority 1 taxa listed by the DPaW
- 47 Priority 2 taxa
- 64 Priority 3 taxa
- 29 Priority 4 taxa.

The locations of conservation significant flora registered on the DPaW databases are provided in Figure 2, Appendix A. A Likelihood of Occurrence assessment for the conservation significant flora is provided in Appendix D.

3.7.3 Introduced flora (weeds)

A search of the *NatureMap* (DPaW 2016) database identified 89 introduced flora taxa previously recorded within the study area. One is listed as a Declared Pest (s22) under the *Biosecurity and Management Act 2007* (BAM Act), **Asparagus asparagoides*, with C3 management required in the whole of state. None are listed as a Weed of National Significance (WoNS) (DotEE 2016d).

3.8 Fauna

3.8.1 Fauna diversity

A search of *NatureMap* identified 187 vertebrate native fauna taxa previously recorded within 20 km of the survey area. This total included 17 mammals (three introduced), 10 amphibians, 111 birds, 47 reptiles and 2 fish. The EPBC Act PMST indicated the potential presence of nine additional fauna taxa within 20 km of the survey area.

3.8.2 Conservation significant fauna

Searches of the EPBC Act PMST and *NatureMap* database identified the presence/potential presence of 16 conservation significant fauna species (Appendix E). Species identified by the PMST as marine and migratory marine were excluded from this assessment as no marine

habitats were present within or nearby the survey area, however species identified by the PMST as migratory terrestrial and wetland were considered as part of this assessment.

In addition to the 16 species identified by the database searches, five additional species were also considered for this assessment as a result of a review of the species listed under Schedules 1-3 and 5-7 of the WC Act (revised 20 November 2015) to occur within the DPaW Swan region (DPaW 2015).

4. Field results

4.1 Vegetation




4.1.1 Vegetation types




Fourteen vegetation types (VT) were identified and described from the survey area (Table 6 and Figure 3, Appendix A). The soil type varied throughout the survey area from white/grey sandy soils on slopes and plains to heavy brown/light brown clay loam soils in drainage lines. Sandy loam soils were also found throughout the survey area on slopes and plains. The varying soil types also had varying degrees of lateritic gravel present, from no gravel through to lateritic boulders. The survey area is dominated by woodlands comprising of either *Eucalyptus wandoo* (VT10), *Corymbia calophylla* (VT09) or a mixed woodland of *Eucalyptus todtiana*, *Banksia attenuata* and *B. menziesii* (VT05) (27.61%, 30.99% and 11.02% of the survey area respectively). VT01 is the most restricted vegetation type and occurs on light brown clay/sandy loam soils on slopes with lateritic gravel occupying only 0.11 ha of the survey area. VT03 and VT07 are associated with *Melaleuca* species along drainage lines, with VT10 also occurring in the valleys between low rises. The remaining seven vegetation types are all heathlands with the vegetation rarely exceeding 1500 mm and comprised of a range of species at varying densities. The areas recovering from previous material extraction activities along the eastern boundary of the survey area is comprised of a similar species composition as the surrounding vegetation and has not been mapped as a separate vegetation type. Areas identified as cleared/highly disturbed (VT14) are areas that have been cleared for pasture species with emergent/isolated *Corymbia calophylla*, *Eucalyptus wandoo* and *Melaleuca raphiophylla* trees.




4.1.2 Other significant vegetation




All of the native vegetation within the survey area is considered significant vegetation as defined by the EPA and DPaW (2015) due to the majority of the survey area being classified in a Pristine condition that contains different combinations of taxa associated with a variety of heathlands and provides a linkage between Lesueur National Park and Coomallo Nature Reserve. In addition, the vegetation is a refuge for a number of conservation significant flora that occur throughout the survey area in a variety of vegetation types.



Table 6 Vegetation associations recorded during the field survey

Vegetation types	Description	Landform and substrate	Extent (ha) and Locality	Representative photograph
<i>Allocasuarina microstachya</i> heathland (VT01)	Heathland of <i>Allocasuarina microstachya</i> with <i>A. humilis</i> , <i>Banksia armata</i> , <i>Hakea incrassata</i> , <i>Hibbertia hypericoides</i> , <i>Hypocalymma xanthopetalum</i> and <i>Melaleuca ?trichophylla</i> over sparse rushland <i>Schoenus ?nanus/latitans</i> , <i>S. subflavus</i> and isolated sedges of <i>Lepidobolus quadratus</i> (P3) over isolated grasses <i>Neurachne alopecuroidea</i> with <i>Xanthorrhoea drummondii</i> .	Light brown clay/sandy loam soils on slopes with lateritic gravel.	0.11 ha Quadrat: HR01	
<i>Petrophile chrysantha</i> heathland (VT02)	Heathland of <i>Petrophile chrysantha</i> with <i>Banksia armata</i> , <i>Calothamnus sanguineus</i> , <i>Daviesia nudiflora</i> , <i>Hakea anadenia</i> , <i>Hakea erinacea</i> and <i>Hibbertia hypericoides</i> over sparse rushland <i>Schoenus ?nanus/latitans</i> , and isolated sedge <i>Lepidosperma squamatum</i> with isolated herbs <i>?Craspedia</i> sp., <i>Burchardia</i> sp., <i>Tetrateca paucifolia</i> and <i>Anigozanthos humilis</i> over isolated grasses <i>Neurachne alopecuroidea</i> .	Grey sandy clay soils on slopes with lateritic gravel.	4.26 ha Quadrat: HR04	
<i>Melaleuca preissiana</i> open woodland (VT03)	<i>Melaleuca preissiana</i> open woodland over sparse shrubland <i>M. ?delta</i> and <i>Acacia saligna</i> over open heathland <i>Verticordia</i> sp., <i>Calothamnus quadrifidus</i> and <i>Hakea varia</i> over isolated herbs <i>Drosera ?macrantha</i> , <i>Chamaescilla corymbosa</i> , <i>Trachymene pilosa</i> and <i>Tricoryne elatior</i> .	Grey sandy drainage lines.	3.64 ha Quadrat: HR02	

Vegetation types	Description	Landform and substrate	Extent (ha) and Locality	Representative photograph
<i>Melaleuca platycalyx</i> heathland and <i>Eucalyptus wandoo</i> subsp. <i>pulverea</i> woodland (VT04)	<i>Eucalyptus wandoo</i> subsp. <i>pulverea</i> woodland over <i>Melaleuca platycalyx</i> heathland with <i>Gastrolobium polystachyum</i> , <i>Banksia armata</i> , <i>Calothamnus sanguineus</i> , <i>G. spinosum</i> , <i>Hakea neospathulata</i> and <i>Hibbertia hypericoides</i> over isolated herbs <i>Tetratheca paucifolia</i> and <i>Opercularia vaginata</i> with sparse grassland of <i>Neurachne alopecuroidea</i> and <i>Xanthorrhoea drummondii</i> .	Orange sandy clay soils on hill crest and slopes with lateritic pebbles.	29.27 ha Quadrat: HR03	
<i>Eucalyptus todtiana</i> , <i>Banksia attenuata</i> and <i>B. menziesii</i> woodland (VT05)	<i>Eucalyptus todtiana</i> , <i>Banksia attenuata</i> and <i>Banksia menziesii</i> woodland over heathland <i>Adenanthos cygnorum</i> subsp. <i>cygnorum</i> , <i>Eremaea</i> spp., <i>Hibbertia</i> spp., <i>Banksia candolleana</i> and <i>Jacksonia floribunda</i> over sparse herbland <i>Blancoa canescens</i> , <i>Conostylis</i> spp., <i>Drosera</i> spp. and <i>Johnsonia pubescens</i> subsp. <i>pubescens</i> .	White sandy plain.	219.93 ha Quadrat: HR10; HR12	
<i>Xanthorrhoea</i> and <i>Kingia</i> heathland (VT06)	<i>Xanthorrhoea</i> spp. and <i>Kingia australis</i> heathland with <i>Banksia</i> spp., <i>Calothamnus</i> spp., <i>Cryptandra</i> spp., <i>Hakea</i> spp., <i>Hibbertia</i> spp. over isolated rushes <i>Caustis dioica</i> and <i>Schoenus</i> spp. and sparse herbland of <i>Conostylis</i> spp., <i>Drosera</i> spp. and <i>Stylidium</i> spp.	White sandy soils on slopes and plains with lateritic gravel.	160.24 ha Quadrat: HR09; HR11; HR14; HR16; HR18	

Vegetation types	Description	Landform and substrate	Extent (ha) and Locality	Representative photograph
<i>Melaleuca raphiophylla</i> woodland (VT07)	<i>Melaleuca raphiophylla</i> woodland with <i>Eucalyptus rudis</i> over open shrubland <i>Pimelea argentea</i> , <i>M. viminea</i> , <i>Calothamnus quadrifidus</i> and <i>Trymalium odoratissimum</i> over open heathland <i>Hypocalymma angustifolium</i> , <i>M. platycalyx</i> and <i>Acacia</i> spp. over open herbland * <i>Lysimachia arvensis</i> , * <i>Romulea rosea</i> and * <i>Ursinia anthemoides</i> .	Brown clayey loam soils on drainage lines and seasonally wet flats.	31.67 ha Quadrat: HR08; HR15	
<i>Ecdeiocolea monostachya</i> herbland (VT08)	<i>Ecdeiocolea monostachya</i> herbland with <i>Drosera</i> spp. and <i>Burchardia</i> sp. with open heathland <i>Allocasuarina microstachya</i> , <i>Banksia armata</i> , <i>B. shuttleworthiana</i> , <i>Daviesia nudiflora</i> , <i>Hibbertia hypericoides</i> and <i>Opercularia vaginata</i> over isolated rushes <i>Schoenus ?nanus/latitans</i> .	Grey sandy soils on slopes.	24.01 ha Quadrat: HR13	
<i>Corymbia calophylla</i> woodland (VT09)	<i>Corymbia calophylla</i> woodland over heathland <i>Acacia</i> spp., <i>Banksia shuttleworthiana</i> , <i>Conospermum</i> sp., <i>Hibbertia hypericoides</i> and <i>Hakea</i> spp. over isolated rushes <i>Lepidosperma</i> sp., <i>Mesomelaena pseudostygia</i> and <i>Schoenus ?clandestinus</i> with isolated grasses <i>Neurachne alopecuroidea</i> and <i>Xanthorrhoea preissii</i> .	Grey sandy soils on slopes and plains.	618.12 ha Quadrat: HR06; HR19	

Vegetation types	Description	Landform and substrate	Extent (ha) and Locality	Representative photograph
<i>Eucalyptus wandoo</i> subsp. <i>pulverea</i> woodland (VT10)	<i>Eucalyptus wandoo</i> subsp. <i>pulverea</i> woodland over isolated heath <i>Banksia armata</i> , <i>Acacia pulchella</i> , <i>Hakea lissocarpha</i> , <i>Hypocalymma angustifolium</i> and <i>Macrozamia fraseri</i> over sparse herbland <i>Drosera</i> spp., * <i>Romulea rosea</i> , <i>Trachymene pilosa</i> and <i>Lagenophora huegelii</i> with sparse grassland <i>Neurachne alopecuroidea</i> , <i>Rytidosperma</i> sp. and <i>Xanthorrhoea drummondii</i> .	Brown clay loam soils on slopes and drainage lines.	550.73 ha Quadrat: HR05	
<i>Banksia attenuata</i> open heathland (VT11)	<i>Banksia attenuata</i> open heathland over <i>Eremaea asterocarpa</i> , <i>Hibbertia hypericoides</i> , <i>Hypocalymma xanthopetalum</i> , <i>Melaleuca ?tinkerii</i> , <i>Stirlingia latifolia</i> and <i>Strangea cynanchicarpa</i> over sparse rushland <i>Mesomelaena pseudostygia</i> and <i>Schoenus</i> spp. with isolated herbs <i>Conostylis</i> spp., <i>Drosera</i> spp. and <i>Stylidium</i> spp.	White sandy soils on slopes.	16.64 ha Quadrat: HR20	
Mixed heath with isolated clumps of mallee (VT12)	Heathland of <i>Allocasuarina humilis</i> , <i>Cryptandra pungens</i> , <i>Hakea anadenia</i> , <i>Hibbertia hypericoides</i> , <i>Conostephium preissii</i> and <i>Hypocalymma xanthopetalum</i> with isolated clumps of mallee <i>Eucalyptus drummondii</i> , <i>E. wandoo</i> subsp. <i>pulverea</i> and <i>Corymbia calophylla</i> over sparse rushland <i>Lepidosperma</i> spp. and <i>Schoenus</i> spp. with isolated herbs <i>Conostylis</i> spp., <i>Drosera</i> spp. and <i>Stylidium</i> spp. and sparse grassland <i>Neurachne alopecuroidea</i> , and <i>Xanthorrhoea drummondii</i> .	Orange sandy loam soils on slopes with occasional lateritic pebbles.	85.04 ha Quadrat: HR07	

Vegetation types	Description	Landform and substrate	Extent (ha) and Locality	Representative photograph
<i>Melaleuca</i> ? <i>concreta</i> heathland (VT13)	<i>Melaleuca</i> ? <i>concreta</i> heathland with <i>Calothamnus quadrifidus</i> , <i>Hakea lissocarpa</i> , <i>M. platycalyx</i> and <i>Verticordia</i> sp. over isolated herbs <i>Borya sphaerocephala</i> , <i>Drosera</i> spp. and <i>Stylidium</i> sp. with isolated rushes <i>Ficinia nodosa</i> and <i>Mesomelaena pseudostygia</i> .	Brown sandy loam soils on slopes with occasional lateritic pebbles.	3.14 ha Quadrat: HR17	
Pasture with emergent trees (VT14)	Pasture species with emergent/isolated <i>Corymbia calophylla</i> , <i>Eucalyptus wandoo</i> subsp. <i>pulverea</i> and <i>Melaleuca raphiophylla</i> trees.	-	247.94 ha	

4.1.3 Vegetation condition

The vegetation condition within the survey area was rated as between Pristine and Completely Degraded. The majority of vegetation throughout the survey area was rated as Pristine; in these areas the vegetation was pristine, or nearly so with no obvious signs of disturbance when removed from the access tracks. Areas mapped as Excellent appeared to be affected by more recent fires, with the occasional weed species present. The areas mapped as Very Good are largely restricted to creeklines and bordering previously cleared areas. These areas have a higher density of herbaceous introduced species present in the understorey with numerous diggings and grazing by feral pigs. The areas mapped as Degraded are areas that have been historically cleared for material extraction where a few native species are recovering. The area mapped as Completely Degraded is largely restricted to the area surrounding the homestead and the cleared paddock area within the central eastern boundary of the survey area. These areas are comprised of isolated native trees over predominantly *Arctotheca calendula*.

The extents of the vegetation condition ratings mapped within the survey area are provided in Table 7 with the vegetation condition of the survey area mapped in Figure 4, Appendix A.

Table 7 Extent of vegetation condition ratings within the survey area

Vegetation Condition	Extent (ha)
Pristine	1220.51 ha
Excellent	502.69 ha
Very Good	19.06 ha
Degraded	4.54 ha
Completely Degraded	247.94 ha
Total	1994.74 ha

4.2 Conservation significant ecological communities

The known location of the TEC 'Lesueur-Coomallo Floristic Community D1' and the three PECs ('Lesueur-Coomallo Floristic Community DFGH'; 'Lesueur-Coomallo Floristic Community M2 (*Melaleuca preissiana* woodland)'; '*Petrophile chrysantha* low heath on Lesueur dissected uplands (Gp200-170)') that were identified during the desktop search as occurring within the survey area (See Section 3.6.2) were targeted during the field survey. The conservation significant ecological communities identified within the survey area and the associated vegetation types are described below:

- Lesueur-Coomallo Floristic Community D1, listed as Critically Endangered under the WC Act. VT01 is associated with this TEC. Quadrat data from HR01 contain most of the species that are identified with this TEC. In addition, the density of the *Allocasuarina* within this vegetation type stands out in the landscape amongst the heath
- VT03 is associated with the Lesueur-Coomallo Floristic Community M2 (*Melaleuca preissiana* woodland) Priority 1 PEC. Quadrat data from HR02 contains all the species identified in the community description from DPAW, with the exception of *Anigozanthos pulcherrimus* which may have been missed during the survey due to the species not being in flower. No other areas identified within the survey area contained the density of *Melaleuca preissiana* along the drainage lines
- VT04 is associated with the Lesueur-Coomallo Floristic Community DFGH Priority 1 PEC, in particular 'D' heath and woodlands on gravelly hills and slopes. The woodland is characterised with *Eucalyptus wandoo* with the quadrat and observational data from HR03 containing all five species identified within the subtypes. Locally, *Melaleuca platycalyx* was one of the more dominant shrubs

- VT02 is associated with the *Petrophile chrysantha* low heath on Lesueur dissected uplands (Gp200-170) Priority 2 PEC. Quadrat data from HR04 contains the three species identified in the community description from DPAW. In addition, no other heath areas within the survey area contained similar species composition.

4.2.1 Flora diversity

The field survey recorded 344 taxa (including subspecies and varieties) representing 51 families and 149 genera within the survey area. This total comprised 330 native species and 13 introduced (exotic) species. Due to the absence of adequate flowering parts and/or fruiting bodies required for identification, nine taxa could only be tentatively identified to family and 56 taxa could only be tentatively identified to genera. Due to the high floral diversity of the survey area and the numerous conservation significant taxa previously recorded within the study area (See section 3.6.4), there is no certainty that collections without flowering or fruiting material are common or conservation significant flora identified in the desktop assessment.

Dominant families recorded from the survey area included:

- Proteaceae (59 taxa)
- Fabaceae (45 taxa)
- Myrtaceae (39 taxa)
- Haemodoraceae (18 taxa)
- Cyperaceae (13 taxa)
- Orchidaceae (13 taxa).

Annual species represented 6.12 % of all recorded plant species within the survey area. The average species richness for the 20 quadrats was 38.55 +/- 1.74 (mean +/- standard error of the mean), with a range of 25 to 53 species per quadrat.

A flora species list for the survey area is provided in Appendix D.

4.2.2 Conservation significant flora

The location of conservation significant flora recorded during the survey is presented in Figure 3, Appendix A.

EPBC Act and WC Act

One EPBC Act and WC Act listed flora taxa was recorded within the survey area during the 2016 survey, *Hakea megalosperma* (listed as Vulnerable under both the EPBC Act and WC Act). *Hakea megalosperma* (Plate 2) is known from 91 records (DPaW 2016). Most of the records are located within the region surrounding Jurien Bay, with a single record located north of Albany near the Stirling Ranges. This species was recorded from two locations within the survey area (Figure 3) with up to 12 shrubs (including juveniles) recorded within 20 m at each location.



Plate 2 *Hakea megalosperma* recorded within survey area (J Foster)

DPaW Priority Listed Flora Taxa

Eight Priority flora taxa were recorded from the survey area:

- *Acacia retrorsa* (Priority 2)
- *Grevillea delta* (Priority 2)
- *Thelymitra variegata* (Priority 2)
- *Hensmania stoniella* (Priority 3)
- *Lepidobolus quadratus* (Priority 3)
- *Stylidium ?hymenocraspedum* (Priority 3)
- *Stylidium ?torticarpum* (Priority 3)
- *Hakea neurophylla* (Priority 4).

Acacia retrorsa (Plate 3) is known from 33 records (DPaW 2016). All of the records are located within the region surrounding Jurien Bay. This species was recorded from three locations within the survey area on slopes and in drainage lines (Figure 3). Species confirmed by Michael Hislop from the WA Herbarium (Accession Number 6917).



Plate 3 *Acacia retrorsa* recorded within survey area (M Gannaway)

Grevillea delta (Plate 4) is known from 22 records (DPaW 2016). All of the records are located within the region surrounding Jurien Bay. This species was recorded from a single location

within the survey area on the lower slope, adjacent to a drainage line (Figure 3). Species confirmed by Michael Hislop from the WA Herbarium (Accession Number 6917).



Plate 4 *Grevillea delta* recorded within survey area (J Foster)

Thelymitra variegata (Plate 5) is known from 52 records (DPaW 2016). Records are mainly scattered along the coastal areas from Perth to Albany, with two records located in the Wheatbelt. A single record is located north of Perth near Lesueur National Park. This species was recorded from a single location within the survey area on a white sandy plain (Figure 3).



Plate 5 *Thelymitra variegata* recorded within survey area (J Foster)

Hensmania stoniella (Plate 6) is known from 44 records (DPaW 2016). All of the records are located within the region surrounding Jurien Bay. This species was recorded from a single location within the survey area on the upper slope of a low rise with white sandy soil (Figure 3). Species confirmed by Michael Hislop from the WA Herbarium (Accession Number 6917).



Plate 6 *Hensmania stoniella* recorded within survey area (J Foster)

Lepidobolus quadratus (Plate 7) is known from 46 records (DPaW 2016). All of the records are located within the region surrounding Jurien Bay. This species was recorded from two locations within the survey area on the mid and upper slopes of a low rise with clayey sandy soil (Figure 3). Species confirmed by Michael Hislop from the WA Herbarium (Accession Number 6917).



Plate 7 *Lepidobolus quadratus* recorded within survey area (J Foster)

Stylidium ?hymenocraspedum (Plate 8) is known from 27 records (DPaW 2016). All of the records are located within the region between Jurien Bay and Lancelin. This species was recorded from two locations within the survey area on grey sandy slopes of a low rise (Figure 3). This species had insufficient flowering material to confirm to species, however the basal leaves and labellum align with the description for this species.



Plate 8 *Stylidium ?hymenocraspedum* recorded within survey area (J Foster)

Stylidium ?torticarpum (Plate 9) is known from 59 records (DPaW 2016). The records are spread along the coast from the north of Geraldton to the south of Lancelin. This species was recorded from a single location within the survey area on brown clay loam soils within a drainage line (Figure 3). This species had insufficient flowering material to confirm to species, however the basal leaves and seed capsule align with the description for this species.



Plate 9 *Stylidium ?torticarpum* recorded within survey area (J Foster)

Hakea neurophylla (Plate 10) is known from 33 records (DPaW 2016). The records are spread along the coast from the north of Geraldton to the south of Lancelin. This species was recorded from two locations within the survey area on grey sandy soils on slopes (Figure 3). This species had sufficient flowering material to positively identify at the WA Herbarium.



Plate 10 *Hakea neurophylla* recorded within survey area (J Foster)

Likelihood of Occurrence

A Likelihood of Occurrence assessment was conducted post-field survey for all conservation significant flora taxa identified in the desktop assessment (Appendix D). This assessment took into account previous records, habitat requirements, efficacy of the survey, intensity of the survey, flowering times and the cryptic nature of species.

The Likelihood of Occurrence assessment post-field survey concluded that seven taxa are known to occur, two are likely to occur, 152 may possibly occur and the remaining 29 taxa are unlikely or highly unlikely to occur within the survey area. A summary of the outcomes of species considered as known or likely to occur is provided below (Table 8). The large number of conservation significant taxa that are considered possibly to occur is due to the survey area comprising of a varied landscape with a range of soils and landforms that align with the habitat considered suitable for the species. In addition, most of the conservation significant taxa have been recorded in the adjacent Lesueur National Park and Coomallo Nature Reserve.

Table 8 Summary of Likelihood of Occurrence Assessment

Species	State (WC Act/ DPaW listing)	Federal (EPBC Act listing)	Likelihood of Occurrence
<i>Hakea megalosperma</i>	VU	VU	Known – species was recorded from within the survey area.
<i>Acacia retrorsa</i>	P2	-	Known – species recorded within the survey area.
<i>Grevillea delta</i>	P2	-	Known – species was recorded within the survey area.
<i>Thelymitra variegata</i>	P2	-	Known – species was recorded from within the survey area.
<i>Hensmania stoniella</i>	P3	-	Known – species was recorded from within the survey area.

Species	State (WC Act/ DPaW listing)	Federal (EPBC Act listing)	Likelihood of Occurrence
<i>Lepidobolus quadratus</i>	P3	-	Known – species was recorded from within the survey area.
<i>Stylidium ?hymenocraspedum</i>	P3	-	Likely – infertile specimen of this species was potentially recorded from within the survey area.
<i>Stylidium ?tortycarpum</i>	P3	-	Likely – infertile specimen of this species was potentially recorded from within the survey area.
<i>Hakea neurophylla</i>	P4	-	Known – species was recorded from within the survey area.

4.2.3 Introduced flora

The majority of the survey area is in a Pristine condition with the presence of introduced species generally restricted to the cleared paddock area, along creeklines and the borders of vegetation adjacent to previously cleared areas (see Section 4.1.3). Thirteen introduced taxa were recorded within the survey area during the field survey (Appendix D). The most commonly recorded weed species in the survey area include **Arctotheca calendula*, **Hypochaeris glabra* and **Romulea rosea*.

Weeds of National Significance and Declared Pests

No introduced species listed as a Declared Pest plant under Section 22 of the BAM Act or a WoNS (DotEE 2016d), was recorded within the survey area.

4.2.4 Other significant flora

No other significant flora as defined by the EPA and DPaW (2015) was identified within the survey area during the field survey.

4.3 Fauna

4.3.1 Fauna habitat

Seven main fauna habitat types were recorded during the field survey, which broadly aligned with the vegetation associations described in section 4.1.1 and mapped in Figure 3, Appendix A and include:

- Wandoo Woodlands
- Marri Woodland
- *Eucalyptus tottiana*, *Banksia attenuata/menziesii* low Open Woodland
- Minor drainage lines and seasonally inundated areas and dams
- Heathlands on sandy soils
- Heathlands on lateritic soils
- Scattered trees of Wandoo and Marri in paddock.

The topography of survey area is undulating ranging from gentle to steep slopes with valleys and small hills present. Several creek lines (from three drainage systems) drain to the east and south, dividing the undulating terrain and low hills within the survey area. Soils were predominantly sandy-clay grey loams in the valleys or white to orange sands in the heaths, with some heaths along elevated areas having lateritic gravels or capping. Occasional exposed lateritic ridgelines were also recorded on small hills.

The habitat types for the survey area are described in Table 9.

Habitat connectivity

The fauna habitats of the survey area are part of a contiguous largely intact area of remnant vegetation within the local area and greater study area. To the north west of the survey area lies Mount Lesueur National Park (26,987 ha) and Beekeeper Nature Reserve (120,000 ha) and to the east Coomallo Nature Reserve (9,200 ha) with numerous areas of vegetated remnant (freehold) lands surrounding. Outside of the reserved remnant areas the land has been extensively cleared for agriculture and is part of the Western Australian Wheatbelt, with portions of the western boundary of the survey area abutting cleared agricultural land. Within the survey area a portion (248 ha) of land has previously been cleared. This area has some large habitat trees scattered throughout, which could be utilised by some fauna species.

The ephemeral drainage lines are part of a larger network of watercourses ultimately draining into the much larger tributaries of the Hill River and Coomallo Creek linking the survey area to surrounding environments.

The southern boundary of the survey area borders Jurien Road and provides a barrier to some fauna moving south through the landscape. Apart from the cleared area within the survey area, a portion of agricultural land to the west and Jurien Road (and other minor access tracks) fauna movement is largely unrestricted. Overall, the habitats within the survey area are largely contiguous through the local area and mostly well connected with habitats through the greater study area.

Disturbance

Portions of the habitats within the survey area have been impacted to some degree by past disturbances including land clearing, dams, minor roads, fire and grazing. Minor roads make up a very small area of impact and were probably maintained by farmers for access and fire control. A small dwelling and associated infrastructure is present north of the large cleared area. Cattle and horse grazing is evident in portions of the survey area, particularly in the cleared areas or bushland adjacent to the cleared area. Feral pest disturbance was also present in selected areas with pig activity most prevalent in the north and west and evidence of rabbits also recorded in the survey area.

There were only small areas impacted by recent fire (less than 5 years) with the majority of the survey area being longer unburnt (> 20 years) or a mosaic of old fire scars. Most of the recent fire scars were in close proximity to the dwelling and infrastructure near the centre of the survey area.

Habitat value


The survey area provides significant habitat diversity for many native fauna species, including species of conservation significance. This is due to the diversity and quality of habitat types (e.g. good to excellent structural and floristic diversity within each habitat type), good connectivity and for supporting known and potential habitat values for conservation significant fauna species (see Table 9). The habitats within the survey area are mostly intact, variable in composition and well connected with habitats within the local area and greater study area.


Aerial photography indicates the habitats of the survey area are well represented within the local area and are probably well represented within the greater study area. The adjoining Mt Lesueur National Park (and Beekeepers Nature Reserve) and Coomallo Nature Reserve are also known to have high value (e.g. habitat quality) habitats for conservation significant fauna, with the survey area linking these two highly important areas. The survey area plus the national park and reserve create an area of approximately 158,187 ha of continuous habitat.


Important Bird Areas

Five avian species considered important populations were recorded during the field survey and include the Western Long-billed Corella (*Cacatua pastinator*), Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*), Blue-breasted Fairy Wren (*Malurus pulcherrimus*), Western Spinebill (*Acanthorhynchus superciliosus*) and Rufous Treecreeper (*Climacteris rufa*). They are all considered to be part of "Globally Important Bird Populations" in this region (Dutson *et al.* 2009). Of these species, the Western Long-billed Corella and Carnaby's Black Cockatoo were recorded breeding in Wandoo in the survey area.

Table 9 Fauna habitat types within survey area

Description	Indicative photograph
<p>Wandoo Woodland – 580 ha Vegetation association: VT10 (550.73 ha), VT04 (29.27 ha)</p> <p>This habitat type occurs across a large portion of the survey area in the valleys or areas of low rises and is mostly dominated by Wandoo (<i>Eucalyptus wandoo</i>) with little understorey, however some areas had an understorey of <i>Melaleuca platycalyx</i> heath of 30% cover. The overstorey consist of open woodland of Wandoo trees (DBH >300 mm) at approximately 26 trees per hectare. These trees were often large (to 20 m) and provided small, medium and large hollows. Large hollows were present in approximately three trees per hectare (based on stem density counts of trees with DBH > 300 mm). The shrub/midstorey layer was sparse but sometimes moderate to dense in small patches and consisted of <i>Acacia</i>, <i>Banksia</i> and <i>Hakea</i> species.</p> <p>The soils consisted of brown clay loam with small areas of gravel incursion. Stony areas are present around valley crests and in some areas formed small breakaways however these were small and scattered.</p> <p>The majority of the Wandoo Woodland area appeared long unburnt (> 20 years) given the lack of historical fire scar evidence. Some small areas (particularly those woodlands closest to the homestead) had more recent burn scars (<5 years).</p> <p>The woodland provides good denning and breeding opportunities for small native ground mammals, birds and reptiles. Seven species of bird were recorded nesting in this habitat. The Western Long-billed Corella, Ringneck Parrot (<i>Barnardius zonarius semitorquatus</i>), Tree Martins (<i>Petrochelidon nigricans</i>), Galah (<i>Eolophus roseicapilla</i>) and Carnaby’s Black Cockatoo were all recorded nesting in hollows while Australian Raven (<i>Corvus coronoides</i>) and Whistling Kite (<i>Haliastur sphenurus</i>) were nesting in large trees. Animal tracks, digs and occasional small burrows were recorded in this habitat type, most of which were from Echidna (<i>Tachyglossus aculeatus</i>).</p> <p>Fallen branches and logs were common in this habitat type with many having a range of hollow sizes. The persistence of logs is probably an artefact of the lack of fire history. Leaf-litter and other forms of non-vascular ground cover (dead plant material) was common beneath trees and shrubs.</p> <p><u>Habitat value for fauna species of conservation significance</u></p> <p>High value</p> <p>Part of a larger area of contiguous remnant vegetation extending throughout the survey area. This habitat provides breeding, foraging and roosting habitat for Carnaby’s Black Cockatoo where at least 10 breeding events were recorded. The Peregrine Falcon (<i>Falco peregrinus</i>) may also utilise selected hollows for breeding but would also utilise the area for hunting and loafing. Chuditch (<i>Dasyurus geoffroyi</i>) could utilise the hollow bearing fallen logs and low hollows for denning and breeding purposes. The Woma python</p>	

Description	Indicative photograph
<p>(<i>Aspidites ramsayi</i>) may also utilise logs for resting. Western Brush Wallaby (<i>Macropus irma</i>) were recorded on camera in the area and known to utilise woodlands.</p>	
<p>Marri Woodland – 618 ha</p> <p>Vegetation association: VT09</p> <p>This habitat type occurs across the survey area mostly between the Wandoo Woodland and heathlands on plain or upper slopes. This habitat is patchy or thin corridors surrounding Wandoo and comprises areas of large Marri trees and smaller mallees in area suppositively where soils limit growth.</p> <p>The overstorey consists of an open woodland of trees including <i>Corymbia</i> and scattered <i>Eucalyptus</i> species (either Wandoo or Jarrah) to 30 m. The density of trees in this habitat was 12 trees per hectare (base on trees with DBH > 500 mm) and provided few small, medium and large hollows. Large hollows were present in approximately 1 tree per hectare with fewer large hollows being recorded in Marri woodland compared to Wandoo woodland habitat. The understorey is a dense mix of <i>Acacia</i>, <i>Banksia</i> and <i>Melaleuca</i> and other native shrubs which thins as you move into more densely clumped Marri areas.</p> <p>Fallen timber, hollow bearing logs were very occasionally recorded in this habitat type, which is probably an artefact of the open nature of this habitat. Leaf-litter and other forms of non-vascular ground cover was dense beneath trees and shrubs.</p> <p>The majority of the habitat was not recently burnt (> 5 years) given the lack of fire evidence recorded.</p> <p>The woodland provides good foraging opportunities for native mammals and birds such as possums, honey eaters, parrots and Cockatoos.</p> <p>Animal tracks and digs were recorded in this habitat type, most of which were Echidna and Western Grey Kangaroo browsing or using the dense foliage as cover. This habitat was also well utilised by pigs for the same purpose.</p> <p><u>Habitat value for fauna species of conservation significance</u></p> <p>High value</p> <p>Part of a larger area of contiguous remnant vegetation extending throughout the survey area. This habitat provides some breeding habitat for Carnaby's Black Cockatoo however no breeding events were recorded. Additionally, numerous observations of loafy/resting were observed and potential roosting could occur in large Marri. This habitat provides potential hunting and foraging opportunities for the Peregrine Falcon. Some of the very large Marri could also be utilised for breeding purposes. Chuditch could utilise the hollow bearing fallen logs and low hollows for denning and breeding purposes. The Woma python may also utilise logs for refuge. The dense understorey on the Marri Woodland could also be utilised by Quenda (<i>Isoodon</i></p>	

Description	Indicative photograph
<p><i>obesulus</i> subsp. <i>fusciventer</i>) and Western Brush Wallaby.</p>	
<p>Low heathlands on sandy soils – 128.83 ha Vegetation association: VT08 (24.01 ha), VT11 (16.64 ha), VT12 (85.04 ha), VT13 (3.14 ha) This habitat type occurs across the survey area and is associated with other heathlands on sandy soils. The low heathlands on sandy soils are a mosaic of vegetation associations in the survey area but are dominated by a dense coverage of <i>Ecdeiocolea monostachya</i>, <i>Melaleuca</i> sp., <i>Banksia</i> sp. (including <i>B. attenuata</i>), <i>Xanthorrhoea</i> sp. and Mallee (<i>Eucalyptus drummondii</i>). The majority of the heathland area appeared long unburnt (> 20 years) given the size and density of the habitat, however some areas were a mosaic of burn ages particularly in heathlands surrounding the homestead. The dense heathland provides good foraging and breeding opportunities for small native ground mammals, birds and reptiles. Small skinks, geckos and snakes were raked from sandy spoil heaps along the track during the survey. Animal tracks (including species run ways), digs and occasional small burrows were recorded in this habitat type, most of which were Echidna, Western Grey Kangaroo (<i>Macropus fuliginosus</i>), some varanid burrows and invertebrates (scorpions/spiders) digs/burrows. Fallen timber was not present however clumps of dead shrubs and <i>Xanthorrhoea</i> were scattered in this habitat type and provide good cover for ground dwelling species. The odd Mallee stump was also present but scattered throughout this habitat. Leaf-litter was scattered and densest in long unburnt areas. Litter was absent from those areas where fauna had created runways through the heathland.</p> <p><u>Habitat value for fauna species of conservation significance</u> High value A large portion of habitat that is part of a larger area of continuous remnant vegetation extending within and beyond the survey area (in both Mount Lesueur and Coomallo). This habitat provides potential hunting and foraging opportunities for the Peregrine Falcon and excellent foraging habitat for Carnaby’s Black Cockatoo where observations of feeding were observed on <i>Banksia attenuata</i>. Chuditch could utilise the heathlands for foraging. The Woma python and Black-striped Snake (<i>Neelaps calonotus</i>) could utilise the sandy soils for housing/denning and this habitat would be considered core habitat for these species. The dense heathland could also be utilised by Western Ground Parrot (<i>Pezoporus flaviventris</i>), Quenda and Western Brush Wallaby and would be considered core habitat.</p>	

Description

Indicative photograph

Low heathlands on lateritic soils – 164.61 ha

Vegetation association: VT01 (0.11 ha), VT02 (4.26 ha), VT06 (160.24 ha)

This habitat type occurs across the survey area and is associated with heathlands on lateritic soils. The low heathlands on lateritic soils are a mosaic of vegetation associations in the survey area but are dominated by a dense coverage of *Allocasuarina microstachya*, *Petrophile chrysantha*, and species of *Xanthorrhoea*, *Kingia* and *Banksia*. In some areas small outcrops or lateritic ridgelines were present but not large enough to be regarded as a stand along habitat. The majority of the heathland area appeared long unburnt (> 20 years) given the size and density of the habitat, however some areas were a mosaic of burn ages particularly in heathlands surrounding the homestead and on the lateritic hill in the north west of the survey area.

The dense heathland provides good foraging and breeding opportunities for small native ground mammals, birds and reptiles. Few small reptiles were recorded in this habitat during the survey and was probably a reflection of the lack of spoil heaps available in this habitat area searched. Animal tracks (including species run ways) and digs, most of which were Echidna, Western Grey Kangaroo and invertebrates (scorpions/spiders) digs/burrows.

Fallen timber was not present however clumps of dead shrubs and *Xanthorrhoea* were scattered in this habitat type and provide good cover for ground dwelling species. Leaf-litter was scattered and densest in long unburnt areas. Litter was absent from those areas where fauna had created runways through the heathland.

Habitat value for fauna species of conservation significance

High value

A large portion of habitat that is part of a larger area of continuous remnant vegetation extending within and beyond the survey area (in both Mount Lesueur and Coomallo). This habitat provides potential hunting and foraging opportunities for the Peregrine Falcon and excellent foraging habitat for Carnaby's Black Cockatoo. Chuditch could utilise the heathlands for foraging. The Woma python and Black-striped Snake may utilise areas of sand incursion for housing/denning and this habitat would be considered habitat for these species. The dense heathland could also be utilised by Western Ground Parrot and Quenda if present and would be considered core habitat. One Western Brush Wallaby was recorded on camera in this habitat type.



Description

Minor drainage lines and seasonally inundated areas and dams – 35.31 ha

Vegetation association: VT03 (3.64 ha), VT07 (31.67 ha)

This habitat type occurs across a small portion of the survey area and comprises ephemeral drainage lines that support a overstorey of Wandoo (*Eucalyptus wandoo*), Flooded Gum (*E. rudis*) and mid storey *Melaleuca preissiana* and *M. raphiophylla*. Sedges and mixed shrubs line portions of some drainage line banks. Dams for stock watering dug/placed within some drainage lines may have impacted flows in these areas. These habitat areas appeared long unburnt (> 20 years).

The drainage lines and seasonally inundated areas and dams provides habitat and breeding environments for frogs with five species recorded in these areas. Pobblebonks (*Lymnodynastes dorsalis*) and Bleating Froglet (*Crinia pseudinsignifera*) were recorded breeding in the survey area. The water bodies would also be utilised by most fauna species as a water source.

Fallen timber was present in this habitat type and consisted of wandoo logs, some with hollows. Non-vascular ground clover was mostly localised under vegetation and uncommon in areas of high water flow.

Habitat value for fauna species of conservation significance

High value

Part of a contiguous remnant vegetation extending beyond the survey area. This habitat provides a water resource for most fauna species in particular the Carnaby's Black Cockatoo that is breeding on site and would require a local water source. The Peregrine Falcon would utilise this area for hunting and if suitable breeding in large Wandoo. Chuditch, Quenda and Western Brush Wallaby may utilise this habitat and would be considered core habitat.

Indicative photograph



Description

***Eucalyptus todtiana*, *Banksia attenuata/menziesii* low open woodland – 219 ha**

Vegetation association: VT 05

This habitat type occurs in a portion of the survey area where soils are deep grey sands. The habitat comprises low open woodland that supports a overstorey of *Eucalyptus todtiana*, a midstorey of *Banksia attenuata* and *B. menziesii* and an understorey of *Macrozamia* sp., *Acacia* sp. and mixed shrubs. The majority of the low open woodland area appeared long unburnt (> 20 years) given the size and density of the habitat, however some areas were a mosaic of burn ages particularly in areas surrounding the homestead.

The dense understorey provides good foraging and breeding opportunities for small native ground mammals, birds and reptiles. Numerous bush birds were recorded in this habitat type and include Grey Shrike Thrush (*Colluricincla harmonica*), White-winged Triller (*Lalage tricolor*), Horsfield's Bronze-Cuckoo (*Chrysococcyx basalis*) and Spiny-cheeked Honeyeater (*Acanthagenys rufogularis*). Animal tracks (including species run ways), digs and occasional small burrows were recorded in this habitat type, most of which were Echidna and Western Grey Kangaroo.

Fallen timber was limited to areas under *E. todtiana*, however dense skirts of *Zamia* were present and where unburnt provided good cover for ground dwelling species. Leaf-litter was scattered and densest in long unburnt areas.


Habitat value for fauna species of conservation significance

High value

This habitat that is part of a larger area of continuous remnant vegetation extending within and beyond the survey area (in both Mount Lesueur and Coomallo). This habitat provides potential hunting and foraging opportunities for the Peregrine Falcon and excellent foraging habitat for Carnaby's Black Cockatoo. Chuditch could utilise the habitat for foraging. The Woma python and Black-striped Snake could utilise the sandy soils for refuge and this habitat would be considered core habitat for these species. The dense heathland could also be utilised by Western Ground Parrot, Quenda and Western Brush Wallaby and would be considered core habitat.

Indicative photograph



Description	Indicative photograph
<p><i>Scattered trees of Wandoo and Marri in Paddock - 247 ha with 27.5 ha of Wandoo, Marri tree cover</i></p> <p>Vegetation association: Disturbed/pasture</p> <p>This habitat type occurs in the cleared area on the eastern portion of the survey area where scattered Wandoo and Marri are present over pasture plants. The soils are light clay loam or sand with small areas of drainage lines and dams. This habitat is mostly disturbed however the isolated scattered paddock tree may provide habitat and linkage for birds and mobile mammals traversing the environment. Due to the nature of the habitat present both native and introduced grazers were recorded.</p> <p>Limited fallen branches, logs or hollows were present in this habitat type and were present only under the scattered trees.</p> <p>Numerous species able to adapt to a modified environment were recorded in this area including White-fronted Chats (<i>Epthianura albifrons</i>), Straw-necked Ibis (<i>Threskiornis spinicollis</i>), Wood Duck (<i>Chenonetta jubata</i>), Black Duck (<i>Anas superciliosa</i>) and Australian Pipit (<i>Anthus australis</i>).</p> <p><u><i>Habitat value for fauna species of conservation significance</i></u></p> <p>Low to Moderate value</p> <p>Cleared habitat within a larger area of contiguous remnant vegetation extending beyond the survey area. This habitat provides few resources for conservation listed species. However, Carnaby's Black Cockatoo were observed resting in a large Marri and the dams maybe utilised by the species for drinking.</p>	

4.3.2 Fauna diversity

One hundred and one native fauna species were recorded within the survey area during the survey, these included:

- 72 birds
- 12 mammals
- 12 reptiles
- Five frogs.

NatureMap (DPaW 2016) indicate 187 vertebrate fauna taxa occur within the study area, many of which occur in the same and similar habitats present and adjoining the survey area. The species diversity recorded during the current survey is considered to be moderate due to the timing and low intensity of the survey.

Of the 101 native fauna species recorded during this survey, all have been previously recorded within the locality of the Jurien area (Atlas of Living Australia (ALA) 2016 and DPaW 2016).

A full list of fauna recorded during the field survey is presented in Appendix E.

Remote cameras

The remote cameras yielded an additional eight fauna species not identified during the field survey and included the Western Brush Wallaby, Australasian Shelduck and Black-headed Monitor. A number of small mammals (House Mouse, Ash Grey Mouse, Western Bush Rat and Dunnarts) were also recorded on camera and identified as likely within the fauna species list Appendix E. Some of these species could not be verified and would require additional survey to confirm to species level.

Bat detection

Five species of microchiropteran bat species were recorded via echolocation call collection within the survey area. These species are listed in the fauna species list Appendix E. No microchiropteran bats of conservation significance were recorded.

Introduced fauna

During the survey, evidence for six introduced fauna species was recorded in the survey area and adjoining areas, including:

- Cat (*Felis catus*) – cat tracks
- Dingo/dog (*Canis lupus* subsp. *dingo*) – tracks
- Pig (*Sus scrofa*) – Scats, tracks and digs
- Fox (*Vulpes vulpes*) - scats and tracks
- Rabbit (*Oryctolagus cuniculus*) – Scats tracks, digs, burrows and sightings
- House Mouse (*Mus musculus*) – recorded on remote camera.

4.3.3 Conservation significant fauna

Two fauna of conservation significance were recorded during the field surveys within the survey area (Table 12).

Western Brush Wallaby (Macropus irma)

The Western Brush Wallaby is listed Priority 4 by the DPaW. The species is a grazer found primarily in open forest or woodland, particularly favouring open, seasonally wet flats with low grasses and open scrubby thickets. It is also found in some areas of mallee and heathlands, and is uncommon in karri forest. This species was once very common in the south-west of Western Australia, but has undergone a reduction in range and a significant decline in abundance (Van Dyke and Strahan 2008). This species was confirmed via a remote camera image as seen in Plate 11. This species is known to be in the region and would utilise all habitats within the survey area. The location of this record is presented in Figure 6, Appendix A.



Plate 11 Western Brush Wallaby recorded in Low Heathland

Carnaby's Black Cockatoo (Calyptorhynchus latirostris)

The Carnaby's Black Cockatoo is listed as Endangered under the EPBC Act and Endangered (Schedule 2) under the WC Act.

Carnaby's Black Cockatoo is endemic to the south-west of Western Australia with a wide-spread distribution from Kalbarri to east of Esperance (Berry 2008, DSEWPaC 2012a).

Breeding takes place between late July and January/February and most breeding occurs in the inland parts of the species distribution (Burbidge 2009, DSEWPaC 2012a). Carnaby's Black Cockatoo nest in hollows of live or dead eucalypts, primarily smooth-barked Salmon Gum and Wandoo (Saunders 1979, 1982) though breeding has been reported in other wheatbelt tree species and some tree species on the Swan Coastal Plain and jarrah forest (Saunders 1979, 1982; Storr 1991, Johnstone and Storr 1998). Success in breeding is dependent on the quality and proximity of feeding habitat within 12 km of nesting sites (Saunders 1977, 1986; Saunders and Ingram 1987). Along with the trees that provide nest hollows, the protection, management and increase of this feeding habitat that supports the breeding of Carnaby's Black Cockatoo is a critical requirement for the conservation of the species.

During the non-breeding season (January to July) the majority of the birds move to the higher rainfall coastal regions of their range including the mid-west coast, Swan Coastal Plain and south coast (DSEWPaC 2012a). This seasonal shift brings 4,600 to 15,000 Carnaby's Black Cockatoos out onto the northern Swan Coastal Plain (Stock et al. 2013). These areas have better natural water sources over the summer period and historically had extensive areas of

proteaceous woodlands and shrublands to provide feed for young birds, and good resources for adult birds to stock up for the following breeding season (DSEWPaC 2012a; Kendrick 2011).

During February, March, April and occasionally lingering into May-June, large transit flocks forage at major food sources including Banksia or Kwongan heaths and Pinus plantations on the Swan Coastal Plain between Lancelin and Perth (Johnstone *et al.* 2011). North of the Swan River, Carnaby's Black Cockatoo are known to feed on a range of food sources, including Pine trees (*Pinus* spp.), *Banksia* (e.g. *B. sessilis*, *B. attenuata*, *B. prionotes*, *B. menziesii*), *Hakea* spp., Marri (*Corymbia calophylla*), insect larvae, market vegetation and fallen seed, orchard fruit or nut (species undetermined), and several unknown food sources on the ground (Finn *et al.* 2009; Valentine and Stock 2008). Pine trees and the pine plantations are an important food source for Carnaby's Black Cockatoo (Kendrick 2011), and flocks of up to several hundred birds have been commonly sighted within pine plantations (Stock *et al.* 2013).

Observations

Ten observations of Carnaby's Black Cockatoo were made over the survey area comprising of 89 birds (excluding birds associated with breeding events). Birds were observed flying throughout the site from heathlands within the survey area and to areas offsite. Birds were also recorded in the middle of the day resting in large Wandoo and Marri (see Plate 12 and Plate 13).



Plate 12 A pair of Carnaby's Black Cockatoo resting in Wandoo (G. Gaikhorst)



Plate 13 A male Carnaby's Black Cockatoo (G. Gaikhorst)

Breeding

The field survey was conducted at the beginning of the known breeding season for Carnaby's Black Cockatoo. Ten actual breeding events were recorded during the survey that included visual observations of female birds exiting large hollows. All hollows were then inspected from the ground with chews recorded on the hollow rim or close to the entrance. Additionally, some active hollows had clipped dropped fresh leaves (on short stems) at the base inferring nest preparation. From the observations made it was concluded that the birds were commencing the breeding season and likely more nesting activity could be recorded. Some images of breeding activity is provided below in Plate 14, Plate 15 and Plate 16. Additional to the 10 confirmed active hollows a further eight were consider highly likely to be currently used based on the size of the hollow, chew marks present and clipped leaves at the base suggesting nest preparation. All trees identified as actual or highly likely are mapped and presented in Figure 6, Appendix A.



Plate 14 Female Carnaby's Black Cockatoo exiting a hollow (G. Gaikhorst)



Plate 15 Female Carnaby's Black Cockatoo at a Wandoo hollow entrance (G. Gaikhorst)



Plate 16 Large hollow a female Carnaby's Black Cockatoo was utilising with large amounts of recent and old chew scarring (G. Gaikhorst)

Feeding

Feeding habitat is present throughout the survey area and feeding evidence was recorded on *Banksia attenuata* twice, Marri, *Lambertia multiflora* and *Hakea neurophylla* (as shown in Plate 17). Feeding observations were made from visible nuts and cones discarded on the tracks or visual observation of feeding events. Due to the amount of feeding habitat available it is likely that this habitat is regularly utilised by the species for feeding. Feeding records were mapped and presented in Figure 6, Appendix A.



Plate 17 Female Carnaby's Black Cockatoo recorded feeding on *Hakea neurophylla*

Roosting

Roosting was recorded once during nocturnal surveys. It consisted of at least two individuals perched in a large wandoo above a running minor drainage line on the southern boundary of the survey area along Jurien Road (as shown on Figure 6, Appendix A). Due to the numbers observed in the survey area it is likely multiple roosting sites are present.

A summary of the habitat values to Carnaby's Black Cockatoo is presented below in Table 10.

Table 10 Type and extent of Carnaby's Black Cockatoo habitat within the survey area (1993 ha)

Habitat type	Wandoo Woodland	Marri Woodland	<i>Eucalyptus tottiana</i> , <i>Banksia attenuata</i> / <i>menziesii</i> low Open Woodland	Low Heathlands (Sandy and Lateritic soils)	Minor Drainage lines and Seasonally Inundated Areas and Dams	Scattered trees of Wandoo and Marri in Paddock	Total	% of total Site
Foraging habitat	Wandoo Woodland present throughout the survey area (580 ha). High habitat value. Approximately 580 ha.	Marri Woodlands throughout the survey area (618 ha). High habitat value. Approximately 618 ha.	Patchy <i>Eucalyptus tottiana</i> , <i>Banksia attenuata</i> <i>menziesii</i> low Open Woodland in the survey area. (219 ha). High habitat value. Approximately 219 ha.	Both Low heathlands (sandy, 128 ha and Lateritic 164 ha) have mixed proteaceous species including <i>Banksia</i> , <i>Grevillea</i> , <i>Lambertia</i> , <i>Hakea</i> , <i>Xanthorrhoea</i> . (292 ha). High habitat value. Approximately 292 ha.	Minor drainage line with <i>E. rudis</i> , <i>Melaleuca</i> and sedges. Some dams present. (35 ha). High habitat value, the dams and water bodies would provide a water resource. Approximately 35 ha.	Scattered Wandoo and Marri in paddock. (248 ha) of which 27.5 ha is foraging habitat. Moderate habitat value. Due to scattered nature. Approximately 27.5 ha.	1771.5 ha of foraging habitat (not including highly modified habitat) of which 1744 ha is high and 27.5 ha is moderate habitat value.	88.87 % (moderate – high value)
Actual breeding habitat	10 pairs were recorded in hollows either nesting or preparing for nesting. A further eight were considered highly likely due to the evidence presented at the time of the survey. All breeding activity was recorded in Wandoo only. High Value Habitat.						580 ha of High value Wandoo Woodland.	29.10%
Potential breeding habitat	All Wandoo and Marri woodland would be considered potential breeding habitat for Carnaby's Black Cockatoo. Ten 50 x 50 m tree plots were undertaken in Wandoo Woodlands and four in Marri Woodlands to ascertain tree densities (Wandoo > 300 mm at DBH and Marri >500 mm at DBH). Tree densities included 13 trees per 50 x 50 m or 26 trees per ha for wandoo and 6 trees per 50 x 50 m or 12 trees per ha for Marri. From this data large hollows were also recorded and it was found that 3 large hollows per present in Wandoo and 1 large hollow was present per ha of Marri. Isolated large hollows were also recorded within the survey area with an additional 29 trees identified to have large hollows suitable for Carnaby's Black Cockatoo, some with evidence of historical use. High value habitat.						1198 ha of potential breeding habitat comprising 580 ha of Wandoo and 618 ha of Marri.	60.11%
Roosting	One roosting site was recorded as being used by Carnaby's Black Cockatoos. There is potential roosting habitat in the Wandoo woodland habitats of the site, particularly those patches of woodland with nearby water sources.						35 ha High value habitat.	1.76%
				Total area of offset site		1993 ha of which 1771.5 ha is Black Cockatoo habitat.	88.87 % (moderate – high value)	

Tree density assessments

Fourteen tree density plot assessments were undertaken in the survey area in both Wandoo and Marri Woodlands. A summary of the findings is provided below. A complete breakdown of the tree plot assessment data can be seen below in **Error! Not a valid bookmark self-reference.:**

Wandoo

- An average of 13 trees per 50 x 50 m plot were recorded or 26 trees per ha for Wandoo.
- Three large hollows per ha was present in Wandoo habitat.
- Feral bees were recorded in five hollows during the plot assessments in both medium and large hollows.

Marri

- An average of 6 trees per 50 x 50 m plot were recorded or 12 trees per ha for Marri.
- One large hollow per ha was present in Marri Woodland.

Tree plots are also mapped and presented in Figure 6, Appendix A.

Table 11 Tree Plot Data from the Survey Area

Plot	Habitat	Tree Species		Hollows Present and Size			Hollow Use Per Plot		
		Wandoo Trees	Marri Trees	Large	Medium	Small	Carnaby's BC Breeding evidence	Pest species	Comments
1	Wandoo	16	0	2	2	20	One large hollow has chews present	Bees in a medium hollow	Western Long-billed Corella breeding in medium hollow
2	Wandoo	18	0	4	14	14	One large hollow has chews present		Galah breeding in a medium hollow
3	Wandoo	8	0	1	9	15			
4	Wandoo	13	0	1	3	15			Galah breeding in a medium hollow
5	Wandoo	16	0	0	2	21			
6	Wandoo	5	0	1	1	3	One large hollow has old chews		
7	Wandoo	12	0	1	3	25		Bees in a medium hollow	
8	Wandoo	15	0	1	5	12	One large hollow has chews present	Bees in a medium hollow	
9	Wandoo	12	0	1	2	11	One large hollow has old chews		
10	Wandoo	14	0	1	3	17		Bees in large and medium hollow	
11	Marri	0	8	0	2	4			
12	Marri	0	6	0	2	3			
13	Marri	0	4	0	0	4			
14	Marri	1	7	2	3	8	One large hollow has old chews		

Likelihood of Occurrence

Searches of the EPBC Act PMST and *NatureMap* database identified the presence/potential presence of 21 conservation significant fauna species. An assessment on the Likelihood of Occurrence for conservation significant fauna species in the survey area was conducted (Appendix E). This assessment was based on species biology, habitat requirements, the quality and availability of suitable habitat and records of the species in the survey area and the surrounding area (e.g. DPaW 2016).

The assessment identified the likely presence of an additional six other species of conservation significance (see Table 12). The Likelihood of Occurrence assessment revealed that other fauna species of conservation significance could occasionally occur within the habitats of the survey area (those species deemed 'unlikely' to occur). However, it is considered unlikely that the survey area provides important habitat (e.g. breeding habitat or key foraging habitat) for any of these species deemed 'unlikely' to occur and that these other species may occasionally use the habitats of the survey area for temporary refuge and dispersal between other areas of habitat.

The Western Ground Parrot and Chuditch are not currently known to persist in the area with anecdotal records present in the region only. Due to the lack of surveys in the region and amount and type of habitat present in are surrounding the survey area these species could not be excluded from the assessment. A summary of the assessment is below in Table 12.

Table 12 Summary of fauna species of conservation significance recorded during survey and determined likely to occur within the survey area

Species and status (EPBC, WC Act)	Justification for Likelihood of Occurrence
Western Ground Parrot (<i>Pezoporus flaviventris</i>) Cr, S1, Cr	Likely – possible regular visitor or possible resident, The survey area provides suitable foraging and residential habitat for the species. The dense heath lands would be regarded as core habitat for the species. The remainder of the habitat in the survey area is supportive only. There are no historical records within survey area, but numerous unconfirmed records are present in the region just outside of the study area. Due to the habitat present and lack of surveys in the region the species cannot be excluded.
Chuditch, Western Quoll (<i>Dasyurus geoffroi</i>) Vu, S3, Vu	Likely – regular visitor or resident The survey area provides suitable denning, hunting and foraging habitat for the species. The woodlands would be regarded as core habitat for the species with denning opportunities available in Wandoo and Marri hollows both on the ground and aerial. The remainder of the habitat in the survey area is foraging and supportive only. There are no historical records within survey area, but numerous unconfirmed records are present in the region just outside of the study area. Due to the habitat present and lack of surveys in the region the species cannot be excluded.
Peregrine Falcon (<i>Falco peregrinus</i>) OS, S7	Likely – regular visitor or resident to survey area The survey area provides suitable breeding, hunting and roosting habitat. The survey area is probably part of the species broader home range; limited breeding habitat occurs within the survey area (breeding potential could occur in the large Wandoo or Marri).

Species and status (EPBC, WC Act)	Justification for Likelihood of Occurrence
	There are no historical records within survey area and several records within the study area the closest being 10 km east.
Woma Python (<i>Aspidites ramsayi</i> SW pop.) P1	<p>Likely – resident to survey area</p> <p>The survey area provides suitable habitat for the species. All sandy soil areas would be considered core habitat for the species including the woodlands with hollows and ground cover.</p> <p>There are no historical records within survey area, but numerous unconfirmed records are present in the region just outside of the study area. Due to the habitat present and lack of surveys in the region the species cannot be excluded.</p>
Southern Brown Bandicoot (<i>Isoodon obesulus</i> subsp. <i>fusciventer</i>) P5	<p>Likely –resident to survey area</p> <p>The survey area provides suitable habitat for the species. All dense areas of either heathlands, shrublands or woodlands would be considered core habitat for the species.</p> <p>There are no historical records within survey area, but numerous unconfirmed records are present in the region in Mount Lesueur. Due to the habitat present and lack of surveys in the region the species cannot be excluded.</p>
Black-striped Snake (<i>Neelaps calonotos</i>) P3	<p>Likely –resident to survey area</p> <p>The survey area provides suitable habitat for the species. All sandy soil areas would be considered core habitat for the species.</p> <p>There are no historical records within survey area, but there is one record 20 km north of the survey area and another 23 km east. The species is highly cryptic and rarely observed and the survey area is within the known range of the species. Due to the habitat present and lack of surveys in the region the species cannot be excluded.</p>

Table note:

Status (see Appendix B for full explanation)

EPBC Act – Species listed as one or more of the following: MiT = migratory terrestrial species, Vu = Vulnerable, En = Endangered, Cr = Critically Endangered

WC Act - Species listed as CR = critically endangered (S1, Schedule 1), En = Endangered (S2, Schedule 2), Vu = Vulnerable (S3, Schedule 3), IA = international migratory agreement migratory birds (S5, Schedule 5), OS = other specially protected fauna S7, Schedule 7)

DPaW – Species listed as Priority (P) 1, 2, 3, 4 or 5

5. Offset Assessment Guide Inputs

The *EPBC Act Offsets Assessment Guide* (the guide) (DSEWPaC 2012b) is designed to accompany the *EPBC Act Environmental Offsets Policy* (the policy) (DSEWPaC 2012c) which is used to support application of the policy for a proposed environmental offset. The guide is a tool to assist in determining the suitability of offset proposals. The guide includes four parts, including:

- Matter of National Environmental Significance assessment box
- Impact Calculator
- Offset Calculator
- Summary box.

For Stage 1 of the Mitchell Freeway Extension, Burns Beach to Hester Avenue, the guide has been used to determine the required offsets for impacts to Carnaby's Black Cockatoo. The document *How to use the Offset Assessment Guide* (DSEWPaC 2012b) has been used to inform the inputs into the guide.

The inputs into the *Impact Calculator* section include:

- Area of habitat – 88.7 ha (including 86.41 ha for Stage 1 and 2.29 ha for geotechnical trace lines)
- Quality of habitat – 8.

This section provides an outline and a justification of the inputs into the *Offsets Calculator* for the proposed offset site (the survey area).

5.1 The offset

A 564 ha portion of Lot 1, 1395 Banovich Road, Hill River (survey area) is being assessed as an environmental offset. The portion of the survey area to be used as the offset is yet to be determined. In providing the input values for the offset calculator the following assumptions have been made:

- At least 50 % (approximately 282 ha) of the offset area is Wandoo woodland containing one or more of the known breeding location
- The balance of the offset is foraging habitat (excluding Wandoo woodland)
- The land will be a conservation estate as vested in the Conservation and Parks Commission of Western Australia and will be managed by DPaW.

5.2 Time horizon

5.2.1 Time over which loss is averted

The *time over which loss is averted* is the foreseeable timeframe (in years) over which changes in the level of risk to a proposed offset site can be considered and quantified. That is, it is the time that any measures for securing a site for conservation purposes, such as conservation covenants on title, are intended to last. Longer time frames are valued more highly than shorter time frames.

Input – 20 years

The value of 20 was assigned as using a conservation covenant has an “in-perpetuity” lifespan. The transfer of land into conservation estate will provide legal protection of the offsets. Once land has been reserved for the purpose of a conservation park the purpose of the land can only be changed by an Act of State Parliament. Conservation estates are vested in the Conservation and Parks Commission of Western Australia and are then managed by DPAW.

5.2.2 Time until ecological benefit

The *time until ecological benefit* is the estimated time (in years) that it will take for the habitat quality to naturally decline if the site is not managed as a proposed offset.

Input – 10 years

The value of 10 was assigned as the survey area is expected to be impacted by weeds and feral species (e.g. bees, cats, foxes and pigs) reducing the quality from the initial habitat quality value for Carnaby’s Black Cockatoo of 8 to 7 over 10 years.

The value of 10 years is the standard decline expected for the nearby Gin gin area used by DotE during the previous assessment of other offset sites, in the absence of any specific threats to a parcel of land (Nikki Ward DotE, pers comm. April 2014). Therefore, the value of 10 years has been applied based on previous correspondence with DoTEE.

5.3 Start area

Input – 564 ha

A 564 ha portion of the 1993 ha survey area, is habitat for Carnaby’s Black Cockatoo. Main Roads intends to purchase the remainder of the survey area (approximately 1429 ha) to fulfil the offset requirements for other projects.

5.4 Start quality

The DotEE’s “How to use the Offset Assessment Guide” provides information on assessing the quality of habitat for EPBC Act listed threatened fauna species (DSEWPaC 2012b). Within this guide, the DotEE outlines the approach for assessing the quality score for area of habitat which is known to support supports EPBC listed threatened fauna (in this case Carnaby’s Black Cockatoo). This quality score is a measure of how well a particular site supports a particular threatened species and contributes to its ongoing viability (DSEWPaC 2012b). There are three components that contribute to the calculation of habitat quality: site condition, site context, and species stocking rates. These three components are defined as follows:

- **Site condition:** This is the condition of a site in relation to the ecological requirements of a threatened species. This includes considerations such as vegetation condition and structure, the diversity of habitat species present, and the number of relevant habitat features
- **Site context:** This is the relative importance of a site in terms of its position in the landscape, taking into account the connectivity needs of a threatened species. This includes considerations such as movement patterns of the species, the proximity of the site in relation to other areas of suitable habitat, and the role of the site in relation to the overall population or extent of a species
- **Species stocking rate:** This is the usage and/or density of a species at a particular site. The principle acknowledges that a particular site may have a high value for a particular threatened species, despite appearing to have poor condition and/or context. It includes

considerations such as survey data for a site in regards to a particular species population. It also includes consideration of the role of the site population in regards to the overall species population viability.

These three components contribute to the final habitat quality score, however the weighting given to each component is dependent on the ecological requirements of the impacted species (DotEE 2014c). When determining the suitability of a proposed offset using the guide, the minimum requirement is that the quality score of the offset site must at least reach the same value as the quality score of the impact site (i.e. for Stage 1 of the project).

5.4.1 Start quality input value

Input – 9

Based on the assessment below of the three components that contribute to the final habitat quality score, a strong weighting was given to all three components. Therefore, the survey area has been assigned a habitat quality score of 9.

An assessment of the quality of the habitat types available to Carnaby's Black Cockatoo within the survey area is provided below.

5.4.2 Site condition

The survey area provides remnant vegetation and habitat in excellent condition for Carnaby's Black Cockatoo. This habitat of the survey area comprises valuable breeding and foraging resources for the species.

A detractor to the survey area value is the presence of feral species which also use large hollows suitable for Carnaby's Black Cockatoo. This includes the Feral Bee and Laughing Kookaburra. During the tree plot assessment feral bees were recorded in at least one hollow per hectare.

Breeding

Ten actual breeding events were recorded during the survey, which included visual observations of female birds exiting large hollows. In addition to the 10 confirmed active hollows, a further eight were considered highly likely to be currently used based on the size of the hollow, chew marks present and clipped leaves at the base suggesting nest preparation.

Feeding

Feeding habitat is presented throughout the survey area and feeding evidence was recorded on *Banksia attenuata* twice, Marri, *Lambertia multiflora* and *Hakea neurophylla*. The feeding habitat present in the survey area was dense. The observations made were from visible nuts and cones discarded on the tracks or visual observation of feeding events. Due to the amount of feeding habitat available it is likely that area is heavily utilised by the species.

Roosting

Roosting was recorded once during nocturnal surveys and consisted of at least two individuals perched in a large Wandoo above a running minor drainage line on the southern boundary on the survey area along Jurien Road. Due to the numbers observed in the survey area it is likely multiple roosting sites are present.

5.4.3 Site context

Proximity to known breeding sites and larger areas of foraging vegetation.

The survey area is located within the known breeding range of Carnaby's Black Cockatoo, and within a region where the vegetation typically contains suitable foraging habitat. The survey area lies alongside Coomallo Nature Reserve a known Carnaby's Cockatoo breeding site and is recognised under the IBAs as a site for bird conservation (Dutson *et al.* 2009). The Coomallo site is known to support 40 breeding pairs of Carnaby's Black Cockatoo with the main breeding location only approximately 6 km from the survey area. Carnaby's Black Cockatoos are largely dependent on an abundance of suitable feeding habitat adjacent to breeding sites to provide the necessary food for the survival of the chick. While breeding, Carnaby's Black Cockatoos will generally forage within a 10–15 km radius of their nesting site.

Therefore, the survey area provides a significant area of suitable high quality foraging habitat within close proximity to known breeding sites in the region. Additionally, from this preliminary survey at least 10 known breeding sites were recorded within the survey area.

Proximity to Important Bird Areas

Thirteen Bird IBA's have been identified as significant to Carnaby Black Cockatoo (Dutson *et al.* 2009). The criteria used for the designation of IBAs for Carnaby's black Cockatoo are sites supporting at least 20 breeding pairs, or 1% of the population regularly utilising an area in the non-breeding part of the range. There are four IBAs within close proximity to the survey area, including:

- Coomallo IBA - known to support at least 40 pairs in nesting and associated feeding habitat. This IBA is located next to on the eastern boundary of the survey area
- The Cataby IBA - known to support at least 24 pairs in nesting and associated feeding habitat. This IBA is located approximately 55 km south of the survey area
- The Moora IBA - known to support up to 60 breeding pairs which nest in woodland remnants and isolated paddock trees and feed in native shrublands in the town of Moora. This IBA is located approximately 80 km south-east of the survey area
- The Koobabie IBA – known to support up to 32 breeding pairs which nest in woodland remnants and feed in native shrublands. This IBA is located approximately 110 km east of the survey.

5.4.4 Species stocking rate

Numerous observations of Carnaby's Black Cockatoos were observed using the habitat within the survey area for foraging, roosting and breeding during the field survey, in total 89 birds were recorded.

It is difficult to determine the specific density and usage of the survey area by Carnaby's Black Cockatoo. Coomallo Nature Reserve to the east of the survey area is 2,078 ha in size and supports approximately 40 breeding pairs of Carnaby's Black Cockatoo. This survey area is only 85 ha smaller and in the same area therefore is likely to hold similar numbers. The reporting of 89 birds within the survey area supports this assessment.

There is currently little information known on the home range of Carnaby's Black Cockatoo, however the species will generally forage within a 10–15 km radius of its nesting site. Given that breeding has been recording within Coomallo Nature Reserve, located within 10 km of the survey area and within the survey area, the habitats present provide foraging habitat within close proximity these breeding birds. Therefore, it is highly likely that Carnaby's Black Cockatoos would utilise the survey area for foraging during the breeding season.

5.5 Future area and quality with and without offset

The *risk of loss* is a percentage figure that describes the chance that the habitat on the proposed offset site will be completely lost (i.e. no longer hold any value for the protected matter) over the foreseeable future (either the life of the offset or 20 years, whichever is shorter). An estimated risk of loss is entered in the guide for both the business as usual (i.e. without offset) and with offset scenarios. The difference between these figures is the level of averted loss provided by the proposed offset.

There are a number of factors that could influence the risk of loss of a site, including:

- Presence and strength of formal protection mechanisms currently in place on the proposed site (e.g. zoning, restrictive covenants or state vegetation clearing laws)
- Presence of pending development applications, mining leases or other activities on the proposed offset site that indicate development intent and likelihood
- Average risk of loss for similar sites.

5.5.1 Risk of loss (%) without offset

Input – 15%

The value of 15% was assigned as the property prior to Main Roads purchase was privately owned for agriculture. The exponential population growth of Western Australia in the past decade has put increasing pressure on Western Australia to increase horticultural production and with this increase the need for extra land has also increased.

The value of 15% is the standard risk of loss for the Gin Gin region area used by DotEE during the previous assessment of other offset sites, in the absence of any specific threats to a parcel of land (Nikki Ward DotE, pers comm. April 2014). Therefore, the value of 15% has been applied based on previous correspondence with DoTEE.

5.5.2 Future quality without offset (scale 1-10)

Input – 8

The value of 8 was assigned as without the proposed offset the quality of the habitat for Carnaby's Black Cockatoo is likely to slightly decrease given the proximity to cleared and degraded land and the increased likelihood of disturbance, such as weed encroachment and feral species increases. During the field survey a number of hollows were observed with bees present, at a rate of approximately one hollow per hectare. There is the potential the rate of infestation could increase further reducing the number of large hollows available. In addition, there is the potential for fire to pass from the remnant vegetation surrounding the survey area, into the survey area which could result in the complete loss of the habitat for Carnaby's Black Cockatoo. Without management by DPaW the quality of the habitat is likely to be reduced in the absence of active management of these issues, i.e. weed, feral bee and fire management.

5.5.3 Risk of loss (%) with offset

Input – 2%

The value of 2% was assigned as the transfer of 564 ha of the total 1993 ha survey area (including 1771.5 ha of Carnaby's Black Cockatoo foraging habitat and 560 ha of known breeding habitat) into conservation estate is unlikely to completely remove all risks to the proposed offset site, as there will still be a small amount of residual risk the vegetation could be lost. This risk incorporates rare events, such as a catastrophic wildfire destroying all of the vegetation within the survey area.

5.5.4 Future quality with offset (scale 1-10)

Input – 9

The value of 9 was assigned as with the proposed offset, the quality of the habitat for Carnaby's Black Cockatoo is likely to remain the same. The quality of the habitat within the survey area for Carnaby's Black Cockatoo is already high, given the excellent site condition, context for the species and stocking rate. Therefore, the habitat does not currently require rehabilitation or revegetation to improve the site condition, and the context and stocking rate are likely to remain relatively static. The management of the survey area by DPaW will also allow the area to be actively managed to maintain the viability of Carnaby's Black Cockatoo habitat.

5.6 Confidence in result (%)

The *confidence in result* is a percentage figure that describes the level of certainty about the success of the proposed offset. Proposed offset actions that are designed to have a lower risk of failure should have a higher confidence in result score.

Averted loss component input – 80%

Change in habitat quality component input – 80%

The value of 80% was assigned to the averted loss component as there is a very high level of confidence in the strength and effectiveness of the proposed conservation covenant.

For the change in habitat quality component, a value of 80% is assigned as there is a high level of certainty that management of the survey area by DPaW (including management measures such as weed control, feral bee control, maintenance of firebreaks and fencing) will maintain and improve the quality of the Carnaby's Black Cockatoo habitat.

It should be noted that Main Roads have not currently allocated funds to the future management or improvement of the proposed offset site (i.e. for land management measures such as feral bee control, fencing and weed control).

5.7 Net present value (adjusted hectares)

The calculation of the net present value is a form of discounting that incorporates the annual probability of extinction and the relevant time horizons (time over which loss is averted and time until ecological benefit). It is used to reflect the fact that a given benefit (i.e. improving habitat quality or averting loss) today holds more value for a protected matter than the same benefit realised in the future.

Output – 75.63 ha

The outcome meets accounts for greater than 100% (106.57%) direct offset for the impact of clearing 88.7 ha of Carnaby's Black Cockatoo habitat for Stage 1 of the project.

5.8 Summary of inputs

A summary of the inputs into the *Offsets Calculator* for the proposed offset site (the survey area) is provided in Table 13. The *Offsets Calculator* is presented in Appendix F.

Table 13 Summary of inputs into Offset Calculator

Offset calculator attribute	Input value
Proposed offset	Portion of Lot 1, 1395 Banovich Road, Hill River. Area: 1993 ha including 1771.5 ha native vegetation and 27.5 ha of highly modified vegetation.
Time horizon (years)	
Time over which loss is averted	20 years
Time until ecological benefit	10 years
Start area (ha)	564 ha
Start quality (scale of 1-10)	9
Future area and quality with and without offset (%)	
Risk of loss (%) without offset	15%
Future quality without offset (scale 1-10)	8
Risk of loss (%) with offset	2%
Future quality with offset (scale 1-10)	9
Confidence in result (%)	
Averted loss component input	80%
Change in habitat quality component input	80%
Output	
Net present value (adjusted hectares)	75.63

6. Conclusion

6.1 Vegetation and Flora

Fourteen vegetation types were identified and described from the survey area. The three woodland vegetation types (VT05, VT09 and VT10) accounted for the majority of the vegetation within the survey area (69.62%). VT03 and VT07 are associated with *Melaleuca* species along drainage lines. The remaining eight native vegetation types are all heathlands with the vegetation rarely exceeding 150 cm in height and comprised of a range of species at varying densities in a range of soil types and landforms. As this was not an intensive survey, not all of the vegetation types may have been accurately assessed or mapped.

Four vegetation types are considered to be conservation significant ecological communities, including:

- VT01 is associated with the Lesueur-Coomallo Floristic Community D1 TEC, listed as Critically Endangered under the WC Act
- VT03 is associated with the Lesueur-Coomallo Floristic Community M2 (*Melaleuca preissiana* woodland) Priority 1 PEC
- VT04 is associated with the Lesueur-Coomallo Floristic Community DFGH Priority 1 PEC, in particular 'D' heath and woodlands on gravelly hills and slopes
- VT02 is associated with the *Petrophile chrysantha* low heath on Lesueur dissected uplands (Gp200-170) Priority 2 PEC.

All of the native vegetation within the survey area is considered significant vegetation as defined by the EPA and DPaW (2015). The majority of the survey area is in a Pristine condition that contains different combinations of taxa associated with a variety of heathlands and provides a linkage between Lesueur National Park and Coomallo Nature Reserve. In addition, the vegetation is a refuge for a number of conservation significant flora that occur throughout the survey area in a variety of vegetation types.

Nine conservation significant flora were recorded from the survey area during the field survey including:

- *Hakea megalosperma* (listed as Vulnerable under both the EPBC Act and WC Act)
- *Acacia retrorsa* (Priority 2)
- *Grevillea delta* (Priority 2)
- *Thelymitra variegata* (Priority 2)
- *Hensmania stoniella* (Priority 3)
- *Lepidobolus quadratus* (Priority 3)
- *Stylidium ?hymenocraspedum* (Priority 3)
- *Stylidium ?torticarpum* (Priority 3)
- *Hakea neurophylla* (Priority 4).

The locations and counts of conservation significant flora within the survey area are likely to increase if the survey effort was to increase to a Level 2 survey during the correct season (mid-September to October).

The majority of the survey area is in a Pristine condition with the presence of introduced species generally restricted to the cleared paddock area, along creeklines and the borders of vegetation

to previously cleared areas (see Section 4.1.3). Thirteen introduced taxa were recorded within the survey area during the field survey. The most commonly recorded weed species in the survey area include **Arctotheca calendula*, **Hypochaeris glabra* and **Romulea rosea*. No introduced species listed as a Declared Pest plant under Section 22 of the BAM Act or a WoNS (DotE 2016d), was recorded within the survey area.

6.2 Fauna

Seven main fauna habitat types were recorded during the field survey, which broadly aligned with the vegetation associations and include, Wandoo Woodlands (560 ha), Marri Woodland (640 ha), *Eucalyptus tottiana*, *Banksia attenuata/ menziesii* low Open Woodland (219 ha), minor drainage lines and seasonally inundated areas and dams (35 ha), Low Heathlands on sandy soils (128 ha), Low Heathlands on lateritic soils (164 ha) and scattered trees of Wandoo and Marri in paddock (248 ha of which 27.5 ha is scattered Wandoo and Marri).

One hundred and seven fauna species were recorded within the survey area during the survey, these included, 72 birds, 18 mammals (6 introduced), 12 reptiles and five frogs. Of these species two were identified as conservation significant and consisted of Carnaby's Black Cockatoo listed as endangered under both EPBC and WC Acts and Brush Wallaby listed as priority 4 under DPAW.

Carnaby's Black Cockatoo were recorded via observations of birds (89 individuals), actual breeding events (10 birds recorded in hollows) with an additional 8 records of hollows highly likely used or being used (but not confirmed), five records of feeding behaviour and one location of roosting.

6.3 Offset Calculator

The EPBC Act Offsets Assessment Guide has been used to determine the required offsets for impacts to Carnaby's Black Cockatoo for Stage 1 of the Mitchell Freeway Extension.

The outcome based on an offset area of 564 ha accounts for greater than 100% (106.57%) direct offset for the impact of clearing 88.7 ha of Carnaby's Black Cockatoo habitat for Stage 1 of the project.

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Appendices

Appendix A – Figures

Figure 1 Project location

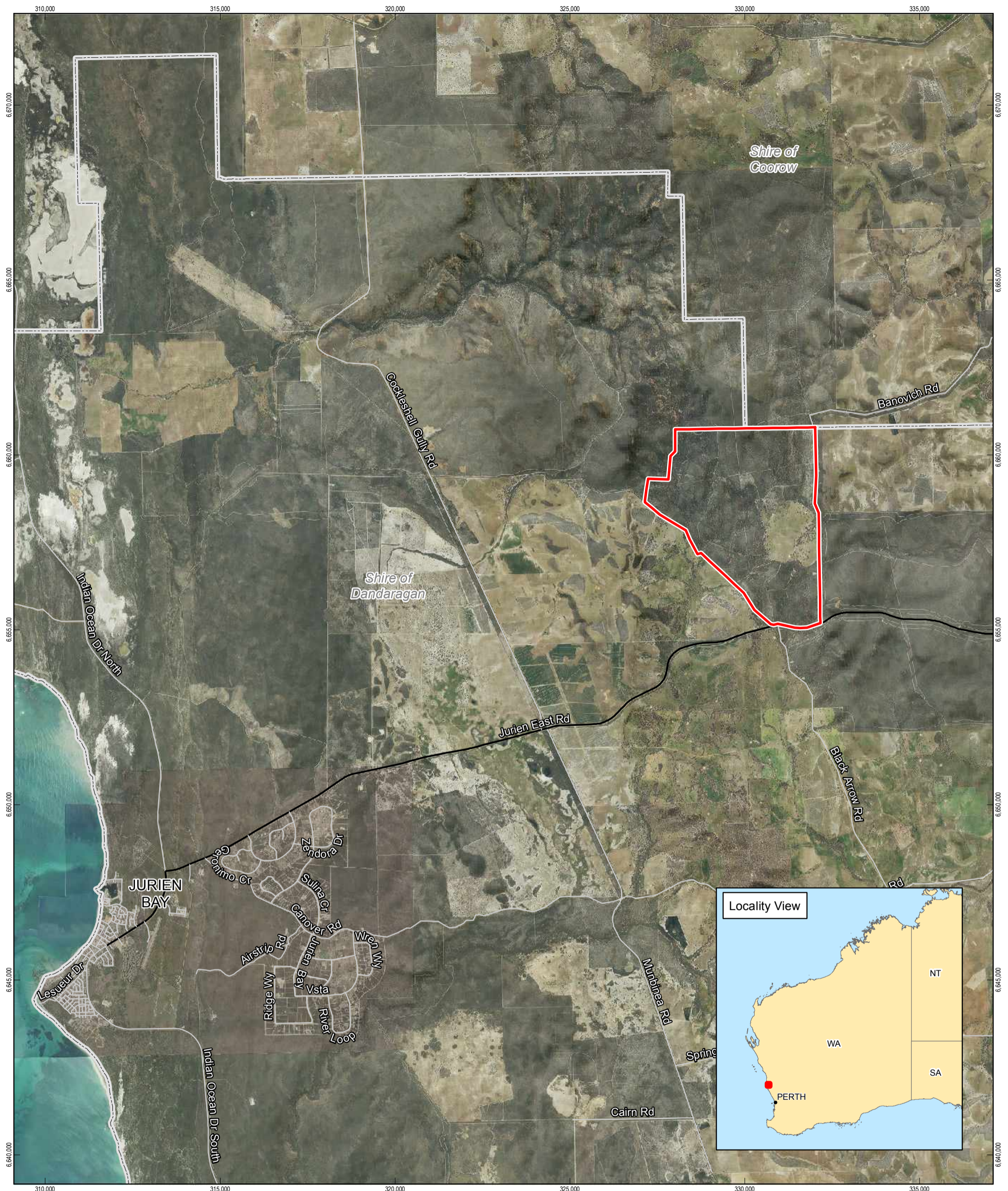
Figure 2 Biological constraints

Figure 3 Vegetation associations, quadrat locations and Conservation Significant Flora

Figure 4 Vegetation condition

Figure 5 Fauna methods and results

Figure 6 Black Cockatoo Habitat



LEGEND

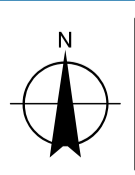
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— Minor road Shire boundary

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Grid: GDA 1994 MGA Zone 50



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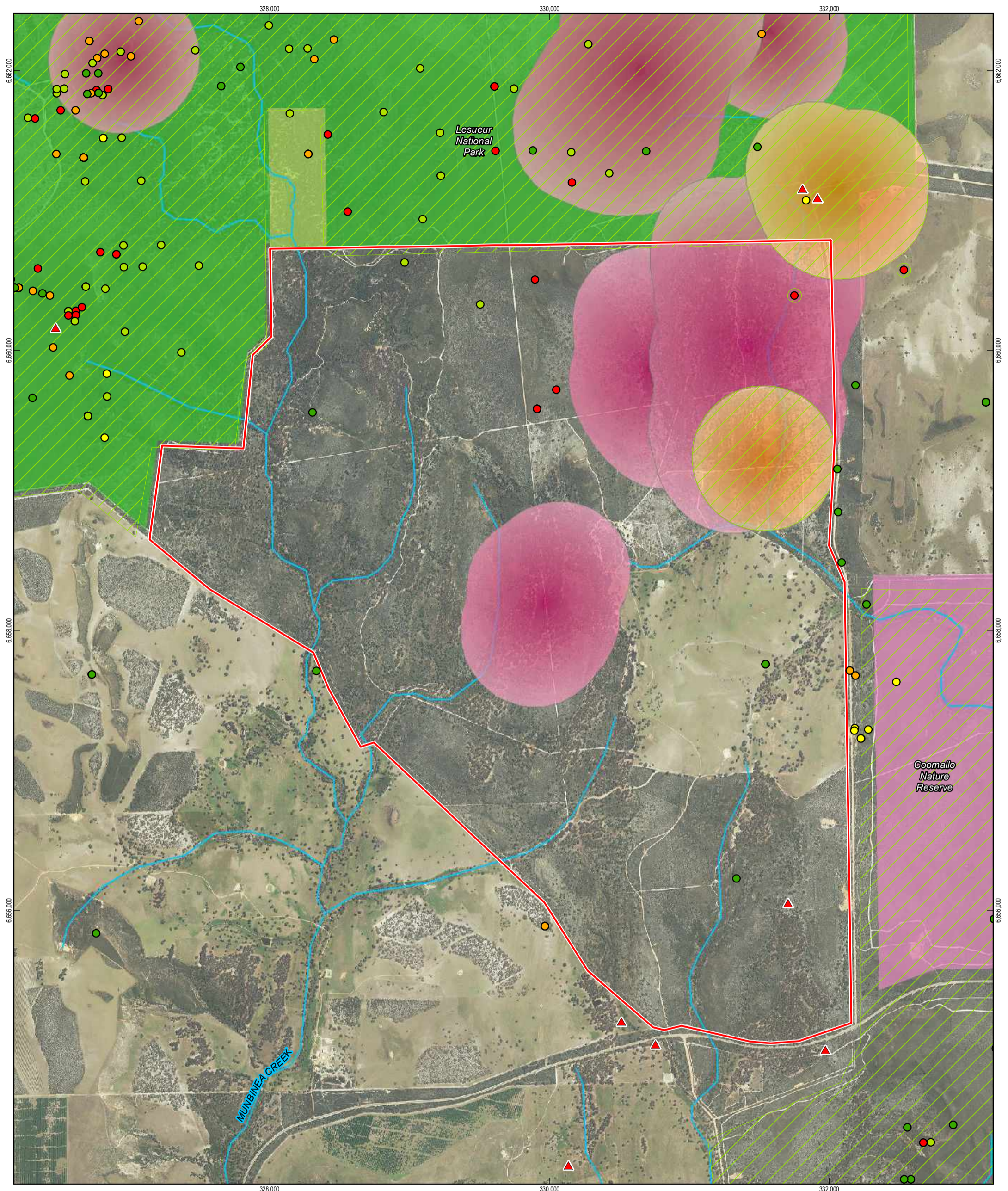
Locality Map

Figure 1

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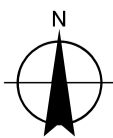
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Data source: MRWA: Roads - 20140723; Landgate: Virtual Mosaic - Imagery; GA: Geodata Topo 250k Series III - 2006; GHD: Site Boundary - 20160722; ABS: Shire Boundaries - 2006. Created by: afeeney



LEGEND

- | | | | | |
|---------------------------------------|----------------------------------|----------------------------------|-------------------------------------|---------------------------|
| Conservation Significant Fauna | ● Priority 1 - Poorly Known Taxa | — Watercourse | ■ Threatened Ecological Communities | DPaW Managed Lands |
| ▲ Endangered | ● Priority 2 - Poorly Known Taxa | ▭ Survey area | ■ Priority Ecological Communities | ■ Conservation Park |
| Conservation Significant Flora | ● Priority 3 - Poorly Known Taxa | ▨ Environmentally Sensitive Area | | ■ National Park |
| ● Threatened | ● Priority 4 - Rare Taxa | | | ■ Nature Reserve |

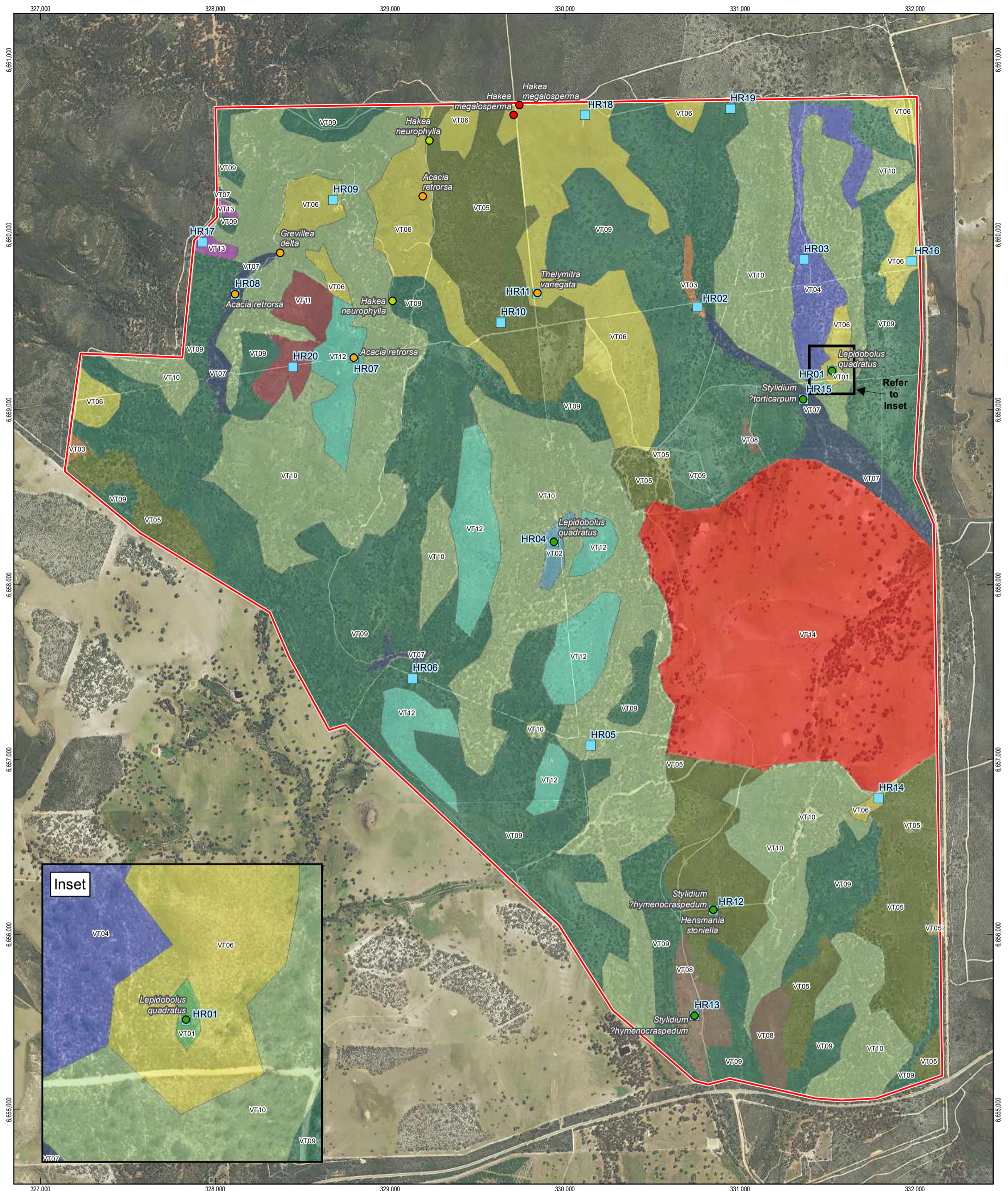


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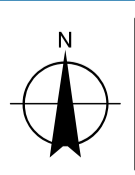
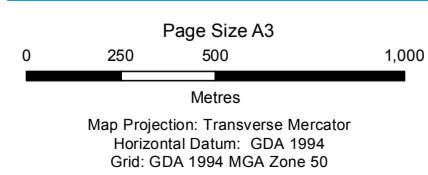
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Biological Constraints

Figure 2



LEGEND		Quadrat site	Vegetation type	VT05 <i>Eucalyptus todiana</i> , <i>Banksia attenuata</i> and <i>B. menziesii</i> woodland	VT10 <i>Eucalyptus wandoo</i> woodland
Threatened	Survey area	VT01 <i>Allocasuarina microstachya</i> heathland	VT06 <i>Xanthorrhoea</i> and <i>Kingia</i> heathland	VT07 <i>Melaleuca raphiophylla</i> woodland	VT11 <i>Banksia attenuata</i> open heathland
Priority 2 - Poorly Known Taxa		VT02 <i>Petrophile chrysantha</i> heathland	VT03 <i>Melaleuca preissiana</i> open woodland	VT08 <i>Ecdeiocolea monostachya</i> herbland	VT12 Mixed heath with isolated clumps of mallee
Priority 3 - Poorly Known Taxa		VT03 <i>Melaleuca preissiana</i> open woodland	VT04 <i>Melaleuca platycalyx</i> heathland and <i>Eucalyptus wandoo</i> woodland	VT09 <i>Corymbia calophylla</i> woodland	VT13 <i>Melaleuca ?concreta</i> heathland
Priority 4 - Rare Taxa					VT14 Pasture with emergent trees



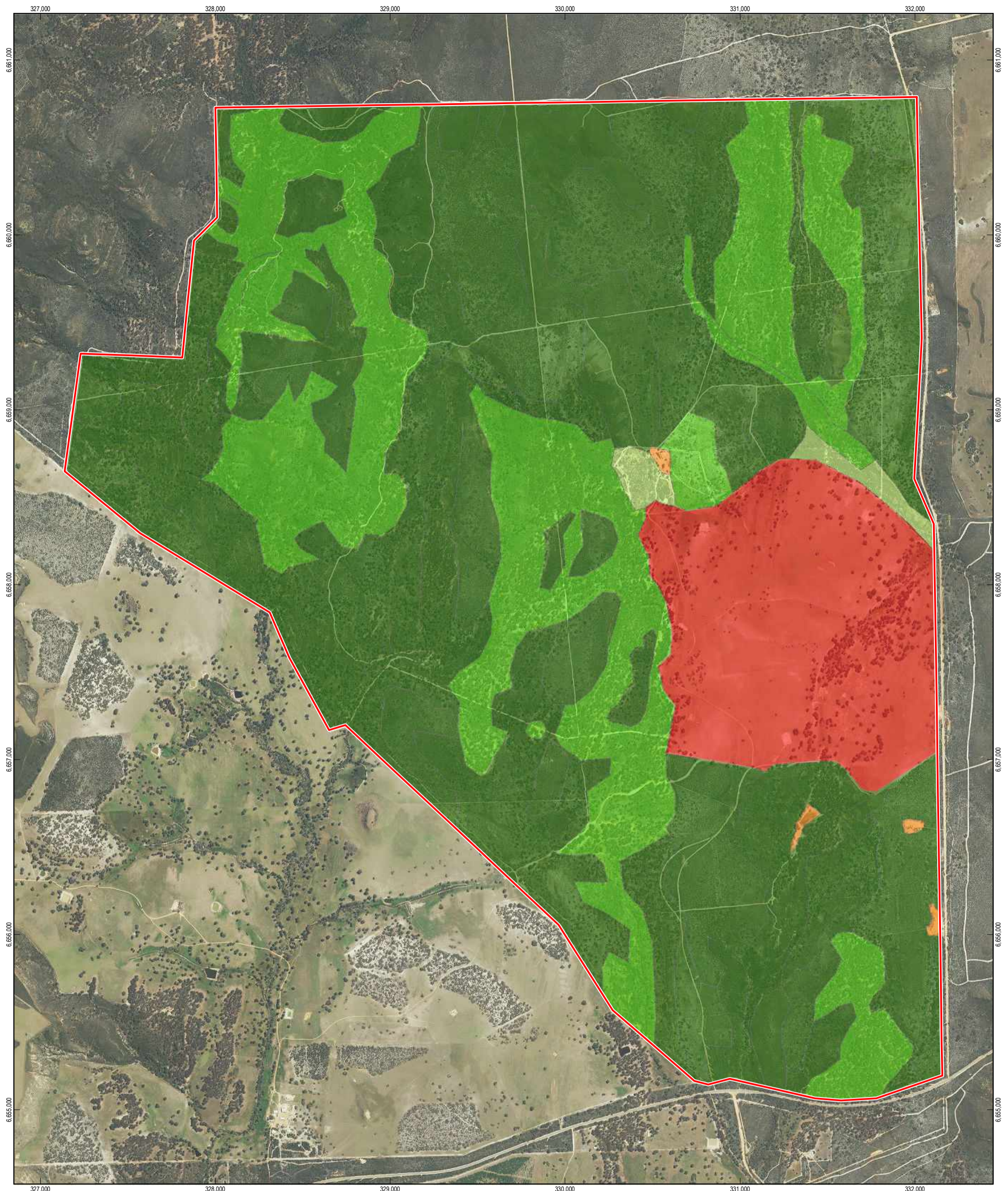
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Vegetation Type

Figure 3

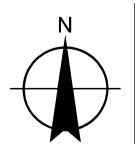
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Data source: GHD: Vegetation Types, Quadrats - 20160728, Site Boundary - 20160722, Conservation Significant Flora - 20160824; Landgate; Aerial Imagery - Virtual Mosaic, Created by:afeeney



LEGEND

 Survey area	 Excellent
Vegetation Condition (EPA and DPaW 2015)	 Very Good
 Pristine	 Degraded
	 Completely Degraded

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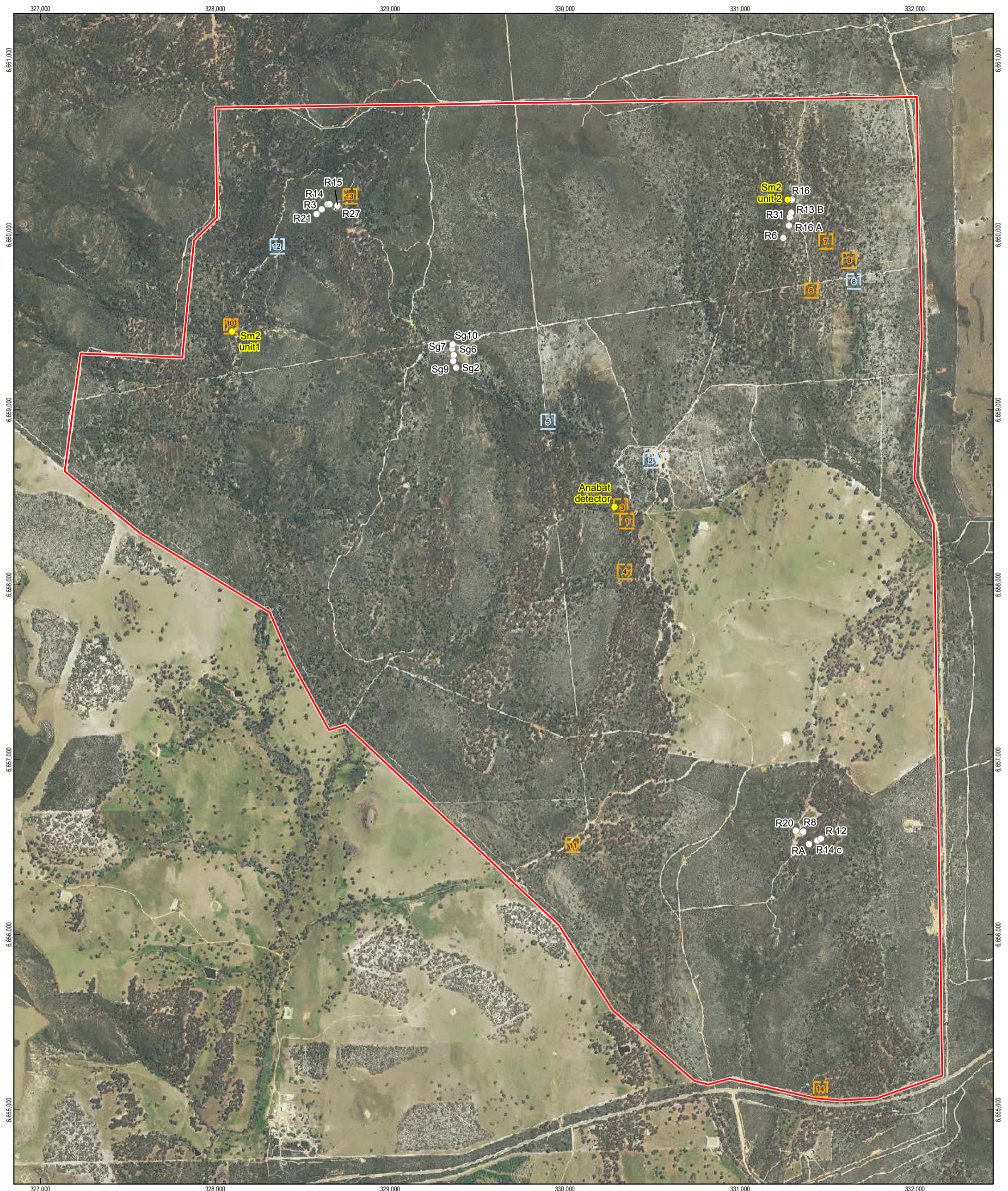


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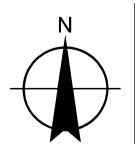
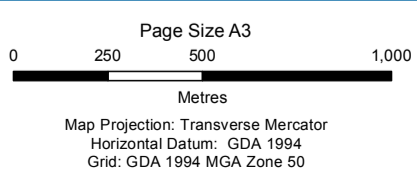
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Vegetation Condition

Figure 4



- LEGEND**
- Bat detector location
 - Remote camera location
 - Marri tree plot
 - Wandoo tree plot
 - ▭ Survey area

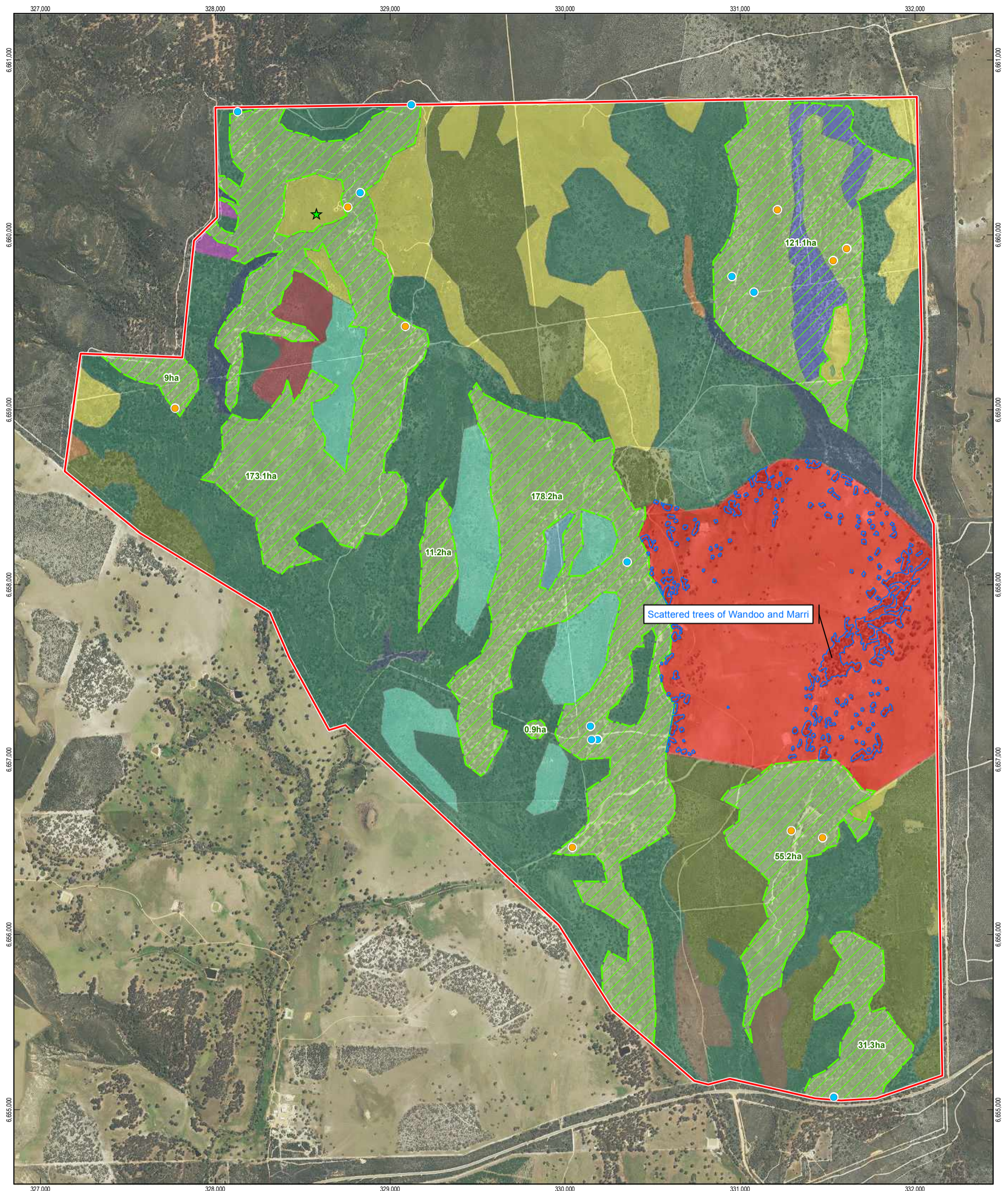


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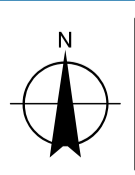
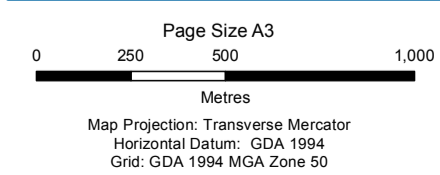
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Fauna Methods

Figure 5



<ul style="list-style-type: none"> ★ Conservation significant fauna - Brush Wallaby ● Suspected Black Cockatoo breeding tree ● Actual Black Cockatoo breeding tree ▭ Survey area ▨ Black Cockatoo breeding habitat 	<p>Vegetation type</p> <ul style="list-style-type: none"> VT01 <i>Allocasuarina microstachya</i> heathland VT02 <i>Petrophile chrysantha</i> heathland VT03 <i>Melaleuca preissiana</i> open woodland VT04 <i>Melaleuca platycalyx</i> heathland and <i>Eucalyptus wandoo</i> woodland VT05 <i>Eucalyptus tottiana</i>, <i>Banksia attenuata</i> and <i>B. menziesii</i> woodland VT06 <i>Xanthorrhoea</i> and <i>Kingia</i> heathland VT07 <i>Melaleuca raphiophylla</i> woodland VT08 <i>Ecdiocollea monostachya</i> herbland VT09 <i>Corymbia calophylla</i> woodland VT10 <i>Eucalyptus wandoo</i> woodland VT11 <i>Banksia attenuata</i> open heathland VT12 Mixed heath with isolated clumps of mallee VT13 <i>Melaleuca ?concreta</i> heathland VT14 Pasture with emergent trees
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Black Cockatoo Habitat

Figure 6

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Data source: GHD: Vegetation Types, Cockatoo Breeding Trees, Cockatoo Breeding Habitat - 20160728, Site Boundary - 20160722, Conservation Significant Fauna - 20160824, Landgate, Aerial Imagery - Virtual Mosaic, Created by:afeeney

Appendix B – Relevant legislation, conservation codes and background information

Legislation

Federal *Environment Protection and Biodiversity Conservation Act 1999*

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Federal Government's central piece of environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places, which are defined in the EPBC Act as Matters of National Environmental Significance (MNES).

The biological aspects listed as MNES include:

- Nationally threatened flora and fauna species and ecological communities
- Migratory species

A person must not take an action that has, will have, or is likely to have a significant impact MNES, without approval from the Federal Minister for the Environment.

A person must not undertake an action that has, will have, or is likely to have a significant impact (direct or indirect) on MNES, without approval from the Australian Government Minister for the Environment.

State *Environmental Protection Act 1986*

The *Environmental Protection Act 1986* (EP Act) is the primary legislative Act dealing with the protection of the environment in Western Australia. It provides for an Environmental Protection Authority (EPA), for the prevention, control and abatement of pollution and environmental harm, for the conservation, preservation, protection, enhancement and management of the environment and for matters incidental to or connected with the above.

Clearing of native vegetation in Western Australia requires a permit from the Department of Environment Regulation (DER) (formerly the Department of Environment and Conservation – DEC), unless exemptions apply. Native vegetation includes aquatic and terrestrial vegetation indigenous to Western Australia, and intentionally planted vegetation declared by regulation to be native, but not vegetation planted in a plantation or planted with commercial intent.

In the EP Act Section 51A, clearing is defined as the killing or destruction of; the removal of; the severing or ringbarking of trunks or stems of; or the doing of substantial damage of some or all of the native vegetation in an area, including the flooding of land, the burning of vegetation, the grazing of stock or an act or activity that results in the above.

When making a decision to grant or refuse a permit to clear native vegetation the assessment considers clearing against the ten clearing principles as specified in Schedule 5 of the EP Act:

- a) Native vegetation should not be cleared if it comprises a high level of biodiversity.
- b) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a significance habitat for fauna indigenous to Western Australia.
- c) Native vegetation should not be cleared if it includes, or is necessary, for the continued existence of rare flora.
- d) Native vegetation should not be cleared if it comprises the whole or part of native vegetation in an area that has been extensively cleared.
- 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.
- f) Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.

- g) 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.
- h) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.
- 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.
- j) Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence of flooding.

There are a number of Environmentally Sensitive Areas (ESAs) within Western Australia where exemptions in regulations do not apply. ESAs include locations of threatened communities and species.

State *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*

ESAs are declared by a notice under Section 51B of the EP Act. The Table below outlines the aspects of areas declared as ESA (under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004 – Reg 6*).

Aspects of Environmentally Sensitive Areas

Aspects of Environmentally Sensitive Areas
A declared World Heritage property as defined in Section 13 of the <i>Environment Protection and Biodiversity Conservation Act 1999</i> (EPBC Act).
An area that is registered on the Register of the National Estate (RNE), because of its natural values, under the <i>Australian Heritage Commission Act 1975</i> of the Commonwealth (the RNE was closed in 2007 and is no longer a statutory list – all references to the RNE were removed from the EPBC Act on 19 February 2012).
A defined wetland and the area within 50 m of the wetland.
The area covered by vegetation within 50 m of rare flora, to the extent to which the vegetation is continuous with the vegetation in which the rare flora is located.
The area covered by a TEC.
A Bush Forever Site.
The areas covered by the following policies:
a) The <i>Environmental Protection (Gnangara Mound Crown Land) Policy 1992</i> .
b) The <i>Environmental Protection (Western Swamp Tortoise Habitat) Policy 2002</i> .
The areas covered by the lakes to which the <i>Environmental Protection (Swan Coastal Plain Lakes) Policy 1992</i> (SCPL) (EPP Lakes) applies.
Protected wetlands as defined in the <i>Environmental Protection (South West Agricultural Zone Wetlands) Policy 1998</i> .
Areas of fringing native vegetation in the policy area as defined in the <i>Environmental Protection (Swan and Canning Rivers) Policy 1997</i> .

State Wildlife Conservation Act 1950

The *Wildlife Conservation Act 1950* (WC Act) provides for the conservation and protection of wildlife. It is administered by the Department of Parks and Wildlife (DPaW) (formerly the DEC) and applies to both flora and fauna. Any person wanting to capture, collect, disturb or study fauna requires a permit to do so. A permit is required under the WC Act if removal of threatened species is required.

State Biosecurity and Agriculture Management Act 2007

Under the *Biosecurity and Agriculture Management Act 2007* (BAM Act), a Declared Pest is a prohibited organism or an organism for which a declaration under Section 22(2) is in force. The Department of Agriculture and Food Western Australia (DAFWA) maintains a list of Declared Pests for Western Australia. If a Pest is declared for the whole of the State or for particular Local Government Areas, all landholders are obliged to comply with the specific category of control. Declared plants are gazetted under categories, which define the action required. The category may apply to the whole of the State, districts, individual properties or even paddocks. Categories of control are defined below. Among the factors considered in categorising Declared Pests are:

- The impact of the plant on individuals, agricultural production and the community in general
- Whether it is already established in the area
- The feasibility and cost of possible control measures

The BAM Act replaces the repealed *Agriculture and Related Resources Protection Act 1976* (ARRP Act).

Department of Agriculture and Food (Western Australia) Categories for Declared Pests under the *Biosecurity and Agriculture Management Act 2007*

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

Background information and conservation codes

Reserves and conservation areas

Department of Parks and Wildlife managed lands and waters

DPaW manages lands and waters throughout Western Australia to conserve ecosystems and species, and to provide for recreation and appreciation of the natural environment. DPaW managed lands and waters include national parks, conservation parks and reserves, marine parks and reserves, regional parks, nature reserves, State forest and timber reserves. DPaW managed conservation estate, is vested with the Conservation Commission of Western Australia. Access to, or through, some areas of DPaW managed lands may require a permit or could be restricted due to management activities. Proposed land use changes and development proposals that about DPaW managed lands will generally be referred to DPaW throughout the assessment process.

Ramsar Listed Wetlands

The Convention of Wetlands of International Importance was signed in 1971 at the Iranian town of Ramsar. The Convention has since been referred to as the Ramsar Convention. Ramsar Listed wetlands are “sites containing representative, rare or unique wetlands, or wetlands that are important for conserving biological diversity ... because of their ecological, botanical, zoological, limnological or hydrological importance” (DotEE 2016a). Once a Ramsar Listed Wetland is designated, the country agrees to manage its conservation and ensure its wise use. Under the Convention, wise use is broadly defined as “maintaining the ecological character of a wetland” (DotEE 2016a).

Nationally important wetlands

Wetlands of national significance are listed under the Directory of Important Wetlands in Australia. Nationally important wetlands are wetlands which meet at least one of the following criteria (DotEE 2016b):

- It is a good example of a wetland type occurring within a biogeographic region in Australia
- It is a wetland which plays an important ecological or hydrological role in the natural functioning of a major wetland system/complex
- It is a wetland which is important as the habitat for animal taxa at a vulnerable stage in their life cycles, or provides a refuge when adverse conditions such as drought prevail
- The wetland supports one percent or more of the national populations of any native plant or animal taxa
- The wetland supports native plant or animal taxa or communities which are considered endangered or vulnerable at the national level
- The wetland is of outstanding historical or cultural significance

Vegetation extent and status

The National Objectives and Targets for Biodiversity Conservation 2001–2005 (Commonwealth of Australia 2001) recognise that the retention of 30 percent or more of the pre-clearing extent of each ecological community is necessary if Australia’s biological diversity is to be protected. This is the threshold level below which species loss appears to accelerate exponentially and loss below this level should not be permitted. This level of recognition is in keeping with the targets recommended in the review of the National Strategy for the Conservation of Australia’s Biological Diversity (ANZECC 2000) and in Environmental Protection Authority (EPA) Position Statement No. 2 on environmental protection of native vegetation in Western Australia (EPA 2000).

From a purely biodiversity perspective and taking no account of any other land degradation issues, there are a number of key criteria now being applied to the clearing of native vegetation in Western Australia (EPA 2000).

- The “threshold level” below which species loss appears to accelerate exponentially at an ecosystem level is regarded as being at a level of 30 percent of the pre-European extent of the vegetation type.
- A level of 10 percent of the original extent is regarded as being a level representing Endangered.
- Clearing which would put the threat level into the class below should be avoided.
- From a biodiversity perspective, stream reserves should generally be in the order of at least 200 metres (m) wide.

Vegetation condition

The vegetation condition in the Geraldton Sandplains IBRA Bioregion can be assessed in accordance with the vegetation condition rating scale for the South West and Interzone Botanical Provinces (EPA and DPaW 2015). The scale recognises the intactness of vegetation and consists of six rating levels as outlined below.

Vegetation condition rating scale

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

Conservation codes

Species of significant flora, fauna and communities are protected under both Federal and State Acts. The Federal EPBC Act provides a legal framework to protect and manage nationally important flora and communities. The State WC Act is the primary wildlife conservation legislation in Western Australia. Information on the conservation codes is summarised in the following sections.

Conservation significant communities

Ecological communities are defined as naturally occurring biological assemblages that occur in a particular type of habitat (English and Blyth 1997). Federally listed Threatened Ecological Communities (TECs) are protected under the EPBC Act administered by the Department of the Environment (DotEE) (formerly Department of Sustainability, Environment, Water, Population and Communities – DSEWPaC). The DPaW also maintains a list of TECs for Western Australia; some of which are also protected under the EPBC Act. TECs are ecological communities that have been assessed and assigned to one of four categories related to the status of the threat to the community, i.e. Presumed Totally Destroyed, Critically Endangered, Endangered and Vulnerable.

Possible TEC that do not meet survey criteria are added to the DPaW Priority Ecological Community (PEC) List under Priorities 1, 2 and 3. These are ecological communities that are adequately known; are rare but not threatened, or meet criteria for Near Threatened. PECs that have been recently removed from the threatened list are placed in Priority 4. These ecological communities require regular

monitoring. Conservation dependent ecological communities are placed in Priority 5. PECs are not listed under any formal Federal or State legislation.

Conservation codes and definitions for Threatened Ecological Communities endorsed by the Western Australian Minister for the Environment and listed under the *Environment Protection and Biodiversity Conservation Act 1999*

Western Australia conservation categories		Federal Government Conservation Categories (EPBC Act)	
Presumed Totally Destroyed (PD)	The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future.	Critically Endangered (CR)	If, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future
Critically Endangered (CR)	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated	Endangered (EN)	If, at that time, it is not critically endangered and is facing a very high risk of extinction in the wild in the near future
Endangered (EN)	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future.	Vulnerable (VU)	If, at that time, it is not critically endangered or endangered, and is facing a high risk of extinction in the wild in the medium-term future
Vulnerable (VU)	An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range.		

Conservation categories and definitions for Priority Ecological Communities as listed by the Department of Parks and Wildlife

Category	Description
Priority 1	<p>Poorly known ecological communities.</p> <p>Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤ 5 occurrences or a total area of ≤ 100 ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.</p>
Priority 2	<p>Poorly known ecological communities.</p> <p>Communities that are known from few occurrences with a restricted distribution (generally ≤ 10 occurrences or a total area of ≤ 200 ha). At least some occurrences are not believed to be under immediate threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.</p>
Priority 3	<p>Poorly known ecological communities.</p> <p>(i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or:</p> <p>(ii) communities known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or;</p> <p>(iii) communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes.</p> <p>Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.</p>
Priority 4	<p>Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring.</p> <p>(i) Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands.</p> <p>(ii) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.</p> <p>(iii) Ecological communities that have been removed from the list of threatened communities during the past five years.</p>

Category	Description
Priority 5	<p>Conservation Dependent ecological communities.</p> <p>Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.</p>

Other significant vegetation

Vegetation may be significant for a range of reasons, other than a statutory listing as TEC or because the extent is below a threshold level. The EPA (2004) states that significant vegetation may include vegetation that includes the following:

- Scarcity
- Unusual species
- Novel combinations of species
- A role as a refuge
- A role as a key habitat for Threatened species or large population representing a significant proportion of the local to regional total population of a species
- Being representative of the range of a unit (particularly, a good local and/or regional example of a unit in 'prime' habitat, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range)
- A restricted distribution

This may apply at a number of levels, so the unit may be significant when considered at the fine-scale (intra-locality), intermediate-scale (locality or inter-locality) or broad-scale (local to region).

Conservation significant flora and fauna

Species of significant flora are protected under both Federal and State legislation. Any activities that are deemed to have a significant impact on species that are recognised by the EPBC Act, and/or the WC Act can warrant referral to the DotEE and/or the EPA.

The Federal conservation level of flora and fauna species and their significance status is assessed under the EPBC Act. The significance levels for fauna used in the EPBC Act are those recommended by the International Union for the Conservation of Nature and Natural Resources (IUCN).

Threatened species have been published as Specially Protected under the WC Act 1950, and listed under Schedules 1 to 7 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora. The schedules align with the categories of the EPBC Act. Threatened species are those species which have been adequately searched for and are deemed to be, in the wild, either rare, at risk of extinction, or otherwise in need of special protection, and have been gazetted as such.

Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora or fauna.

Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring.

For the purposes of this assessment, all species listed under the EPBC Act, WC Act and DPaW Priority species are considered conservation significant.

Conservation categories and definitions for *Environment Protection and Biodiversity Conservation Act 1999* listed flora & fauna species

Conservation category	Definition
Extinct	Taxa not definitely located in the wild during the past 50 years
Extinct in the Wild	Taxa known to survive only in captivity
Critically Endangered	Taxa facing an extremely high risk of extinction in the wild in the immediate future
Endangered	Taxa facing a very high risk of extinction in the wild in the near future
Vulnerable	Taxa facing a high risk of extinction in the wild in the medium-term
Near Threatened	Taxa that risk becoming Vulnerable in the wild
Conservation Dependent	Taxa whose survival depends upon ongoing conservation measures. Without these measures, a conservation dependent taxon would be classified as Vulnerable or more severely threatened.
Data Deficient (Insufficiently Known)	Taxa suspected of being Rare, Vulnerable or Endangered, but whose true status cannot be determined without more information.
Least Concern	Taxa that are not considered Threatened

Conservation codes and descriptions for Western Australian flora and fauna

Code	Conservation category	Description
<i>Wildlife Conservation Act 1950</i>		
T	Threatened species	<p>Published as Specially Protected under the <i>Wildlife Conservation Act 1950</i>, and listed under Schedules 1 to 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora (which may also be referred to as Declared Rare Flora).</p> <p>Threatened fauna is that subset of ‘Specially Protected Fauna’ declared to be ‘likely to become extinct’ pursuant to section 14(4) of the Wildlife Conservation Act.</p> <p>Threatened flora is flora that has been declared to be ‘likely to become extinct or is rare, or otherwise in need of special protection’, pursuant to section 23F(2) of the Wildlife Conservation Act.</p> <p>The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below.</p>
CR	Critically endangered species	Threatened species considered to be facing an extremely high risk of extinction in the wild. Published as Specially Protected under the <i>Wildlife Conservation Act 1950</i> , in Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.
EN	Endangered species	Threatened species considered to be facing a very high risk of extinction in the wild. Published as Specially Protected under the <i>Wildlife Conservation Act 1950</i> , in Schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.
VU	Vulnerable species	Threatened species considered to be facing a high risk of extinction in the wild. Published as Specially Protected under the <i>Wildlife Conservation Act 1950</i> , in Schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.
EX	Presumed extinct species	Species which have been adequately searched for and there is no reasonable doubt that the last individual has died. Published as Specially Protected under the <i>Wildlife Conservation Act 1950</i> , in Schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Presumed Extinct Fauna and Wildlife Conservation (Rare Flora) Notice for Presumed Extinct Flora.
IA	Migratory birds protected under an international agreement	Birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and the Bonn Convention, relating to the protection of migratory birds. Published as Specially Protected under the <i>Wildlife Conservation Act 1950</i> , in Schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice.
CD	Conservation dependent fauna	Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened. Published as Specially Protected under the <i>Wildlife Conservation Act 1950</i> , in Schedule 6 of the Wildlife Conservation (Specially Protected Fauna) Notice.
OS	Other specially protected fauna	Fauna otherwise in need of special protection to ensure their conservation. Published as Specially Protected under the <i>Wildlife Conservation Act 1950</i> , in Schedule 7 of the Wildlife Conservation (Specially Protected Fauna) Notice.

Code	Conservation category	Description
DPaW Priority Listed		
1	Priority One: Poorly-known taxa	Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
2	Priority Two: Poorly-known taxa	Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
3	Priority Three: Poorly-known taxa	Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
4	Priority Four: Rare, Near Threatened and other taxa in need of monitoring	(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands. (b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for Vulnerable, but are not listed as Conservation Dependent. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

Migratory species listed under the EPBC Act

The EPBC Act also protects land and migratory species that are listed under International Agreements. The list of migratory species established under section 209 of the EPBC Act comprises:

- Migratory species which are native to Australia and are included in the appendices to the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals Appendices I and II)
- Migratory species included in annexes established under the Japan-Australia Migratory Bird Agreement (JAMBA) and the China–Australia Migratory Bird Agreement (CAMBA)

- Native, migratory species identified in a list established under, or an instrument made under, an international agreement approved by the Minister, such as the Republic of Korea–Australia Migratory Bird Agreement (ROKAMBA)

Other significant flora and fauna

Flora species, subspecies, varieties, hybrids and ecotypes may be significant for a range of reasons, other than as Threatened (Declared Rare) Flora or Priority Flora. The EPA (2004) states that significant flora may include taxa that have:

- A keystone role in a particular habitat for threatened species or supporting large populations representing a significant proportion of the local regional population of a species
- Relic status
- Anomalous features that indicate a potential new discovery
- Being representative of the range of a species (particularly, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range)
- The presence of restricted subspecies, varieties, or naturally occurring hybrids
- Local endemism/a restricted distribution
- Being poorly reserved

The application of the degree of significance may apply at a range of scales.

Introduced plants (weeds)

Declared Pests

Information on species considered to be Declared Pests is provided under *State Biosecurity and Agriculture Management Act 2007*.

Weeds of National Significance

The spread of weeds across a range of land uses or ecosystems is important in the context of socio-economic and environmental values. The assessment of Weeds of National Significance (WoNS) is based on four major criteria:

- Invasiveness
- Impacts
- Potential for spread
- Socio-economic and environmental values

Australian state and territory governments have identified thirty two Weeds of National Significance (WoNS); a list of 20 WoNS was endorsed in 1999 and a further 12 were added in 2012 (Australian Government 2014).

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Appendix C – Desktop searches

EPBC Act PMST Report (20 km buffer)

NatureMap Flora Report (20 km buffer)

NatureMap Fauna Report (20 km buffer)



EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

Report created: 20/07/16 17:07:14

[Summary](#)

[Details](#)

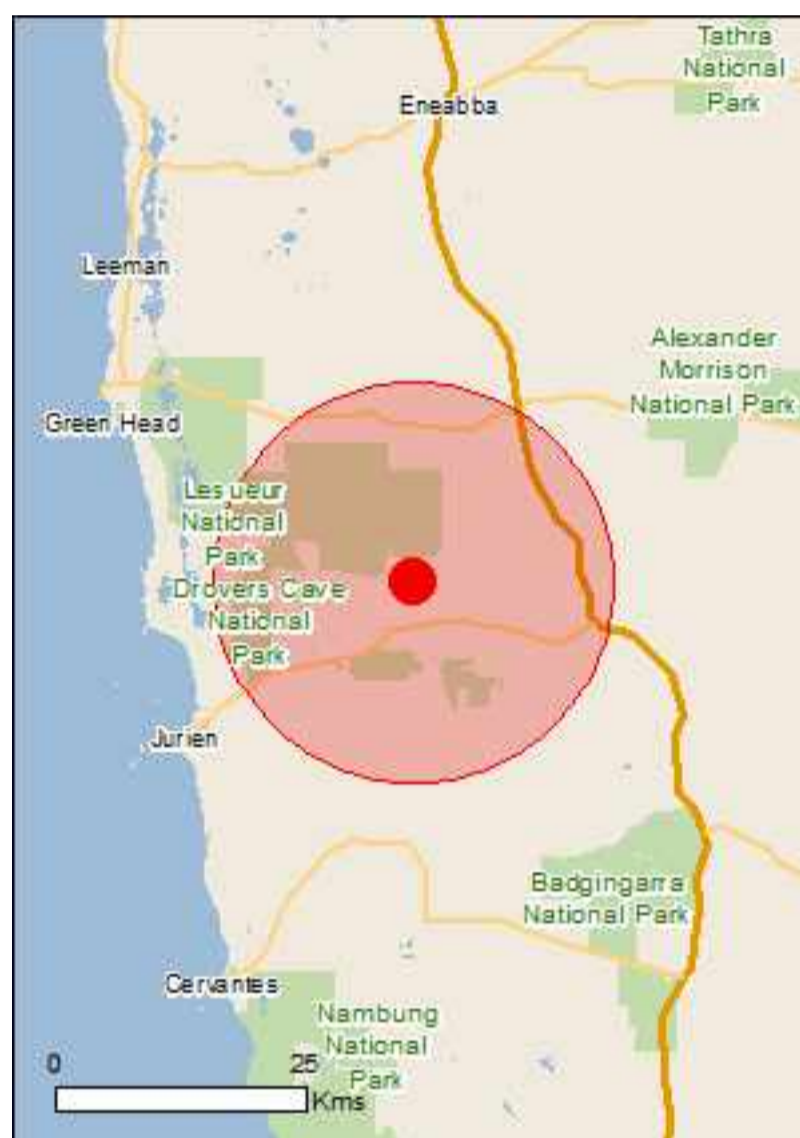
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

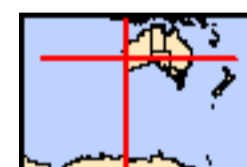
[Acknowledgements](#)



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[Coordinates](#)

Buffer: 20.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the [Administrative Guidelines on Significance](#).

World Heritage Properties:	None
National Heritage Places:	1
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	30
Listed Migratory Species:	5

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at <http://www.environment.gov.au/heritage>

A [permit](#) may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	10
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	18
Regional Forest Agreements:	None
Invasive Species:	17
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

National Heritage Properties		[Resource Information]
Name	State	Status
Natural		
Lesueur National Park	WA	Listed place

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Calyptorhynchus latirostris Carnaby's Black-Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Breeding likely to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area

Mammals		
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat likely to occur within area

Plants		
Acacia forrestiana Forest's Wattle [17235]	Vulnerable	Species or species habitat known to occur within area
Andersonia gracilis Slender Andersonia [14470]	Endangered	Species or species habitat likely to occur within area
Anigozanthos viridis subsp. terraspectans Dwarf Green Kangaroo Paw [3435]	Vulnerable	Species or species habitat likely to occur within area
Banksia serratuloides subsp. perissa Northern Serrate Dryandra [82767]	Critically Endangered	Species or species habitat may occur within area
Caladenia hoffmanii Hoffman's Spider-orchid [56719]	Endangered	Species or species habitat may occur within area
Caladenia huegelii King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat may occur within area
Drakaea elastica Glossy-leafed Hammer-orchid, Praying Virgin [16753]	Endangered	Species or species habitat may occur within area
Eleocharis keigheryi Keighery's Eleocharis [64893]	Vulnerable	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Eucalyptus absita Badgingarra Box [24260]	Endangered	Species or species habitat likely to occur within area
Eucalyptus balanites Cadda Road Mallee, Cadda Mallee [24264]	Endangered	Species or species habitat likely to occur within area
Eucalyptus crispata Yandanooka Mallee [24268]	Vulnerable	Species or species habitat known to occur within area
Eucalyptus impensa Eneabba Mallee [56711]	Endangered	Species or species habitat known to occur within area
Eucalyptus johnsoniana Johnson's Mallee [14516]	Vulnerable	Species or species habitat likely to occur within area
Eucalyptus lateritica Laterite Mallee [6271]	Vulnerable	Species or species habitat likely to occur within area
Eucalyptus leprophloia Scaly Butt Mallee, Scaly-butt Mallee [56712]	Endangered	Species or species habitat known to occur within area
Eucalyptus pruiniramis Midlands Gum, Jingymia Gum [56403]	Endangered	Species or species habitat likely to occur within area
Eucalyptus rhodantha Rose Mallee [9362]	Vulnerable	Species or species habitat may occur within area
Eucalyptus suberea Cork Mallee, Mount Lesueur Mallee [5529]	Vulnerable	Species or species habitat likely to occur within area
Grevillea batrachioides Mt Lesueur Grevillea [21735]	Endangered	Species or species habitat known to occur within area
Grevillea humifusa Spreading Grevillea [61182]	Endangered	Species or species habitat known to occur within area
Hakea megalosperma Lesueur Hakea [10505]	Vulnerable	Species or species habitat likely to occur within area
Hemiandra gardneri Red Snakebush [7945]	Endangered	Species or species habitat known to occur within area
Leucopogon obtectus Hidden Beard-heath [19614]	Endangered	Species or species habitat known to occur within area
Paracaleana dixonii Sandplain Duck Orchid [86882]	Endangered	Species or species habitat known to occur within area
Tetratheca nephelioides [83217]	Critically Endangered	Species or species habitat known to occur within area
Thelymitra stellata Star Sun-orchid [7060]	Endangered	Species or species habitat known to occur within area

Reptiles

Name	Status	Type of Presence
Egernia stokesii badia Western Spiny-tailed Skink, Baudin Island Spiny-tailed Skink [64483]	Endangered	Species or species habitat likely to occur within area

Listed Migratory Species [\[Resource Information \]](#)

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
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Migratory Marine Birds

Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
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Sterna dougallii Roseate Tern [817]		Foraging, feeding or related behaviour likely to occur within area
--	--	--

Migratory Terrestrial Species

Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
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Migratory Wetlands Species

Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area
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Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area
---	--	--

Other Matters Protected by the EPBC Act

Commonwealth Land [\[Resource Information \]](#)

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -

Listed Marine Species [\[Resource Information \]](#)

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
------	------------	------------------

Birds

Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
---	--	--

Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
--	--	---

Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
--	--	--

Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
---	--	--

Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
---	--	--

Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within
---	--	---

Name	Threatened	Type of Presence area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area
Sterna dougallii Roseate Tern [817]		Foraging, feeding or related behaviour likely to occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Beekeepers	WA
Coomallo	WA
Drovers Cave	WA
Hill River	WA
Lesueur	WA
South Eneabba	WA
Southern Beekeepers	WA
Unnamed WA26125	WA
Unnamed WA29901	WA
Unnamed WA33287	WA
Unnamed WA35593	WA
Unnamed WA35594	WA
Unnamed WA42481	WA
Unnamed WA43786	WA
Unnamed WA46713	WA
Unnamed WA48717	WA
Unnamed WA51272	WA
Victoria Location 3860	WA

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resources Audit, 2001.

Name	Status	Type of Presence
Birds		
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area

Mammals

Name	Status	Type of Presence
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Brachiaria mutica Para Grass [5879]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-30.19194 115.23639

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [-Office of Environment and Heritage, New South Wales](#)
- [-Department of Environment and Primary Industries, Victoria](#)
- [-Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [-Department of Environment, Water and Natural Resources, South Australia](#)
- [-Parks and Wildlife Commission NT, Northern Territory Government](#)
- [-Department of Environmental and Heritage Protection, Queensland](#)
- [-Department of Parks and Wildlife, Western Australia](#)
- [-Environment and Planning Directorate, ACT](#)
- [-Birdlife Australia](#)
- [-Australian Bird and Bat Banding Scheme](#)
- [-Australian National Wildlife Collection](#)
- Natural history museums of Australia
- [-Museum Victoria](#)
- [-Australian Museum](#)
- [-South Australian Museum](#)
- [-Queensland Museum](#)
- [-Online Zoological Collections of Australian Museums](#)
- [-Queensland Herbarium](#)
- [-National Herbarium of NSW](#)
- [-Royal Botanic Gardens and National Herbarium of Victoria](#)
- [-Tasmanian Herbarium](#)
- [-State Herbarium of South Australia](#)
- [-Northern Territory Herbarium](#)
- [-Western Australian Herbarium](#)
- [-Australian National Herbarium, Atherton and Canberra](#)
- [-University of New England](#)
- [-Ocean Biogeographic Information System](#)
- [-Australian Government, Department of Defence Forestry Corporation, NSW](#)
- [-Geoscience Australia](#)
- [-CSIRO](#)
- Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the [Contact Us](#) page.

Hill River Flora NatureMap Species Report

Created By Guest user on 20/07/2016

Kingdom Plantae
Current Names Only Yes
Core Datasets Only Yes
Species Group Vascular Plants
Method 'By Circle'
Centre 115° 14' 11" E, 30° 11' 31" S
Buffer 20km
Group By Family

Family	Species	Records
Amaranthaceae	7	27
Anacardiaceae	1	1
Anarthriaceae	8	51
Apiaceae	15	127
Apodanthaceae	1	1
Araliaceae	4	23
Asparagaceae	39	185
Asphodelaceae	2	3
Asteraceae	77	252
Boraginaceae	1	1
Boryaceae	3	8
Brassicaceae	2	3
Byblidaceae	2	8
Campanulaceae	12	43
Caryophyllaceae	6	10
Casuarinaceae	8	51
Celastraceae	5	43
Centrolepidaceae	9	20
Chenopodiaceae	7	8
Colchicaceae	6	26
Convolvulaceae	2	7
Crassulaceae	6	10
Cucurbitaceae	1	2
Cupressaceae	3	56
Cyperaceae	69	241
Dasygongonaceae	7	53
Dennstaedtiaceae	1	1
Dilleniaceae	23	229
Dioscoreaceae	1	6
Droseraceae	31	151
Ecdiocoleaceae	2	46
Elaeocarpaceae	8	45
Emblingiaceae	1	1
Ericaceae	70	600
Euphorbiaceae	11	55
Fabaceae	167	1297
Gentianaceae	2	5
Geraniaceae	6	9
Goodeniaceae	48	351
Gyrostemonaceae	7	28
Haemodoraceae	51	421
Haloragaceae	6	13
Hemerocallidaceae	14	85
Hypoxidaceae	3	10
Iridaceae	9	26
Juncaceae	6	16
Juncaginaceae	6	8
Lamiaceae	25	162
Lauraceae	10	43
Lentibulariaceae	2	4
Loganiaceae	4	47
Loranthaceae	3	6
Malvaceae	26	163
Menyanthaceae	1	1
Molluginaceae	2	8
Myrtaceae	228	2202
Olacaceae	2	31
Onagraceae	3	3
Orchidaceae	52	122
Orobanchaceae	3	6
Oxalidaceae	3	5
Papaveraceae	1	1
Philydraceae	2	4
Phyllanthaceae	2	11
Pittosporaceae	6	27
Poaceae	51	108
Polygalaceae	10	58
Polygonaceae	3	12
Portulacaceae	7	18
Primulaceae	3	11
Proteaceae	185	1862
Pteridaceae	3	8
Ranunculaceae	2	2
Restionaceae	31	236

Rhamnaceae	22	147
Rubiaceae	2	9
Rutaceae	22	194
Santalaceae	4	19
Sapindaceae	7	28
Scrophulariaceae	5	10
Selaginellaceae	1	3
Solanaceae	8	29
Stylidiaceae	53	352
Surianaceae	1	9
Thymelaeaceae	11	79
Typhaceae	1	1
Urticaceae	1	2
Violaceae	4	30
Vitaceae	1	3
Xanthorrhoeaceae	4	23
Zamiaceae	2	10
TOTAL	1595	10772

Name ID	Species Name	Naturalised	Conservation Code	Endemic To Query Area
Amaranthaceae				
1.	44602 <i>Ptilotus clivicola</i>		P2	
2.	2718 <i>Ptilotus drummondii</i> (Narrowleaf Mulla Mulla)			
3.	2733 <i>Ptilotus humilis</i>			
4.	2742 <i>Ptilotus manglesii</i> (Pom Poms, Mulamula)			
5.	2751 <i>Ptilotus polystachyus</i> (Prince of Wales Feather)			
6.	<i>Ptilotus</i> sp.			
7.	40841 <i>Ptilotus stirlingii</i> subsp. <i>stirlingii</i>			
Anacardiaceae				
8.	17056 <i>Schinus molle</i> var. <i>areira</i>	Y		
Anarthriaceae				
9.	1058 <i>Anarthria gracilis</i>			
10.	1059 <i>Anarthria humilis</i>			
11.	1060 <i>Anarthria laevis</i>			
12.	<i>Anarthria</i> sp.			
13.	1097 <i>Lyginia barbata</i>			
14.	19245 <i>Lyginia excelsa</i>		P1	
15.	18049 <i>Lyginia imberbis</i>			
16.	<i>Lyginia</i> sp.			
Apiaceae				
17.	6205 <i>Actinotus leucocephalus</i> (Flannel Flower)			
18.	6214 <i>Centella asiatica</i>			
19.	6218 <i>Daucus glochidiatus</i> (Australian Carrot)			
20.	6219 <i>Eryngium pinnatifidum</i> (Blue Devils)			
21.	15446 <i>Eryngium pinnatifidum</i> subsp. <i>pinnatifidum</i>			
22.	<i>Eryngium</i> sp.			
23.	6222 <i>Homalosciadium homalocarpum</i>			
24.	6255 <i>Platysace juncea</i>			
25.	11132 <i>Platysace ramosissima</i>		P3	
26.	6262 <i>Platysace xerophila</i>			
27.	6285 <i>Xanthosia ciliata</i>			
28.	6287 <i>Xanthosia fruticulosa</i>			
29.	6289 <i>Xanthosia huegelii</i>			
30.	<i>Xanthosia</i> sp.			
31.	6294 <i>Xanthosia tomentosa</i> (Lesueur Southern Cross)		P4	
Apodanthaceae				
32.	2408 <i>Pilostyles hamiltonii</i>			
Araliaceae				
33.	6223 <i>Hydrocotyle alata</i>			
34.	6226 <i>Hydrocotyle callicarpa</i> (Small Pennywort)			
35.	6268 <i>Trachymene cyanopetala</i>			
36.	6280 <i>Trachymene pilosa</i> (Native Parsnip)			
Asparagaceae				
37.	1205 <i>Acanthocarpus canaliculatus</i>			
38.	1208 <i>Acanthocarpus preissii</i>			
39.	1209 <i>Acanthocarpus robustus</i>			
40.	20797 <i>Acanthocarpus</i> sp. <i>Ajana</i> (C.A. Gardner 8596)			
41.	<i>Arthropodium</i> sp.			
42.	8779 <i>Asparagus asparagoides</i> (Bridal Creeper)	Y		
43.	1280 <i>Chamaescilla corymbosa</i> (Blue Squill)			
44.	11299 <i>Chamaescilla corymbosa</i> var. <i>corymbosa</i>			
45.	8788 <i>Chamaescilla versicolor</i>			
46.	1287 <i>Dichopogon capillipes</i>			
47.	1289 <i>Dichopogon preissii</i>			
48.	1305 <i>Laxmannia omnifertilis</i>			
49.	11911 <i>Laxmannia ramosa</i> subsp. <i>ramosa</i>			
50.	11464 <i>Laxmannia sessiliflora</i> subsp. <i>australis</i>			
51.	11679 <i>Laxmannia sessiliflora</i> subsp. <i>drummondii</i>			
52.	11732 <i>Laxmannia sessiliflora</i> subsp. <i>sessiliflora</i>			
53.	<i>Laxmannia</i> sp.			
54.	1223 <i>Lomandra caespitosa</i> (Tufted Mat Rush)			
55.	1227 <i>Lomandra hastilis</i>			
56.	14542 <i>Lomandra micrantha</i> subsp. <i>micrantha</i>			
57.	1239 <i>Lomandra preissii</i>			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
58.	1243 <i>Lomandra sericea</i> (Silky Mat Rush)			
59.	1246 <i>Lomandra suaveolens</i>			
60.	1312 <i>Sowerbaea laxiflora</i> (Purple Tassels)			
61.	1317 <i>Thysanotus anceps</i>		P3	
62.	1318 <i>Thysanotus arbuscula</i>			
63.	1319 <i>Thysanotus arenarius</i>			
64.	1320 <i>Thysanotus asper</i> (Hairy Fringe Lily)			
65.	1334 <i>Thysanotus glaucus</i>		P4	
66.	1338 <i>Thysanotus manglesianus</i> (Fringed Lily)			
67.	1343 <i>Thysanotus patersonii</i>			
68.	<i>Thysanotus</i> sp.			
69.	13783 <i>Thysanotus</i> sp. Badgingarra (E.A. Griffin 2511)		P2	
70.	29456 <i>Thysanotus</i> sp. Twining Wheatbelt (N.H. Brittan 81/29)			
71.	1351 <i>Thysanotus sparteus</i>			
72.	1356 <i>Thysanotus teretifolius</i>			
73.	1357 <i>Thysanotus thyrsoides</i>			
74.	1358 <i>Thysanotus triandrus</i>			
75.	1359 <i>Thysanotus vernalis</i>		P3	

Asphodelaceae

76.	1366 <i>Bulbine semibarbata</i> (Leek Lily)			
77.	1368 <i>Trachyandra divaricata</i>	Y		

Asteraceae

78.	7832 <i>Angianthus milnei</i> (Cone-spike Angianthus)			
79.	7833 <i>Angianthus preissianus</i>			
80.	7838 <i>Arctotheca calendula</i> (Cape Weed)	Y		
81.	7840 <i>Arctotis stoechadifolia</i> (White Arctotis)	Y		
82.	7851 <i>Asteridea pulverulenta</i> (Common Bristle Daisy)			
83.	7856 <i>Blennospora drummondii</i>			
84.	7867 <i>Brachyscome bellidioides</i>			
85.	7875 <i>Brachyscome glandulosa</i>			
86.	7878 <i>Brachyscome iberidifolia</i>			
87.	7883 <i>Brachyscome pusilla</i>			
88.	<i>Brachyscome</i> sp.			
89.	7916 <i>Centaurea melitensis</i> (Maltese Cockspur)	Y		
90.	12612 <i>Chrysocephalum apiculatum</i>			
91.	7941 <i>Conyza parva</i>	Y		
92.	20074 <i>Conyza sumatrensis</i>	Y		
93.	7943 <i>Cotula australis</i> (Common Cotula)			
94.	7944 <i>Cotula bipinnata</i> (Ferny Cotula)	Y		
95.	7945 <i>Cotula coronopifolia</i> (Waterbuttons)	Y		
96.	7946 <i>Cotula cotuloides</i> (Smooth Cotula)			
97.	13354 <i>Craspedia variabilis</i>			
98.	12740 <i>Erymophyllum tenellum</i>			
99.	15137 <i>Euchiton sphaericus</i>			
100.	16311 <i>Gazania linearis</i>	Y		
101.	7991 <i>Gnephosis drummondii</i>			
102.	8002 <i>Gnephosis tenuissima</i>			
103.	12741 <i>Hyalosperma cotula</i>			
104.	8086 <i>Hypochoeris glabra</i> (Smooth Catsear)	Y		
105.	8087 <i>Isoetopsis graminifolia</i> (Cushion Grass)			
106.	18585 <i>Lagenophora huegelii</i>			
107.	17852 <i>Leptorhynchus scaber</i> (Lanky Buttons)			
108.	8105 <i>Millotia myosotidifolia</i>			
109.	14344 <i>Millotia tenuifolia</i> var. <i>tenuifolia</i> (Soft Millotia)			
110.	29418 <i>Monoculus monstrosus</i>	Y		
111.	8114 <i>Myriocephalus appendiculatus</i> (White-tip Myriocephalus)			
112.	14187 <i>Myriocephalus occidentalis</i>			
113.	8136 <i>Olearia homolepis</i>			
114.	32716 <i>Olearia lehmanniana</i>			
115.	8143 <i>Olearia paucidentata</i> (Autumn Scrub Daisy)			
116.	8149 <i>Olearia rudis</i> (Rough Daisybush)			
117.	42024 <i>Olearia</i> sp. Kennedy Range (G. Byrne 66)			
118.	18353 <i>Pithocarpa pulchella</i> var. <i>pulchella</i>			
119.	<i>Pithocarpa</i> sp.			
120.	45237 <i>Podolepis aristata</i> subsp. <i>aristata</i>			
121.	8173 <i>Podolepis capillaris</i> (Wiry Podolepis)			
122.	8175 <i>Podolepis gracilis</i> (Slender Podolepis)			
123.	8177 <i>Podolepis lessonii</i>			
124.	8182 <i>Podotrochea angustifolia</i> (Sticky Longheads)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
125.	8183 <i>Podotheca chrysantha</i> (Yellow Podotheca)			
126.	8184 <i>Podotheca gnaphalioides</i> (Golden Long-heads)			
127.	8188 <i>Pogonolepis stricta</i>			
128.	13255 <i>Pterochaeta paniculata</i>			
129.	8195 <i>Quinetia urvillei</i>			
130.	15035 <i>Rhodanthe corymbosa</i>			
131.	13234 <i>Rhodanthe manglesii</i>			
132.	20663 <i>Senecio multicaulis</i> subsp. <i>multicaulis</i>			
133.	20161 <i>Senecio pinnatifolius</i>			
134.	25884 <i>Senecio pinnatifolius</i> var. <i>latilobus</i>			
135.	<i>Senecio</i> sp.			
136.	8224 <i>Siloxerus filifolius</i>			
137.	8225 <i>Siloxerus humifusus</i> (<i>Procumbent Siloxerus</i>)			
138.	14583 <i>Siloxerus multiflorus</i>			
139.	8230 <i>Sonchus asper</i> (<i>Rough Sowthistle</i>)	Y		
140.	9367 <i>Sonchus hydrophilus</i> (<i>Native Sowthistle</i>)			
141.	8231 <i>Sonchus oleraceus</i> (<i>Common Sowthistle</i>)	Y		
142.	8251 <i>Trichocline spathulata</i> (<i>Native Gerbera</i>)			
143.	8254 <i>Urospermum picroides</i> (<i>False Hawkbit</i>)	Y		
144.	8255 <i>Ursinia anthemoides</i> (<i>Ursinia</i>)	Y		
145.	38388 <i>Ursinia anthemoides</i> subsp. <i>anthemoides</i>	Y		
146.	8257 <i>Vellereophyton dealbatum</i> (<i>White Cudweed</i>)	Y		
147.	8275 <i>Waitzia acuminata</i> (<i>Orange Immortelle</i>)			
148.	13330 <i>Waitzia acuminata</i> var. <i>albicans</i>			
149.	13328 <i>Waitzia nitida</i>			
150.	8281 <i>Waitzia podolepis</i>			
151.	13333 <i>Waitzia suaveolens</i> var. <i>suaveolens</i>			
152.	19938 <i>Xerochrysum bracteatum</i>			
153.	44861 <i>Xerochrysum macranthum</i>			
154.	<i>Xerochrysum</i> sp.			
Boraginaceae				
155.	6707 <i>Heliotropium curassavicum</i> (<i>Smooth Heliotrope</i>)			
Boryaceae				
156.	1269 <i>Borya laciniata</i>			
157.	1272 <i>Borya scirpoidea</i>			
158.	1273 <i>Borya sphaerocephala</i> (<i>Pincushions</i>)			
Brassicaceae				
159.	3000 <i>Brassica tournefortii</i> (<i>Mediterranean Turnip</i>)	Y		
160.	3042 <i>Lepidium pseudotasmanicum</i>		P4	
Byblidaceae				
161.	3178 <i>Byblis gigantea</i> (<i>Rainbow Plant</i>)		P3	
162.	20230 <i>Byblis lamellata</i>			
Campanulaceae				
163.	7396 <i>Isotoma hypocraeteriformis</i> (<i>Woodbridge Poison</i>)			
164.	7398 <i>Isotoma pusilla</i> (<i>Small Isotome</i>)			
165.	7399 <i>Isotoma scapigera</i> (<i>Long-scaped Isotome</i>)			
166.	9289 <i>Lobelia anceps</i> (<i>Angled Lobelia</i>)			
167.	7403 <i>Lobelia heterophylla</i> (<i>Wing-seeded Lobelia</i>)			
168.	36863 <i>Lobelia heterophylla</i> subsp. <i>heterophylla</i>			
169.	7405 <i>Lobelia rarifolia</i>			
170.	7407 <i>Lobelia rhytidosperra</i> (<i>Wrinkled-seeded Lobelia</i>)			
171.	7410 <i>Monopsis debilis</i>	Y		
172.	37440 <i>Monopsis debilis</i> var. <i>depressa</i>	Y		
173.	7384 <i>Wahlenbergia capensis</i> (<i>Cape Bluebell</i>)	Y		
174.	7389 <i>Wahlenbergia preissii</i>			
Caryophyllaceae				
175.	13489 <i>Cerastium pumilum</i>	Y		
176.	19825 <i>Petrorhagia dubia</i>	Y		
177.	2905 <i>Polycarpon tetraphyllum</i> (<i>Fourleaf Allseed</i>)	Y		
178.	2909 <i>Silene gallica</i> (<i>French Catchfly</i>)	Y		
179.	2914 <i>Spergularia diandra</i> (<i>Lesser Sand Spurry</i>)	Y		
180.	2918 <i>Stellaria media</i> (<i>Chickweed</i>)	Y		
Casuarinaceae				
181.	1721 <i>Allocasuarina campestris</i>			
182.	1729 <i>Allocasuarina grevilleoides</i>		P3	
183.	1732 <i>Allocasuarina humilis</i> (<i>Dwarf Sheoak</i>)			
184.	13908 <i>Allocasuarina lehmanniana</i> subsp. <i>lehmanniana</i>			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
185.	1734 <i>Allocasuarina microstachya</i>			
186.	1736 <i>Allocasuarina ramosissima</i>		P3	
187.	1739 <i>Allocasuarina thuyoides</i> (Horned Sheoak)			
188.	1742 <i>Casuarina obesa</i> (Swamp Sheoak, Kuli)			
Celastraceae				
189.	4733 <i>Stackhousia monogyna</i>			
190.	9070 <i>Stackhousia pubescens</i> (Downy Stackhousia)			
191.	<i>Stackhousia</i> sp.			
192.	43540 <i>Stackhousia</i> sp. Red-blotched corolla (A. Markey 911)		P3	
193.	4737 <i>Tripterococcus brunonis</i> (Winged Stackhousia)			
Centrolepidaceae				
194.	1116 <i>Aphelia brizula</i>			
195.	<i>Aphelia</i> sp.			
196.	43548 <i>Aphelia</i> sp. Albany (B.G. Briggs 596)			
197.	1120 <i>Centrolepis alepyroides</i>			
198.	1121 <i>Centrolepis aristata</i> (Pointed Centrolepis)			
199.	1125 <i>Centrolepis drummondiana</i>			
200.	45093 <i>Centrolepis milleri</i>		P3	
201.	1133 <i>Centrolepis pilosa</i>			
202.	1134 <i>Centrolepis polygyna</i> (Wiry Centrolepis)			
Chenopodiaceae				
203.	2452 <i>Atriplex cinerea</i> (Grey Saltbush)			
204.	2490 <i>Chenopodium glaucum</i> (Glaucous Goosefoot)	Y		
205.	11254 <i>Rhagodia preissii</i> subsp. <i>preissii</i>			
206.	2591 <i>Sarcocornia blackiana</i>			
207.	2593 <i>Sarcocornia quinqueflora</i> (Beaded Samphire)			
208.	2639 <i>Suaeda australis</i> (Seablite)			
209.	33319 <i>Tecticornia indica</i> subsp. <i>bidens</i>			
Colchicaceae				
210.	1383 <i>Burchardia bairdiae</i>			
211.	12770 <i>Burchardia congesta</i>			
212.	1385 <i>Burchardia multiflora</i> (Dwarf Burchardia)			
213.	12072 <i>Wurmbea dioica</i> subsp. <i>alba</i>			
214.	1398 <i>Wurmbea monantha</i>			
215.	1401 <i>Wurmbea pygmaea</i>			
Convolvulaceae				
216.	6614 <i>Convolvulus remotus</i>			
217.	6630 <i>Ipomoea indica</i> (Morning Glory)	Y		
Crassulaceae				
218.	3136 <i>Crassula alata</i>	Y		
219.	17701 <i>Crassula closiana</i>			
220.	11709 <i>Crassula colorata</i> var. <i>acuminata</i>			
221.	11563 <i>Crassula colorata</i> var. <i>colorata</i>			
222.	11349 <i>Crassula decumbens</i> var. <i>decumbens</i>			
223.	15706 <i>Crassula natans</i> var. <i>minus</i>	Y		
Cucurbitaceae				
224.	7370 <i>Citrullus lanatus</i> (Pie Melon)	Y		
Cupressaceae				
225.	36520 <i>Callitris acuminata</i> (Dwarf Cypress)			
226.	36560 <i>Callitris arenaria</i> (Sandplain Cypress)			
227.	36600 <i>Callitris pyramidalis</i> (Swamp Cypress)			
Cyperaceae				
228.	741 <i>Baumea articulata</i> (Jointed Rush)			
229.	743 <i>Baumea juncea</i> (Bare Twigrush)			
230.	749 <i>Bolboschoenus caldwelii</i> (Marsh Club-rush)			
231.	760 <i>Caustis dioica</i>			
232.	13765 <i>Caustis gigas</i> (Giant Twigrush)		P2	
233.	763 <i>Chorizandra enodis</i> (Black Bristlerush)			
234.	768 <i>Cyathochaeta avenacea</i>			
235.	<i>Cyathochaeta</i> sp.			
236.	794 <i>Cyperus gymnocaulos</i> (Spiny Flat-sedge)			
237.	806 <i>Cyperus polystachyos</i> (Bunchy Sedge)	Y		
238.	816 <i>Cyperus tenuiflorus</i> (Scaly Sedge)	Y		
239.	822 <i>Eleocharis acuta</i> (Common Spikerush)			
240.	17605 <i>Eleocharis keigheryi</i>		T	
241.	20216 <i>Ficinia nodosa</i> (Knotted Club Rush)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
242.	901 <i>Gahnia australis</i>			
243.	907 <i>Gahnia trifida</i> (Coast Saw-sedge)			
244.	910 <i>Isolepis cernua</i> (Nodding Club-rush)			
245.	20200 <i>Isolepis cernua</i> var. <i>setiformis</i>			
246.	911 <i>Isolepis congrua</i>			
247.	912 <i>Isolepis cyperoides</i>			
248.	<i>Isolepis levynsiana</i>			
249.	917 <i>Isolepis marginata</i> (Coarse Club-rush)			
250.	<i>Isolepis multicaulis</i>			
251.	<i>Isolepis</i> sp.			
252.	925 <i>Lepidosperma angustatum</i>			
253.	42741 <i>Lepidosperma apricola</i>			
254.	41620 <i>Lepidosperma asperatum</i>			
255.	929 <i>Lepidosperma carphoides</i> (Black Rapier Sedge)			
256.	937 <i>Lepidosperma longitudinale</i> (Pithy Sword-sedge)			
257.	940 <i>Lepidosperma pubisquamium</i>			
258.	41647 <i>Lepidosperma sanguinolentum</i>			
259.	944 <i>Lepidosperma scabrum</i>			
260.	<i>Lepidosperma</i> sp.			
261.	945 <i>Lepidosperma squamatum</i>			
262.	946 <i>Lepidosperma striatum</i>			
263.	947 <i>Lepidosperma tenue</i>			
264.	949 <i>Lepidosperma tuberculatum</i>			
265.	951 <i>Lepidosperma viscidum</i> (Sticky Sword Sedge)			
266.	953 <i>Mesomelaena graciliceps</i>			
267.	954 <i>Mesomelaena preissii</i>			
268.	955 <i>Mesomelaena pseudostygia</i>			
269.	957 <i>Mesomelaena tetragona</i> (Semaphore Sedge)			
270.	<i>Schoenoplectus tabernaemontani</i>			
271.	972 <i>Schoenus armeria</i>			
272.	978 <i>Schoenus brevisetis</i>			
273.	979 <i>Schoenus caespititius</i>			
274.	982 <i>Schoenus clandestinus</i>			
275.	984 <i>Schoenus curvifolius</i>			
276.	992 <i>Schoenus grandiflorus</i> (Large Flowered Bogrush)			
277.	17617 <i>Schoenus insolitus</i>			
278.	1000 <i>Schoenus minutulus</i>			
279.	1002 <i>Schoenus nanus</i> (Tiny Bog Rush)			
280.	1005 <i>Schoenus obtusifolius</i>			
281.	1006 <i>Schoenus odontocarpus</i>			
282.	1007 <i>Schoenus pedicellatus</i>			
283.	1009 <i>Schoenus pleiostemoneus</i>			
284.	17614 <i>Schoenus plumosus</i>			
285.	1011 <i>Schoenus rigens</i>			
286.	1013 <i>Schoenus sculptus</i> (Gimlet Bog-rush)			
287.	<i>Schoenus</i> sp.			
288.	16274 <i>Schoenus</i> sp. A3 Ciliate Sheaths (K.R. Newbey 9402)			
289.	18164 <i>Schoenus</i> sp. smooth culms (K.R. Newbey 7823)			
290.	1018 <i>Schoenus subfascicularis</i>			
291.	1019 <i>Schoenus subflavus</i> (Yellow Bog-rush)			
292.	1023 <i>Schoenus tenellus</i>			
293.	1026 <i>Schoenus unispiculatus</i>			
294.	1036 <i>Tetraria octandra</i>			
295.	35579 <i>Tetraria</i> sp. Jarrah Forest (R. Davis 7391)			
296.	43400 <i>Tricostularia</i> sp. Ongerup (L. Strahan 409)			
Dasypogonaceae				
297.	19304 <i>Calectasia browneana</i>		P2	
298.	1213 <i>Calectasia cyanea</i> (Blue Tinsel Lily)		T	
299.	19312 <i>Calectasia hispida</i>			
300.	19309 <i>Calectasia narragara</i>			
301.	1218 <i>Dasypogon bromeliifolius</i> (Pineapple Bush)			
302.	1220 <i>Dasypogon obliquifolius</i>			
303.	1221 <i>Kingia australis</i> (Kingia, Pulonok)			
Dennstaedtiaceae				
304.	41651 <i>Pteridium esculentum</i> subsp. <i>esculentum</i>			
Dilleniaceae				
305.	5108 <i>Hibbertia acerosa</i> (Needle Leaved Guinea Flower)			
306.	5112 <i>Hibbertia aurea</i>			
307.	5116 <i>Hibbertia crassifolia</i>			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
308.	5120 <i>Hibbertia desmophylla</i>			
309.	5130 <i>Hibbertia glomerosa</i> (Guinea-flower)			
310.	5133 <i>Hibbertia helianthemoides</i>		P4	
311.	20046 <i>Hibbertia hibbertioides</i> var. <i>hibbertioides</i>			
312.	5134 <i>Hibbertia huegelii</i>			
313.	5135 <i>Hibbertia hypericoides</i> (Yellow Buttercups)			
314.	45534 <i>Hibbertia hypericoides</i> subsp. <i>hypericoides</i>			
315.	45533 <i>Hibbertia hypericoides</i> subsp. <i>septentrionalis</i>			
316.	35520 <i>Hibbertia leucocrossa</i>			
317.	5148 <i>Hibbertia mylnei</i>			
318.	5153 <i>Hibbertia pachyrrhiza</i>			
319.	5157 <i>Hibbertia polystachya</i>			
320.	35518 <i>Hibbertia propinqua</i>		P4	
321.	5162 <i>Hibbertia racemosa</i> (Stalked Guinea Flower)			
322.	44609 <i>Hibbertia robur</i>			
323.	<i>Hibbertia</i> sp.			
324.	<i>Hibbertia</i> sp. Bankstown (R.T.Miller & C.P.Gibson s.n. 18/10/06)			
325.	5171 <i>Hibbertia spicata</i>			
326.	11481 <i>Hibbertia spicata</i> subsp. <i>spicata</i>			
327.	5173 <i>Hibbertia subvaginata</i>			

Dioscoreaceae

328. 1509 *Dioscorea hastifolia* (Warrine, Warram)

Droseraceae

329.	31231 <i>Drosera allantostigma</i>		P1	
330.	3090 <i>Drosera barbiger</i>			
331.	13219 <i>Drosera bulbosa</i> subsp. <i>bulbosa</i>			
332.	13202 <i>Drosera echinoblastus</i>			
333.	13201 <i>Drosera eneabba</i>			
334.	3095 <i>Drosera erythrorhiza</i> (Red Ink Sundew)			
335.	13217 <i>Drosera erythrorhiza</i> subsp. <i>erythrorhiza</i>			
336.	13212 <i>Drosera erythrorhiza</i> subsp. <i>magna</i>			
337.	3097 <i>Drosera gigantea</i> (Giant Sundew)			
338.	15453 <i>Drosera gigantea</i> subsp. <i>gigantea</i>			
339.	3098 <i>Drosera glanduligera</i> (Pimpernel Sundew)			
340.	3101 <i>Drosera heterophylla</i> (Swamp Rainbow)			
341.	8910 <i>Drosera humilis</i>			
342.	3105 <i>Drosera leucoblata</i> (Wheel Sundew)			
343.	14298 <i>Drosera macrantha</i> subsp. <i>macrantha</i>			
344.	13209 <i>Drosera marchantii</i> subsp. <i>marchantii</i>			
345.	13208 <i>Drosera marchantii</i> subsp. <i>prophylla</i>		P3	
346.	3109 <i>Drosera menziesii</i> (Pink Rainbow)			
347.	11853 <i>Drosera menziesii</i> subsp. <i>menziesii</i>			
348.	13216 <i>Drosera menziesii</i> subsp. <i>penicillaris</i>			
349.	11196 <i>Drosera menziesii</i> subsp. <i>thysanosepala</i>			
350.	3110 <i>Drosera microphylla</i> (Golden Rainbow)			
351.	15710 <i>Drosera miniata</i> (Orange Sundew)			
352.	3115 <i>Drosera occidentalis</i> (Western Sundew)			
353.	3118 <i>Drosera pallida</i> (Pale Rainbow)			
354.	3119 <i>Drosera parvula</i> (Small Sundew)			
355.	29178 <i>Drosera porrecta</i>			
356.	3128 <i>Drosera ramellosa</i> (Branched Sundew)			
357.	<i>Drosera</i> sp.			
358.	13185 <i>Drosera spilos</i>			
359.	3133 <i>Drosera subhirtella</i> (Sunny Rainbow)			

Ecdeiocolaceae

360. 1066 *Ecdeiocola monostachya*

361. 18404 *Georgeantha hexandra*

Elaeocarpaceae

362.	4524 <i>Platytheca galioides</i>			
363.	23982 <i>Tetratheca angulata</i>		P3	
364.	4528 <i>Tetratheca confertifolia</i>			
365.	23989 <i>Tetratheca nephelioides</i>		T	
366.	4539 <i>Tetratheca paucifolia</i>			
367.	4542 <i>Tetratheca remota</i>		P1	
368.	4544 <i>Tetratheca setigera</i>			
369.	<i>Tetratheca</i> sp.			

Emblingiaceae

370. 2989 *Emblingia calceoliflora*

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
Ericaceae				
371.	6311 <i>Andersonia heterophylla</i>			
372.	6312 <i>Andersonia involucrata</i>			
373.	6314 <i>Andersonia lehmanniana</i>			
374.	11471 <i>Andersonia lehmanniana</i> subsp. <i>lehmanniana</i>			
375.	11606 <i>Andersonia lehmanniana</i> subsp. <i>pubescens</i>			
376.	<i>Andersonia</i> sp.			
377.	17647 <i>Andersonia</i> sp. Mt Lesueur (E.A. Griffin 5536)		P2	Y
378.	41738 <i>Andersonia</i> sp. Mysosma (E.A. Griffin 2213)			
379.	6323 <i>Astroloma ciliatum</i> (Candle Cranberry)			
380.	6326 <i>Astroloma epacridis</i>			
381.	6328 <i>Astroloma glaucescens</i>			
382.	6331 <i>Astroloma microcalyx</i> (Native Cranberry)			
383.	6332 <i>Astroloma microdonta</i> (Sandplain Cranberry)			
384.	42144 <i>Astroloma oblongifolium</i>			
385.	6334 <i>Astroloma pallidum</i> (Kick Bush)			
386.	6336 <i>Astroloma serratifolium</i> (Kondrung)			
387.	<i>Astroloma</i> sp.			
388.	14501 <i>Astroloma</i> sp. Eneabba (N. Marchant s.n. PERTH 01291777)			
389.	6337 <i>Astroloma stomarrhena</i> (Red Swamp Cranberry)			
390.	6339 <i>Astroloma xerophyllum</i>			
391.	30133 <i>Brachyloma jillup</i>			
392.	6341 <i>Brachyloma preissii</i> (Globe Heath)			
393.	30136 <i>Brachyloma preissii</i> subsp. <i>preissii</i>			
394.	19026 <i>Conostephium magnum</i>		P4	
395.	6347 <i>Conostephium minus</i> (Pink-tipped Pearl flower)			
396.	6348 <i>Conostephium pendulum</i> (Pearl Flower)			
397.	6349 <i>Conostephium preissii</i>			
398.	6350 <i>Conostephium roei</i>			
399.	13527 <i>Croninia kingiana</i>			
400.	6368 <i>Leucopogon carinatus</i>			
401.	6370 <i>Leucopogon cochlearifolius</i>			
402.	6374 <i>Leucopogon conostephioides</i>			
403.	6379 <i>Leucopogon crassiflorus</i>			
404.	6380 <i>Leucopogon crassifolius</i>			
405.	6397 <i>Leucopogon glaucifolius</i>			
406.	6405 <i>Leucopogon insularis</i>			
407.	6410 <i>Leucopogon leptanthus</i>			
408.	6417 <i>Leucopogon obovatus</i>			
409.	6418 <i>Leucopogon obtectus</i> (Hidden Beard-heath)		T	
410.	6419 <i>Leucopogon obtusatus</i>			
411.	6420 <i>Leucopogon oldfieldii</i>			
412.	6421 <i>Leucopogon oliganthus</i>			
413.	6425 <i>Leucopogon oxycedrus</i>			
414.	6426 <i>Leucopogon ozothamnoides</i>		P1	
415.	6429 <i>Leucopogon phyllostachys</i>			
416.	6430 <i>Leucopogon planifolius</i>			
417.	6432 <i>Leucopogon plumuliflorus</i>		P2	
418.	6434 <i>Leucopogon polymorphus</i>			
419.	6436 <i>Leucopogon propinquus</i>			
420.	6438 <i>Leucopogon pubescens</i>			
421.	<i>Leucopogon</i> sp.			
422.	19578 <i>Leucopogon</i> sp. Bifid Eneabba (M. Hislop 1927)			
423.	20868 <i>Leucopogon</i> sp. Cataby (F. Hort 1638)			
424.	34162 <i>Leucopogon</i> sp. Cocksleshell Gully (J.M. Powell 1749)			
425.	39501 <i>Leucopogon</i> sp. Coomallo (R.J. Cranfield 1457)			
426.	17723 <i>Leucopogon</i> sp. Lesueur (B. Evans 530)			
427.	19579 <i>Leucopogon</i> sp. Murdoch (M. Hislop 1037)			
428.	34163 <i>Leucopogon</i> sp. Newdegate (M. Hislop 3585)			
429.	29053 <i>Leucopogon</i> sp. South Eneabba (E.A. Griffin 8027)			
430.	19368 <i>Leucopogon</i> sp. Warradarge (M. Hislop 1908)			
431.	37040 <i>Leucopogon</i> sp. Watheroo (R.D. Royce 9616)			
432.	34156 <i>Leucopogon</i> sp. short style (S. Barrett 1578)			
433.	6446 <i>Leucopogon striatus</i>			
434.	6447 <i>Leucopogon strictus</i>			
435.	6448 <i>Leucopogon stronglylophyllus</i>			
436.	20648 <i>Lissanthe powelliae</i>			
437.	20647 <i>Lissanthe rubicunda</i>			
438.	6456 <i>Lysinema ciliatum</i> (Curry Flower)			
439.	34736 <i>Lysinema pentapetalum</i>			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
440.	<i>Styphelia tenuifolia</i>			
Euphorbiaceae				
441.	4582 <i>Adriana quadripartita</i> (Bitter Bush)			
442.	4594 <i>Beyeria cinerea</i>			
443.	34237 <i>Beyeria cinerea</i> subsp. <i>borealis</i>			
444.	34236 <i>Beyeria cinerea</i> subsp. <i>cinerea</i>		P3	
445.	4600 <i>Beyeria similis</i>		P2	
446.	34297 <i>Beyeria sulcata</i> var. <i>gracilis</i>			
447.	4662 <i>Monotaxis grandiflora</i> (Diamond of the Desert)			
448.	19585 <i>Monotaxis grandiflora</i> var. <i>grandiflora</i>			
449.	4699 <i>Ricinocarpos psilocladus</i>			
450.	19942 <i>Ricinocarpos undulatus</i>			
451.	4713 <i>Stachystemon axillaris</i> (Leafy Stachystemon)			
Fabaceae				
452.	3207 <i>Acacia alata</i> (Winged Wattle)			
453.	15430 <i>Acacia alata</i> var. <i>tetrantha</i>			
454.	15466 <i>Acacia applanata</i>			
455.	3231 <i>Acacia auronitens</i>			
456.	3242 <i>Acacia blakelyi</i>			
457.	15471 <i>Acacia brumalis</i>			
458.	14055 <i>Acacia carens</i>		P2	
459.	14061 <i>Acacia clydonophora</i>			
460.	3262 <i>Acacia cochlearis</i> (Rigid Wattle)			
461.	14066 <i>Acacia cummingiana</i>		P3	
462.	3282 <i>Acacia cyclops</i> (Coastal Wattle)			
463.	20435 <i>Acacia daphnifolia</i>			
464.	3303 <i>Acacia dilatata</i>			
465.	11661 <i>Acacia drummondii</i> subsp. <i>drummondii</i>			
466.	3319 <i>Acacia epacantha</i>		P3	
467.	3323 <i>Acacia ericifolia</i>			
468.	3324 <i>Acacia erinacea</i>			
469.	3332 <i>Acacia fagonioides</i>			
470.	3341 <i>Acacia forrestiana</i> (Forrest's Wattle)		T	
471.	3342 <i>Acacia fragilis</i>			
472.	3382 <i>Acacia incrassata</i>			
473.	3409 <i>Acacia lasiocarpa</i> (Panjang)			
474.	11519 <i>Acacia lasiocarpa</i> var. <i>bracteolata</i>			
475.	11611 <i>Acacia lasiocarpa</i> var. <i>lasiocarpa</i>			
476.	14931 <i>Acacia lasiocarpa</i> var. <i>lasiocarpa</i> Cockleshell Gully variant (E.A. Griffin 2039)		P2	
477.	3412 <i>Acacia latipes</i>			
478.	15476 <i>Acacia latipes</i> subsp. <i>latipes</i>			
479.	11448 <i>Acacia leptospermoides</i> subsp. <i>leptospermoides</i>			
480.	3419 <i>Acacia ligulata</i> (Umbrella Bush, Watarka)			
481.	3442 <i>Acacia microbotrya</i> (Manna Wattle, Kalyang)			
482.	11678 <i>Acacia moirii</i> subsp. <i>recurvistipula</i>			
483.	3451 <i>Acacia multispicata</i>			
484.	3464 <i>Acacia obovata</i>			
485.	3493 <i>Acacia plicata</i>		P3	
486.	3502 <i>Acacia pulchella</i> (Prickly Moses)			
487.	15481 <i>Acacia pulchella</i> var. <i>glaberrima</i>			
488.	15480 <i>Acacia pulchella</i> var. <i>reflexa</i>			
489.	3518 <i>Acacia retrorsa</i>		P2	
490.	3525 <i>Acacia rostellifera</i> (Summer-scented Wattle)			
491.	3527 <i>Acacia saligna</i> (Orange Wattle, Kudjong)			
492.	30033 <i>Acacia saligna</i> subsp. <i>lindleyi</i>			
493.	30032 <i>Acacia saligna</i> subsp. <i>saligna</i>			
494.	3532 <i>Acacia scirpifolia</i>			
495.	3534 <i>Acacia sclerosperma</i> (Limestone Wattle)			
496.	3541 <i>Acacia sessilis</i>			
497.	3543 <i>Acacia shuttleworthii</i>			
498.	<i>Acacia</i> sp.			
499.	18615 <i>Acacia</i> sp. Mullewa (B.R. Maslin 4269)			
500.	3549 <i>Acacia spathulifolia</i>			
501.	3550 <i>Acacia sphacelata</i>			
502.	15484 <i>Acacia sphacelata</i> subsp. <i>sphacelata</i>			
503.	15486 <i>Acacia sphacelata</i> subsp. <i>verticillata</i>			
504.	3554 <i>Acacia squamata</i>			
505.	3557 <i>Acacia stenoptera</i> (Narrow Winged Wattle)			
506.	3571 <i>Acacia tayloriana</i>		P4	

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
507.	3574 <i>Acacia teretifolia</i>			
508.	3581 <i>Acacia trigonophylla</i>			
509.	3584 <i>Acacia truncata</i>			
510.	3592 <i>Acacia validinervia</i>			
511.	3602 <i>Acacia willdenowiana</i> (Grass Wattle)			
512.	14154 <i>Acacia wilsonii</i>		T	
513.	3604 <i>Acacia xanthina</i> (White-stemmed Wattle)			
514.	3692 <i>Aotus procumbens</i>			
515.	3710 <i>Bossiaea eriocarpa</i> (Common Brown Pea)			
516.	3719 <i>Bossiaea spinescens</i>			
517.	13111 <i>Chorizema aciculare subsp. laxum</i>			
518.	8971 <i>Chorizema cordatum</i>			
519.	<i>Chorizema sp.</i>			
520.	35837 <i>Cristonia biloba subsp. pubescens</i>			
521.	3793 <i>Daviesia angulata</i>			
522.	14199 <i>Daviesia chapmanii</i>			
523.	3803 <i>Daviesia daphnoides</i>			
524.	11562 <i>Daviesia debilior subsp. debilior</i>		P2	
525.	3805 <i>Daviesia decurrens</i> (Prickly Bitter-pea)			
526.	3807 <i>Daviesia divaricata</i> (Marno)			
527.	18560 <i>Daviesia divaricata subsp. divaricata</i>			
528.	3809 <i>Daviesia epiphyllum</i>			
529.	11879 <i>Daviesia hakeoides subsp. hakeoides</i>			
530.	15505 <i>Daviesia incrassata subsp. incrassata</i>			
531.	15506 <i>Daviesia incrassata subsp. teres</i>			
532.	3818 <i>Daviesia lancifolia</i>			
533.	3819 <i>Daviesia longifolia</i>			
534.	16585 <i>Daviesia nudiflora subsp. nudiflora</i>			
535.	3831 <i>Daviesia pedunculata</i>			
536.	3833 <i>Daviesia podophylla</i>			
537.	3834 <i>Daviesia polyphylla</i>			
538.	3835 <i>Daviesia preissii</i>			
539.	14201 <i>Daviesia pteroclada</i>		P3	
540.	3837 <i>Daviesia quadrilatera</i>			
541.	<i>Daviesia sp.</i>			
542.	3845 <i>Daviesia triflora</i>			
543.	<i>Dillwynia sp.</i>			
544.	29078 <i>Dillwynia sp.</i> Northern Sandplains (M. Hislop 3278)			
545.	20515 <i>Gastrolobium axillare</i>			
546.	3894 <i>Gastrolobium callistachys</i> (Rock Poison)			
547.	20475 <i>Gastrolobium capitatum</i>			
548.	20473 <i>Gastrolobium ebracteolatum</i>			
549.	3904 <i>Gastrolobium hamulosum</i> (Hookpoint Poison)		T	
550.	3906 <i>Gastrolobium ilicifolium</i>			
551.	3907 <i>Gastrolobium laytonii</i> (Breelya, Prilya)			
552.	20483 <i>Gastrolobium linearifolium</i>			
553.	20482 <i>Gastrolobium nervosum</i>			
554.	3910 <i>Gastrolobium obovatum</i> (Boat-leaved Poison)			
555.	3912 <i>Gastrolobium oxylobioides</i> (Champion Bay Poison)			
556.	3915 <i>Gastrolobium plicatum</i>			
557.	3916 <i>Gastrolobium polystachyum</i> (Horned Poison)			
558.	3924 <i>Gastrolobium spinosum</i> (Prickly Poison)			
559.	3945 <i>Gompholobium aristatum</i>			
560.	10909 <i>Gompholobium confertum</i>			
561.	23489 <i>Gompholobium gairdnerianum</i>		P3	
562.	<i>Gompholobium gairdnerium</i>			Y
563.	3950 <i>Gompholobium knightianum</i>			
564.	3951 <i>Gompholobium marginatum</i>			
565.	3955 <i>Gompholobium preissii</i>			
566.	19295 <i>Gompholobium pungens</i>			
567.	3956 <i>Gompholobium shuttleworthii</i>			
568.	<i>Gompholobium sp.</i>			
569.	3957 <i>Gompholobium tomentosum</i> (Hairy Yellow Pea)			
570.	3958 <i>Gompholobium venustum</i> (Handsome Wedge-pea)			
571.	3961 <i>Hardenbergia comptoniana</i> (Native Wisteria)			
572.	3966 <i>Hovea pungens</i> (Devil's Pins, Puyenak)			
573.	<i>Hovea sp.</i>			
574.	3967 <i>Hovea stricta</i>			
575.	3968 <i>Hovea trisperma</i> (Common Hovea)			
576.	3992 <i>Isotropis cuneifolia</i> (Granny Bonnets)			

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577.	19700 <i>Isotropis cuneifolia</i> subsp. <i>cuneifolia</i>			
578.	3998 <i>Jacksonia angulata</i>			
579.	14747 <i>Jacksonia anthoclada</i>		P3	
580.	14783 <i>Jacksonia calcicola</i>			
581.	4005 <i>Jacksonia condensata</i>			
582.	4010 <i>Jacksonia floribunda</i> (Holly Pea)			
583.	4015 <i>Jacksonia hakeoides</i>			
584.	4018 <i>Jacksonia lehmannii</i>			
585.	14778 <i>Jacksonia nutans</i>			
586.	20709 <i>Jacksonia ramulosa</i>			
587.	4025 <i>Jacksonia restioides</i>			
588.	4029 <i>Jacksonia sternbergiana</i> (Stinkwood, Kapur)			
589.	37960 <i>Kennedia coccinea</i> subsp. <i>calcaria</i>			
590.	4044 <i>Kennedia prostrata</i> (Scarlet Runner)			
591.	<i>Kennedia</i> sp.			
592.	3664 <i>Labichea cassioides</i>			
593.	3667 <i>Labichea lanceolata</i> (Tall Labichea)			
594.	11289 <i>Labichea lanceolata</i> subsp. <i>lanceolata</i>			
595.	3669 <i>Labichea punctata</i> (Lance-leaved Cassia)			
596.	4091 <i>Mirbelia floribunda</i> (Purple Mirbelia)			
597.	4094 <i>Mirbelia microphylla</i>			
598.	4097 <i>Mirbelia ramulosa</i>			
599.	4100 <i>Mirbelia spinosa</i>			
600.	4104 <i>Mirbelia trichocalyx</i>			
601.	4113 <i>Ornithopus compressus</i> (Yellow Serradella)	Y		
602.	4172 <i>Pultenaea ericifolia</i>			
603.	<i>Pultenaea</i> sp.			
604.	<i>Pultenaea</i> sp. Mt Lesueur (Beard 7827)			Y
605.	23460 <i>Pultenaea</i> sp. Mt Lesueur (L.A. Orthia 86)			Y
606.	17551 <i>Sphaerolobium drummondii</i>			
607.	4206 <i>Sphaerolobium macranthum</i>			
608.	4207 <i>Sphaerolobium medium</i>			
609.	10800 <i>Sphaerolobium pulchellum</i>			
610.	4256 <i>Templetonia retusa</i> (Cockies Tongues)			
611.	17542 <i>Trifolium arvense</i> var. <i>arvense</i>	Y		
612.	4292 <i>Trifolium campestre</i> (Hop Clover)	Y		
613.	17763 <i>Trifolium campestre</i> var. <i>campestre</i> (Hop Clover)	Y		
614.	4295 <i>Trifolium dubium</i> (Suckling Clover)	Y		
615.	4297 <i>Trifolium glomeratum</i> (Cluster Clover)	Y		
616.	4298 <i>Trifolium hirtum</i> (Rose Clover)	Y		
617.	4313 <i>Trifolium subterraneum</i> (Subterranean Clover)	Y		
618.	4325 <i>Viminaria juncea</i> (Swishbush, Koweda)			
Gentianaceae				
619.	6542 <i>Centaurium tenuiflorum</i>	Y		
620.	41660 <i>Schenkia australis</i>			
Geraniaceae				
621.	4332 <i>Erodium botrys</i> (Long Storksbill)	Y		
622.	4333 <i>Erodium cicutarium</i> (Common Storksbill)	Y		
623.	4335 <i>Erodium cygnorum</i> (Blue Heronsbill)			
624.	4343 <i>Pelargonium capitatum</i> (Rose Pelargonium)	Y		
625.	4346 <i>Pelargonium littorale</i>			
626.	<i>Pelargonium</i> sp.			
Goodeniaceae				
627.	7425 <i>Dampiera carinata</i> (Summer Dampiera)			
628.	7428 <i>Dampiera coronata</i> (Wedge-leaved Dampiera)			
629.	7449 <i>Dampiera juncea</i> (Rush-like Dampiera)			
630.	7451 <i>Dampiera lavandulacea</i>			
631.	7453 <i>Dampiera lindleyi</i>			
632.	7454 <i>Dampiera linearis</i> (Common Dampiera)			
633.	7459 <i>Dampiera oligophylla</i> (Sparse-leaved Dampiera)			
634.	<i>Dampiera</i> sp.			
635.	18441 <i>Dampiera</i> sp. Jurien (G. Lullfitz s.n. 10/7/1986)		P2	
636.	7475 <i>Dampiera spicigera</i> (Spiked Dampiera)			
637.	7481 <i>Dampiera tephrea</i>		P2	
638.	7482 <i>Dampiera teres</i> (Terete-leaved Dampiera)			
639.	7488 <i>Goodenia affinis</i> (Silver Goodenia)			
640.	7495 <i>Goodenia berardiana</i>			
641.	29362 <i>Goodenia coerulea</i>			
642.	7508 <i>Goodenia filiformis</i> (Thread-leaved Goodenia)			

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643.	7513 <i>Goodenia hassallii</i>			
644.	12551 <i>Goodenia micrantha</i>			
645.	19286 <i>Goodenia pulchella</i> subsp. Coastal Plain A (M. Hislop 634)			
646.	19284 <i>Goodenia pulchella</i> subsp. Coastal Plain B (L.W. Sage 2336)			
647.	<i>Goodenia</i> sp.			
648.	7566 <i>Goodenia xanthotricha</i> (Yellow-haired Goodenia)		P2	
649.	7568 <i>Lechenaultia biloba</i> (Blue Leschenaultia)			
650.	7572 <i>Lechenaultia expansa</i>			
651.	7574 <i>Lechenaultia floribunda</i> (Free-flowering Leschenaultia)			
652.	7577 <i>Lechenaultia hirsuta</i> (Hairy Leschenaultia)			
653.	7580 <i>Lechenaultia linarioides</i> (Yellow Leschenaultia)			
654.	<i>Lechenaultia</i> sp.			
655.	7586 <i>Lechenaultia stenosepala</i> (Narrow-sepaled Leschenaultia)			
656.	7595 <i>Scaevola anchusifolia</i>			
657.	7603 <i>Scaevola canescens</i> (Grey Scaevola)			
658.	7613 <i>Scaevola glandulifera</i> (Viscid Hand-flower)			
659.	7614 <i>Scaevola globulifera</i>			
660.	7619 <i>Scaevola lanceolata</i> (Long-leaved Scaevola)			
661.	7626 <i>Scaevola nitida</i> (Shining Fanflower)			
662.	7634 <i>Scaevola phlebopetala</i> (Velvet Fanflower)			
663.	7635 <i>Scaevola pilosa</i> (Hairy Fan-flower)			
664.	12585 <i>Scaevola repens</i>			
665.	29356 <i>Scaevola repens</i> subsp. Northern Sandplains (R.J. Cranfield & P.J. Spencer 8445)			
666.	<i>Scaevola repens</i> subsp. Northern Sandplains (R.J.Cranfield & P.J.Spencer 8445)			
667.	13181 <i>Scaevola repens</i> var. <i>angustifolia</i>			
668.	13182 <i>Scaevola repens</i> var. <i>repens</i>			
669.	7643 <i>Scaevola sericophylla</i>			
670.	<i>Scaevola</i> sp.			
671.	13152 <i>Scaevola thesioides</i> subsp. <i>thesioides</i>			
672.	12588 <i>Scaevola virgata</i>			
673.	7665 <i>Velleia trinervis</i>			
674.	7666 <i>Verreauxia reinwardtii</i> (Common Verreauxia)			

Gyrostemonaceae

675.	2778 <i>Codonocarpus cotinifolius</i> (Native Poplar, Kundurangu)			
676.	2783 <i>Gyrostemon racemiger</i>			
677.	2784 <i>Gyrostemon ramulosus</i> (Corkybark)			
678.	<i>Gyrostemon</i> sp.			
679.	2788 <i>Gyrostemon subnudus</i>			
680.	2791 <i>Tersonia cyathiflora</i> (Button Creeper)			
681.	2792 <i>Walteranthus erectus</i>		P2	

Haemodoraceae

682.	1407 <i>Anigozanthos flavidus</i> (Tall Kangaroo Paw)			
683.	1409 <i>Anigozanthos humilis</i> (Catspaw)			
684.	11434 <i>Anigozanthos humilis</i> subsp. <i>humilis</i>			
685.	1411 <i>Anigozanthos manglesii</i> (Mangles Kangaroo Paw, Kurulbrang)			
686.	11261 <i>Anigozanthos manglesii</i> subsp. <i>manglesii</i>			
687.	11565 <i>Anigozanthos manglesii</i> subsp. <i>quadrans</i>			
688.	1414 <i>Anigozanthos pulcherrimus</i> (Yellow Kangaroo Paw)			
689.	<i>Anigozanthos</i> sp.			
690.	1417 <i>Blancoa canescens</i> (Winter Bell)			
691.	11414 <i>Conostylis aculeata</i> subsp. <i>breviflora</i>			
692.	12109 <i>Conostylis aculeata</i> subsp. <i>preissii</i>			
693.	11641 <i>Conostylis aculeata</i> subsp. <i>rhypidion</i>			
694.	1420 <i>Conostylis androstemma</i> (Trumpets)			
695.	1421 <i>Conostylis angustifolia</i>			
696.	1423 <i>Conostylis aurea</i> (Golden Conostylis)			
697.	1427 <i>Conostylis candicans</i> (Grey Cottonhead)			
698.	12027 <i>Conostylis candicans</i> subsp. <i>calcicola</i>			
699.	11438 <i>Conostylis candicans</i> subsp. <i>candicans</i>			
700.	11515 <i>Conostylis candicans</i> subsp. <i>procumbens</i>			
701.	1428 <i>Conostylis canteriata</i>			
702.	<i>Conostylis crassinerva</i> subsp. <i>absens</i>			
703.	<i>Conostylis crassinerva</i> subsp. <i>crassinerva</i>			
704.	11773 <i>Conostylis crassinerva</i> subsp. <i>absens</i>			
705.	11938 <i>Conostylis crassinerva</i> subsp. <i>crassinerva</i>			
706.	1435 <i>Conostylis hiemalis</i>			
707.	1436 <i>Conostylis juncea</i>			
708.	1437 <i>Conostylis latens</i>			
709.	1446 <i>Conostylis prolifera</i> (Mat Cottonheads)			

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710.	1451 <i>Conostylis seminuda</i>			
711.	1454 <i>Conostylis setigera</i> (Bristly Cottonhead)			
712.	<i>Conostylis</i> sp.			
713.	1456 <i>Conostylis stylidioides</i>			
714.	1457 <i>Conostylis teretifolia</i>			
715.	11870 <i>Conostylis teretifolia</i> subsp. <i>teretifolia</i>			
716.	1458 <i>Conostylis teretiuscula</i>			
717.	1464 <i>Haemodorum brevisepalum</i>			
718.	1465 <i>Haemodorum discolor</i>			
719.	1469 <i>Haemodorum loratum</i>		P3	
720.	1470 <i>Haemodorum paniculatum</i> (Mardja)			
721.	1472 <i>Haemodorum simplex</i>			
722.	1473 <i>Haemodorum simulans</i>			
723.	<i>Haemodorum</i> sp.			
724.	1475 <i>Haemodorum spicatum</i> (Mardja)			
725.	1476 <i>Haemodorum venosum</i>			
726.	1477 <i>Macropidia fuliginosa</i> (Black Kangaroo Paw)			
727.	1478 <i>Phlebocarya ciliata</i>			
728.	1479 <i>Phlebocarya filifolia</i>			
729.	11557 <i>Phlebocarya pilosissima</i> subsp. <i>pilosissima</i>		P3	
730.	11906 <i>Phlebocarya pilosissima</i> subsp. <i>teretifolia</i>		P2	
731.	1481 <i>Tribonanthes australis</i>			
732.	1483 <i>Tribonanthes longipetala</i>			

Haloragaceae

733.	33620 <i>Glischrocaryon angustifolium</i>			
734.	6143 <i>Glischrocaryon aureum</i> (Common Popflower)			
735.	6159 <i>Gonocarpus nodulosus</i>			
736.	6161 <i>Gonocarpus pithyoides</i>			
737.	<i>Gonocarpus</i> sp.			
738.	34676 <i>Meionectes brownii</i> (Swamp Raspwort)			

Hemerocallidaceae

739.	1263 <i>Arnocrinum gracillimum</i>		P2	
740.	1264 <i>Arnocrinum preissii</i>			
741.	1276 <i>Caesia micrantha</i> (Pale Grass Lily)			
742.	29439 <i>Caesia</i> sp. Wongan (K.F. Kenneally 8820)			
743.	11883 <i>Corynotheca micrantha</i> var. <i>elongata</i>			
744.	11283 <i>Corynotheca micrantha</i> var. <i>micrantha</i>			
745.	1259 <i>Dianella revoluta</i> (Blueberry Lily)			
746.	11636 <i>Dianella revoluta</i> var. <i>divaricata</i>			
747.	1292 <i>Hensmania stoniella</i>		P3	
748.	1293 <i>Hensmania turbinata</i>			
749.	1298 <i>Johnsonia pubescens</i> (Pipe Lily)			
750.	19632 <i>Johnsonia pubescens</i> subsp. <i>pubescens</i>			
751.	1361 <i>Tricoryne elatior</i> (Yellow Autumn Lily)			
752.	29481 <i>Tricoryne</i> sp. <i>Eneabba</i> (E.A. Griffin 1200)			

Hypoxidaceae

753.	43764 <i>Pauridia glabella</i> var. <i>leptantha</i>			
754.	43760 <i>Pauridia occidentalis</i>			
755.	43761 <i>Pauridia occidentalis</i> var. <i>occidentalis</i>			

Iridaceae

756.	19179 <i>Moraea flaccida</i> (One-leaf Cape Tulip)	Y		
757.	11749 <i>Orthrosanthus laxus</i> var. <i>laxus</i> (Morning Iris)			
758.	1541 <i>Patersonia argyrea</i>		P3	
759.	1546 <i>Patersonia juncea</i> (Rush Leaved Patersonia)			
760.	1550 <i>Patersonia occidentalis</i> (Purple Flag, Koma)			
761.	30476 <i>Patersonia occidentalis</i> var. <i>latifolia</i>			
762.	30472 <i>Patersonia occidentalis</i> var. <i>occidentalis</i>			
763.	1556 <i>Romulea rosea</i> (Guildford Grass)	Y		
764.	11544 <i>Romulea rosea</i> var. <i>australis</i> (Guildford Grass)	Y		

Juncaceae

765.	1177 <i>Juncus articulatus</i> (Jointed Rush)	Y		
766.	1178 <i>Juncus bufonius</i> (Toad Rush)	Y		
767.	1179 <i>Juncus caespiticius</i> (Grassy Rush)			
768.	11922 <i>Juncus kraussii</i> subsp. <i>australiensis</i>			
769.	1188 <i>Juncus pallidus</i> (Pale Rush)			
770.	1189 <i>Juncus pauciflorus</i> (Loose Flower Rush)			

Juncaginaceae

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
771.	40661 <i>Cynogeton lineare</i>			
772.	33276 <i>Triglochin isingiana</i>			
773.	146 <i>Triglochin minutissima</i>			
774.	147 <i>Triglochin mucronata</i>			
775.	18587 <i>Triglochin nana</i>			
776.	<i>Triglochin procera</i>			
Lamiaceae				
777.	6835 <i>Hemiandra gardneri</i> (Red Snakebush)		T	
778.	16933 <i>Hemiandra glabra</i>			
779.	6837 <i>Hemiandra leiantha</i>			
780.	6838 <i>Hemiandra linearis</i> (Speckled Snakebush)			
781.	6839 <i>Hemiandra pungens</i> (Snakebush)			
782.	6840 <i>Hemiandra rubriflora</i>			
783.	<i>Hemiandra</i> sp.			
784.	38320 <i>Hemiandra</i> sp. <i>Jurien</i> (B.J. Conn & M.E. Tozer BJC 3885)			
785.	<i>Hemiandra</i> sp. <i>Jurien</i> (B.J.Conn 3885 & M.E.Tozer)			
786.	14595 <i>Hemiandra</i> sp. <i>Watheroo</i> (S. Hancocks 4)		P4	
787.	33756 <i>Hemigenia appressa</i>			
788.	6847 <i>Hemigenia curvifolia</i>		P2	
789.	6849 <i>Hemigenia diplanthera</i>			
790.	6856 <i>Hemigenia incana</i> (Silky Hemigenia)			
791.	6871 <i>Hemigenia sericea</i> (Silky Hemigenia)			
792.	<i>Hemigenia</i> sp.			
793.	41020 <i>Hemiphora bartlingii</i> (Woolly Dragon)			
794.	6780 <i>Lachnostachys eriobotrya</i> (Lambswool)			
795.	<i>Microcorys</i> sp.			
796.	15456 <i>Microcorys</i> sp. <i>Coomallo</i> (L. Haegi 2677)			
797.	6797 <i>Physopsis spicata</i> (Hill River Lambstail)			
798.	<i>Pityrodia</i> sp.			
799.	41063 <i>Quoya loxocarpa</i>			
800.	41080 <i>Quoya verbascina</i> (Golden Bush)			
801.	6930 <i>Stachys arvensis</i> (Staggerweed)	Y		
Lauraceae				
802.	2948 <i>Cassytha aurea</i>			
803.	12073 <i>Cassytha aurea</i> var. <i>aurea</i>			
804.	2951 <i>Cassytha flava</i> (Dodder Laurel)			
805.	2952 <i>Cassytha glabella</i> (Tangled Dodder Laurel)			
806.	11206 <i>Cassytha glabella</i> forma <i>bicallosa</i>			
807.	2956 <i>Cassytha pomiformis</i> (Dodder Laurel)			
808.	2957 <i>Cassytha racemosa</i> (Dodder Laurel)			
809.	11242 <i>Cassytha racemosa</i> forma <i>pilosa</i>			
810.	11799 <i>Cassytha racemosa</i> forma <i>racemosa</i>			
811.	<i>Cassytha</i> sp.			
Lentibulariaceae				
812.	7145 <i>Utricularia menziesii</i> (Redcoats)			
813.	7148 <i>Utricularia multifida</i>			
Loganiaceae				
814.	6506 <i>Logania campanulata</i> (Bell-flowered Logania)			
815.	6508 <i>Logania flaviflora</i> (Yellow Logania)			
816.	6512 <i>Logania spermacoea</i>			
817.	16825 <i>Phyllangium divergens</i>			
Loranthaceae				
818.	13267 <i>Amyema linophylla</i> subsp. <i>linophylla</i>			
819.	2380 <i>Amyema miquelii</i> (Stalked Mistletoe)			
820.	2401 <i>Nuytsia floribunda</i> (Christmas Tree, Mudja)			
Malvaceae				
821.	4906 <i>Alyogyne huegelii</i> (Lilac Hibiscus)			
822.	43023 <i>Alyogyne</i> sp. <i>Hutt River</i> (B.J. Lepschi & T.R. Lally 2310)			
823.	<i>Alyogyne</i> sp. <i>Hutt River</i> (B.J.Lepschi & T.R.Lally 2310)			
824.	40908 <i>Androcalva pulchella</i>			
825.	40872 <i>Commersonia borealis</i>			
826.	13233 <i>Guichenotia alba</i>		P3	
827.	5011 <i>Guichenotia ledifolia</i>			
828.	5012 <i>Guichenotia macrantha</i> (Large-flowered Guichenotia)			
829.	5014 <i>Guichenotia sarotes</i>			
830.	4927 <i>Hibiscus drummondii</i> (Drummond's Hibiscus)			
831.	<i>Hibiscus</i> sp.			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
832.	5022 <i>Keraudrenia hermanniifolia</i>			
833.	5023 <i>Keraudrenia integrifolia</i> (Common Firebush)			
834.	5031 <i>Lasiopetalum drummondii</i>			
835.	5033 <i>Lasiopetalum floribundum</i> (Free Flowering Lasiopetalum)			
836.	5035 <i>Lasiopetalum indutum</i>			
837.	5042 <i>Lasiopetalum ogilvieanum</i>		P1	
838.	36660 <i>Lasiopetalum</i> sp. Mount Lesueur (E.A. Griffin 1997)		P2	
839.	4958 <i>Lawrenzia spicata</i>			
840.	4959 <i>Lawrenzia squamata</i>			
841.	4980 <i>Sida hookeriana</i>			
842.	5080 <i>Thomasia foliosa</i>			
843.	5084 <i>Thomasia grandiflora</i> (Large Flowered Thomasia)			
844.	5086 <i>Thomasia macrocalyx</i>			
845.	<i>Thomasia</i> sp.			
846.	42040 <i>Thomasia</i> sp. Lesueur (M. Hislop 4217)			Y

Menyanthaceae

847.	36160 <i>Liparophyllum capitatum</i>			
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Molluginaceae

848.	2838 <i>Macarthuria apetala</i>			
849.	2839 <i>Macarthuria australis</i>			

Myrtaceae

850.	5330 <i>Astartea fascicularis</i>			
851.	36441 <i>Babingtonia camphorosmae</i> (Camphor Myrtle)			
852.	45397 <i>Babingtonia cherticola</i>		P3	
853.	45398 <i>Babingtonia erecta</i>			
854.	45416 <i>Babingtonia grandiflora</i> (Large-flowered Babingtonia)			
855.	<i>Baeckea crispiflora</i> subsp. Mt Lesueur (E.A. Griffin 2325)			Y
856.	<i>Baeckea</i> sp.			
857.	17761 <i>Beaufortia aestiva</i>			
858.	5377 <i>Beaufortia bicolor</i>		P3	
859.	5378 <i>Beaufortia bracteosa</i>			
860.	5382 <i>Beaufortia elegans</i>			
861.	5384 <i>Beaufortia eriocephala</i> (Woolly Bottlebrush)		P3	
862.	<i>Beaufortia</i> sp.			
863.	5393 <i>Beaufortia squarrosa</i> (Sand Bottlebrush, Puno)			
864.	5401 <i>Calothamnus blepharospermus</i>			
865.	35856 <i>Calothamnus glaber</i>			
866.	5411 <i>Calothamnus hirsutus</i>			
867.	5417 <i>Calothamnus longissimus</i>			
868.	5426 <i>Calothamnus quadrifidus</i> (One-sided Bottlebrush, Kwondjard)			
869.	35756 <i>Calothamnus quadrifidus</i> subsp. angustifolius			
870.	35816 <i>Calothamnus quadrifidus</i> subsp. quadrifidus			
871.	5429 <i>Calothamnus sanguineus</i> (Silky-leaved Blood flower, Pindak)			
872.	<i>Calothamnus</i> sp.			
873.	5431 <i>Calothamnus torulosus</i>			
874.	5441 <i>Calytrix aurea</i>			
875.	5447 <i>Calytrix chrysantha</i>		P4	
876.	5450 <i>Calytrix depressa</i>			
877.	5453 <i>Calytrix drummondii</i>			
878.	19980 <i>Calytrix ecalycata</i> subsp. brevis		P3	
879.	5458 <i>Calytrix flavescens</i> (Summer Starflower)			
880.	5460 <i>Calytrix fraseri</i> (Pink Summer Calytrix)			
881.	5465 <i>Calytrix leschenaultii</i>			
882.	5476 <i>Calytrix sapphirina</i>			
883.	<i>Calytrix</i> sp.			
884.	5479 <i>Calytrix strigosa</i>			
885.	5493 <i>Chamelaucium drummondii</i>			
886.	5498 <i>Chamelaucium uncinatum</i> (Geraldton Wax)			
887.	5502 <i>Conothamnus trinervis</i>			
888.	17104 <i>Corymbia calophylla</i> (Marri)			
889.	17105 <i>Corymbia haematoxylon</i> (Mountain Marri)			
890.	<i>Corymbia</i> sp.			
891.	5503 <i>Corynanthera flava</i>			
892.	5511 <i>Darwinia helichrysoides</i>			
893.	5518 <i>Darwinia neildiana</i> (Fringed Bell)			
894.	5522 <i>Darwinia pauciflora</i>			
895.	5523 <i>Darwinia pimelioides</i>		P4	
896.	5528 <i>Darwinia sanguinea</i>			
897.	<i>Darwinia</i> sp.			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
898.	5529 <i>Darwinia speciosa</i>			
899.	5534 <i>Darwinia virescens</i> (Murchison <i>Darwinia</i>)			
900.	13949 <i>Eremaea asterocarpa</i>			
901.	13950 <i>Eremaea asterocarpa</i> subsp. <i>asterocarpa</i>			
902.	14097 <i>Eremaea asterocarpa</i> subsp. <i>brachyclada</i>			
903.	13952 <i>Eremaea asterocarpa</i> subsp. <i>histoclada</i>			
904.	5537 <i>Eremaea beaufortoides</i>			
905.	14098 <i>Eremaea beaufortoides</i> var. <i>beaufortoides</i>			
906.	14099 <i>Eremaea beaufortoides</i> var. <i>lachnosanthe</i>			
907.	14100 <i>Eremaea beaufortoides</i> var. <i>microphylla</i>			
908.	5538 <i>Eremaea brevifolia</i>			
909.	14102 <i>Eremaea ebracteata</i> var. <i>ebracteata</i>			
910.	13955 <i>Eremaea ectadioclada</i>			
911.	5540 <i>Eremaea fimbriata</i>			
912.	13951 <i>Eremaea hadra</i>			
913.	5541 <i>Eremaea pauciflora</i>			
914.	14103 <i>Eremaea pauciflora</i> var. <i>calyptra</i>			
915.	13818 <i>Eremaea pauciflora</i> var. <i>lonchophylla</i>			
916.	14104 <i>Eremaea pauciflora</i> var. <i>pauciflora</i>			
917.	5542 <i>Eremaea purpurea</i>			
918.	<i>Eremaea</i> sp.			
919.	5543 <i>Eremaea violacea</i> (<i>Violet Eremaea</i>)			
920.	17459 <i>Eremaea violacea</i> subsp. <i>raphiophylla</i>			
921.	36239 <i>Eremaea violacea</i> subsp. <i>violacea</i>			
922.	13953 <i>Eremaea x codonocarpa</i>			
923.	13956 <i>Eremaea x phoenicea</i>			
924.	45253 <i>Ericomyrtus</i> sp. <i>Mt Lesueur</i> (E.A. Griffin 2325)			
925.	45215 <i>Ericomyrtus tenuior</i>			
926.	12898 <i>Eucalyptus abdita</i>		P2	
927.	5545 <i>Eucalyptus accedens</i> (<i>Powderbark Wandoo</i>)			
928.	5548 <i>Eucalyptus albida</i> (<i>White-leaved Mallee</i>)			
929.	13545 <i>Eucalyptus angularis</i>		P2	
930.	12895 <i>Eucalyptus arachnaea</i> subsp. <i>arachnaea</i>			
931.	13091 <i>Eucalyptus argutifolia</i> (<i>Wabling Hill Mallee</i>)		T	
932.	5560 <i>Eucalyptus beardiana</i> (<i>Beard's Mallee</i>)		T	
933.	5580 <i>Eucalyptus camaldulensis</i> (<i>River Gum, Yaballynba</i>)			
934.	35345 <i>Eucalyptus camaldulensis</i> subsp. <i>obtusa</i> (<i>Blunt-budded River Red Gum</i>)			
935.	15684 <i>Eucalyptus conveniens</i>			
936.	12885 <i>Eucalyptus crispata</i> (<i>Yandanooka Mallee</i>)		T	
937.	15494 <i>Eucalyptus diminuta</i>			
938.	5628 <i>Eucalyptus drummondii</i> (<i>Drummond's Gum</i>)			
939.	5638 <i>Eucalyptus erythrocorys</i> (<i>Illyarrie</i>)			
940.	5642 <i>Eucalyptus exilis</i> (<i>Boyagin Mallee</i>)		P4	
941.	5643 <i>Eucalyptus falcata</i> (<i>Silver Mallet, Dulyumuk</i>)			
942.	5649 <i>Eucalyptus foecunda</i> (<i>Narrow-leaved Red Mallee</i>)			
943.	5658 <i>Eucalyptus gittinsii</i> (<i>Northern Sandplain Mallee</i>)			
944.	19472 <i>Eucalyptus gittinsii</i> subsp. <i>gittinsii</i>			
945.	18292 <i>Eucalyptus gittinsii</i> subsp. <i>illucida</i>			
946.	13532 <i>Eucalyptus impensa</i>		T	
947.	5680 <i>Eucalyptus johnsoniana</i> (<i>Johnson's Mallee</i>)		T	
948.	5690 <i>Eucalyptus lane-poolei</i> (<i>Salmon White Gum</i>)			
949.	5691 <i>Eucalyptus lateritica</i> (<i>Laterite Mallee</i>)		T	
950.	13543 <i>Eucalyptus leprophloia</i> (<i>Scaly Butt Mallee</i>)		T	
951.	11295 <i>Eucalyptus loxophleba</i> subsp. <i>loxophleba</i> (<i>York Gum</i>)			
952.	5705 <i>Eucalyptus macrocarpa</i> (<i>Mottlecah, Mudelka</i>)			
953.	13531 <i>Eucalyptus macrocarpa</i> subsp. <i>elachantha</i> (<i>Small-leaved Mottlecah</i>)		P4	
954.	13530 <i>Eucalyptus macrocarpa</i> subsp. <i>macrocarpa</i> (<i>Mottlecah</i>)			
955.	5708 <i>Eucalyptus marginata</i> (<i>Jarra, Djara</i>)			
956.	13547 <i>Eucalyptus marginata</i> subsp. <i>marginata</i> (<i>Jarra</i>)			
957.	5722 <i>Eucalyptus obtusiflora</i> (<i>Dongara Mallee</i>)			
958.	19815 <i>Eucalyptus obtusiflora</i> subsp. <i>dongarraensis</i>			
959.	19559 <i>Eucalyptus obtusiflora</i> subsp. <i>obtusiflora</i>			
960.	42062 <i>Eucalyptus opimiflora</i>			
961.	18664 <i>Eucalyptus optima</i>			
962.	5730 <i>Eucalyptus oraria</i> (<i>Ooragmandee</i>)			
963.	5741 <i>Eucalyptus pendens</i> (<i>Badgingarra Mallee</i>)		P4	
964.	13541 <i>Eucalyptus petrensis</i>			
965.	16180 <i>Eucalyptus pleurocarpa</i>			
966.	12866 <i>Eucalyptus pluricaulis</i> subsp. <i>pluricaulis</i>			
967.	13040 <i>Eucalyptus pruiniramis</i>		T	

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968.	5756 <i>Eucalyptus pyriformis</i> (Pear-fruited Mallee)			
969.	5763 <i>Eucalyptus rudis</i> (Flooded Gum, Kulurda)			
970.	13511 <i>Eucalyptus rudis</i> subsp. <i>rudis</i>			
971.	<i>Eucalyptus</i> sp.			
972.	<i>Eucalyptus</i> sp. <i>Badgingarra</i> (D.Nicolle & M.French DN 3515)			Y
973.	5781 <i>Eucalyptus suberea</i> (Mount Lesueur Mallee)		T	
974.	5790 <i>Eucalyptus todtiana</i> (Coastal Blackbutt)			
975.	5797 <i>Eucalyptus wandoo</i> (Wandoo, Wandu)			
976.	12905 <i>Eucalyptus wandoo</i> subsp. <i>pulverea</i>			
977.	12906 <i>Eucalyptus wandoo</i> subsp. <i>wandoo</i>			
978.	5817 <i>Hypocalymma angustifolium</i> (White Myrtle, Kudjid)			
979.	35070 <i>Hypocalymma angustifolium</i> subsp. <i>Swan Coastal Plain</i> (G.J. Keighery 16777)			
980.	20851 <i>Hypocalymma gardneri</i>		P3	
981.	20044 <i>Hypocalymma hirsutum</i>			
982.	31412 <i>Hypocalymma</i> sp. <i>Gairdner Range</i> (C.A. Gardner 9091)		P2	Y
983.	16179 <i>Hypocalymma tenuatum</i>		P2	Y
984.	5829 <i>Hypocalymma xanthopetalum</i>			
985.	5835 <i>Kunzea micrantha</i>			
986.	17785 <i>Kunzea micrantha</i> subsp. <i>petiolata</i>			
987.	5850 <i>Leptospermum laevigatum</i> (Coast Teatree)	Y		
988.	5853 <i>Leptospermum oligandrum</i>			
989.	<i>Leptospermum</i> sp.			
990.	5857 <i>Leptospermum spinescens</i>			
991.	37580 <i>Melaleuca acutifolia</i>			
992.	5878 <i>Melaleuca blairiifolia</i>			
993.	5881 <i>Melaleuca brevifolia</i>			
994.	17982 <i>Melaleuca carrii</i>			
995.	5888 <i>Melaleuca ciliosa</i>			
996.	19387 <i>Melaleuca clavifolia</i>			
997.	5893 <i>Melaleuca concreta</i>			
998.	18125 <i>Melaleuca delta</i>			
999.	5904 <i>Melaleuca depressa</i>			
1000.	19952 <i>Melaleuca dichroma</i>			
1001.	19486 <i>Melaleuca hamata</i>			
1002.	5919 <i>Melaleuca holosericea</i>			
1003.	5920 <i>Melaleuca huegelii</i> (Chenille Honeymyrtle)			
1004.	13271 <i>Melaleuca huegelii</i> subsp. <i>huegelii</i>			
1005.	13273 <i>Melaleuca incana</i> subsp. <i>incana</i>			
1006.	5926 <i>Melaleuca lateritia</i> (Robin Redbreast Bush)			
1007.	5930 <i>Melaleuca leiopyxis</i>			
1008.	18112 <i>Melaleuca leuropoma</i>			
1009.	18435 <i>Melaleuca longistaminea</i>			
1010.	41120 <i>Melaleuca marginata</i>			
1011.	5936 <i>Melaleuca megacephala</i>			
1012.	5949 <i>Melaleuca platycalyx</i>			
1013.	5952 <i>Melaleuca preissiana</i> (Moonah)			
1014.	5958 <i>Melaleuca radula</i> (Graceful Honeymyrtle)			
1015.	5959 <i>Melaleuca raphiophylla</i> (Swamp Paperbark)			
1016.	19365 <i>Melaleuca ryeae</i>			
1017.	5961 <i>Melaleuca scabra</i> (Rough Honeymyrtle, Wurru Bush)			
1018.	5964 <i>Melaleuca seriata</i>			
1019.	<i>Melaleuca</i> sp.			
1020.	18598 <i>Melaleuca systema</i>			
1021.	18278 <i>Melaleuca tinkeri</i>			
1022.	5983 <i>Melaleuca trichophylla</i>			
1023.	5984 <i>Melaleuca uncinata</i> (Broom Bush, Kwidjard)			
1024.	5986 <i>Melaleuca urceolaris</i>			
1025.	5987 <i>Melaleuca viminea</i> (Mohan)			
1026.	19611 <i>Melaleuca zonalis</i>			
1027.	6008 <i>Phymatocarpus porphyrocephalus</i>			
1028.	<i>Phymatocarpus</i> sp.			
1029.	6009 <i>Pileanthus filifolius</i> (Summer Coppercups)			
1030.	6010 <i>Pileanthus limacis</i> (Coastal Coppercups)			
1031.	6011 <i>Pileanthus peduncularis</i> (Coppercups)			
1032.	6012 <i>Regelia ciliata</i>			
1033.	6033 <i>Scholtzia involucrata</i> (Spiked Scholtzia)			
1034.	6034 <i>Scholtzia laxiflora</i>			
1035.	6035 <i>Scholtzia leptantha</i>			
1036.	6037 <i>Scholtzia parviflora</i>			
1037.	<i>Scholtzia</i> sp.			

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1038.	20379 <i>Scholtzia</i> sp. <i>Jurien</i> (R. Cranfield & P. Spencer RJC 8443)			
1039.	20382 <i>Scholtzia</i> sp. <i>Wongonderrah</i> (M.E. & M.R. Trudgen MET 12000)			
1040.	6039 <i>Scholtzia teretifolia</i>			
1041.	6041 <i>Scholtzia umbellifera</i>			
1042.	6057 <i>Thryptomene hyporhytis</i>			
1043.	6060 <i>Thryptomene mucronulata</i>			
1044.	<i>Thryptomene</i> sp.			
1045.	12388 <i>Verticordia acerosa</i> var. <i>preissii</i>			
1046.	12390 <i>Verticordia amphigia</i>		P3	
1047.	12393 <i>Verticordia aurea</i>		P4	
1048.	12396 <i>Verticordia blepharophylla</i>			
1049.	6071 <i>Verticordia brachypoda</i>			
1050.	6072 <i>Verticordia brownii</i>			
1051.	12401 <i>Verticordia centipeda</i>			
1052.	6073 <i>Verticordia chrysantha</i>			
1053.	12402 <i>Verticordia chrysanthella</i>			
1054.	6076 <i>Verticordia densiflora</i> (<i>Compacted Featherflower</i>)			
1055.	12411 <i>Verticordia densiflora</i> var. <i>cespitosa</i>			
1056.	15432 <i>Verticordia densiflora</i> var. <i>densiflora</i>			
1057.	12414 <i>Verticordia densiflora</i> var. <i>stelluligera</i>			
1058.	15620 <i>Verticordia endlicheriana</i> var. <i>manicula</i>			
1059.	12422 <i>Verticordia eriocephala</i> (<i>Common Cauliflower</i>)			
1060.	12425 <i>Verticordia fragrans</i>		P3	
1061.	6082 <i>Verticordia grandiflora</i> (<i>Claw Featherflower</i>)			
1062.	6083 <i>Verticordia grandis</i> (<i>Scarlet Featherflower</i>)			
1063.	6088 <i>Verticordia huegelii</i> (<i>Variogated Featherflower</i>)			
1064.	15433 <i>Verticordia huegelii</i> var. <i>huegelii</i>			
1065.	12434 <i>Verticordia insignis</i> subsp. <i>eomagis</i>		P3	
1066.	12437 <i>Verticordia laciniata</i>			
1067.	14688 <i>Verticordia luteola</i> var. <i>rosea</i>		P1	
1068.	14716 <i>Verticordia muelleriana</i> subsp. <i>muelleriana</i>		P3	
1069.	10822 <i>Verticordia nobilis</i>			
1070.	6103 <i>Verticordia ovalifolia</i>			
1071.	6107 <i>Verticordia pennigera</i>			
1072.	6109 <i>Verticordia picta</i> (<i>Painted Featherflower</i>)			
1073.	6110 <i>Verticordia plumosa</i> (<i>Plumed Featherflower</i>)			
1074.	12449 <i>Verticordia plumosa</i> var. <i>brachyphylla</i>			
1075.	12456 <i>Verticordia rutilastra</i>		P3	
1076.	<i>Verticordia</i> sp.			
1077.	12468 <i>Verticordia venusta</i>		P3	

Olacaceae

1078.	2365 <i>Olax benthamiana</i>			
1079.	2367 <i>Olax scalariformis</i>			

Onagraceae

1080.	6138 <i>Oenothera drummondii</i> (<i>Beach Evening Primrose</i>)	Y		
1081.	16390 <i>Oenothera drummondii</i> subsp. <i>drummondii</i>	Y		
1082.	14292 <i>Oenothera stricta</i> subsp. <i>stricta</i>	Y		

Orchidaceae

1083.	1582 <i>Caladenia crebra</i> (<i>Arrowsmith Spider Orchid</i>)			
1084.	44893 <i>Caladenia denticulata</i> subsp. <i>denticulata</i>			
1085.	15348 <i>Caladenia flava</i> subsp. <i>flava</i>			
1086.	15502 <i>Caladenia footeana</i>			
1087.	15354 <i>Caladenia hirta</i> subsp. <i>hirta</i>			
1088.	15358 <i>Caladenia longicauda</i> subsp. <i>albella</i>			
1089.	15360 <i>Caladenia longicauda</i> subsp. <i>borealis</i>			
1090.	15369 <i>Caladenia lorea</i>			
1091.	17760 <i>Caladenia nobilis</i>			
1092.	17589 <i>Caladenia occidentalis</i>			
1093.	1611 <i>Caladenia radialis</i> (<i>Drooping Spider Orchid</i>)			
1094.	18019 <i>Caladenia vulgata</i>			
1095.	15114 <i>Cyanicula gemmata</i>			
1096.	11049 <i>Diuris corymbosa</i>			
1097.	1634 <i>Diuris laxiflora</i> (<i>Bee Orchid</i>)			
1098.	42182 <i>Diuris perialla</i>			
1099.	42229 <i>Diuris segregata</i>			
1100.	42228 <i>Diuris septentrionalis</i>			
1101.	1638 <i>Diuris setacea</i> (<i>Bristly Donkey Orchid</i>)			
1102.	<i>Diuris</i> sp.			
1103.	44162 <i>Diuris tinkeri</i>			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
1104.	1643 <i>Elythranthera brunonis</i> (Purple Enamel Orchid)			
1105.	1644 <i>Elythranthera emarginata</i> (Pink Enamel Orchid)			
1106.	<i>Eriochilus</i> sp.			
1107.	1653 <i>Leporella fimbriata</i> (Hare Orchid)			
1108.	15418 <i>Leptoceras menziesii</i>			
1109.	1657 <i>Microtis alba</i> (White Mignonette Orchid)			
1110.	10954 <i>Microtis media</i> (Tall Mignonette Orchid)			
1111.	15419 <i>Microtis media</i> subsp. <i>media</i>			
1112.	13867 <i>Paracaleana dixonii</i>		T	
1113.	1667 <i>Paracaleana nigrita</i> (Flying Duck Orchid)			
1114.	20460 <i>Pheladenia deformis</i>			
1115.	1671 <i>Prasophyllum elatum</i> (Tall Leek Orchid)			
1116.	1672 <i>Prasophyllum fimbria</i> (Fringed Leek Orchid)			
1117.	16688 <i>Prasophyllum gracile</i>			
1118.	1677 <i>Prasophyllum macrostachyum</i> (Laughing Leek Orchid)			
1119.	1680 <i>Prasophyllum parvifolium</i> (Autumn Leek Orchid)			
1120.	10853 <i>Prasophyllum plumiforme</i>			
1121.	1682 <i>Prasophyllum sargentii</i>			
1122.	1687 <i>Pterostylis dilatata</i>			
1123.	45343 <i>Pterostylis platypetala</i>			
1124.	12217 <i>Pterostylis sanguinea</i>			
1125.	<i>Pterostylis scabrida</i>			
1126.	1698 <i>Pterostylis vittata</i> (Banded Greenhood)			
1127.	16367 <i>Pyrorchis nigricans</i> (Red beaks, Elephants ears)			
1128.	1701 <i>Thelymitra antennifera</i> (Vanilla Orchid)			
1129.	11032 <i>Thelymitra apiculata</i>		P4	
1130.	1702 <i>Thelymitra campanulata</i> (Shirt Orchid)			
1131.	20734 <i>Thelymitra pulcherima</i>		P2	
1132.	10862 <i>Thelymitra stellata</i> (Star Orchid)		T	
1133.	1717 <i>Thelymitra variegata</i> (Queen of Sheba)		P2	
1134.	1718 <i>Thelymitra villosa</i> (Custard Orchid)			
Orobanchaceae				
1135.	15037 <i>Bartsia trixago</i>	Y		
1136.	7122 <i>Orobanche minor</i> (Lesser Broomrape)	Y		
1137.	7089 <i>Parentucellia latifolia</i> (Common Bartsia)	Y		
Oxalidaceae				
1138.	30375 <i>Oxalis exilis</i>			
1139.	4352 <i>Oxalis glabra</i>	Y		
1140.	4355 <i>Oxalis perennans</i>			
Papaveraceae				
1141.	2969 <i>Fumaria capreolata</i> (Whiteflower Fumitory)	Y		
Philydraceae				
1142.	1173 <i>Philydrella pygmaea</i> (Butterfly Flowers)			
1143.	14306 <i>Philydrella pygmaea</i> subsp. <i>pygmaea</i>			
Phyllanthaceae				
1144.	4675 <i>Phyllanthus calycinus</i> (False Boronia)			
1145.	4691 <i>Poranthera microphylla</i> (Small Poranthera)			
Pittosporaceae				
1146.	25788 <i>Billardiera fraseri</i> (Elegant Pronaya)			
1147.	25779 <i>Billardiera venusta</i>			
1148.	19421 <i>Marianthus bicolor</i> (Painted Marianthus)			
1149.	17636 <i>Marianthus coeruleopunctatus</i> (Blue-spotted Marianthus)			
1150.	17633 <i>Marianthus erubescens</i>			
1151.	19745 <i>Pittosporum ligustrifolium</i>			
Poaceae				
1152.	196 <i>Amphipogon caricinus</i> (Long Greybeard Grass)			
1153.	12025 <i>Amphipogon caricinus</i> var. <i>caricinus</i>			
1154.	197 <i>Amphipogon debilis</i>			
1155.	20184 <i>Amphipogon laguroides</i> subsp. <i>laguroides</i>			
1156.	200 <i>Amphipogon turbinatus</i>			
1157.	<i>Aristida</i> sp.			
1158.	17234 <i>Austrostipa compressa</i>			
1159.	17237 <i>Austrostipa elegantissima</i>			
1160.	17240 <i>Austrostipa flavescens</i>			
1161.	17241 <i>Austrostipa hemipogon</i>			
1162.	17244 <i>Austrostipa macalpinei</i>			
1163.	19959 <i>Austrostipa</i> sp. <i>Cairn Hill</i> (M.E. Trudgen 21176)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
			P3	
1164.	17254 <i>Austrostipa tenuifolia</i>			
1165.	17257 <i>Austrostipa variabilis</i>			
1166.	231 <i>Avellinia michelii</i>	Y		
1167.	233 <i>Avena barbata</i> (Bearded Oat)	Y		
1168.	8661 <i>Brachypodium distachyon</i> (False Brome)	Y		
1169.	244 <i>Briza maxima</i> (Blowfly Grass)	Y		
1170.	245 <i>Briza minor</i> (Shivery Grass)	Y		
1171.	249 <i>Bromus diandrus</i> (Great Brome)	Y		
1172.	250 <i>Bromus hordeaceus</i> (Soft Brome)	Y		
1173.	252 <i>Bromus madritensis</i> (Madrid Brome)	Y		
1174.	253 <i>Bromus rubens</i> (Red Brome)	Y		
1175.	283 <i>Cynodon dactylon</i> (Couch)	Y		
1176.	311 <i>Digitaria ciliaris</i> (Summer Grass)	Y		
1177.	347 <i>Ehrharta calycina</i> (Perennial Veldt Grass)	Y		
1178.	349 <i>Ehrharta longiflora</i> (Annual Veldt Grass)	Y		
1179.	379 <i>Eragrostis elongata</i> (Clustered Lovegrass)			
1180.	19954 <i>Lachnagrostis aemula</i>			
1181.	20019 <i>Lachnagrostis filiformis</i>			
1182.	19955 <i>Lachnagrostis plebeia</i>			
1183.	19956 <i>Lachnagrostis preissii</i>			
1184.	485 <i>Microlaena stipoides</i> (Weeping Grass)			
1185.	492 <i>Neurachne alopecuroidea</i> (Foftail Mulga Grass)			
1186.	<i>Neurachne alopecuroidea</i>			
1187.	527 <i>Paspalum dilatatum</i>	Y		
1188.	40424 <i>Pentameris airoides</i> subsp. <i>airoides</i>	Y		
1189.	571 <i>Poa annua</i> (Winter Grass)	Y		
1190.	573 <i>Poa drummondiana</i> (Knotted Poa)			
1191.	578 <i>Poa porphyroclados</i>			
1192.	582 <i>Polypogon monspeliensis</i> (Annual Beardgrass)	Y		
1193.	583 <i>Polypogon tenellus</i>			
1194.	40431 <i>Rytidosperma acerosum</i>			
1195.	40425 <i>Rytidosperma caespitosum</i>			
1196.	40426 <i>Rytidosperma occidentale</i>			
1197.	635 <i>Sporobolus virginicus</i> (Marine Couch)			
1198.	673 <i>Themeda triandra</i>			
1199.	722 <i>Vulpia bromoides</i> (Squirrel Tail Fescue)	Y		
1200.	11137 <i>Vulpia fasciculata</i>	Y		
1201.	11018 <i>Vulpia muralis</i>	Y		
1202.	33101 <i>Vulpia myuros</i> forma <i>myuros</i>	Y		

Polygalaceae

1203.	4549 <i>Comesperma acerosum</i>			
1204.	4550 <i>Comesperma calymega</i> (Blue-spike Milkwort)			
1205.	4551 <i>Comesperma ciliatum</i>			
1206.	4552 <i>Comesperma confertum</i>			
1207.	4553 <i>Comesperma drummondii</i> (Drummond's Milkwort)			
1208.	4554 <i>Comesperma flavum</i>			
1209.	4561 <i>Comesperma scoparium</i> (Broom Milkwort)			
1210.	<i>Comesperma</i> sp.			
1211.	4564 <i>Comesperma virgatum</i> (Milkwort)			
1212.	4566 <i>Comesperma volubile</i> (Love Creeper)			

Polygonaceae

1213.	2412 <i>Muehlenbeckia adpressa</i> (Climbing Lignum)			
1214.	2415 <i>Muehlenbeckia polybotrya</i>			
1215.	13911 <i>Persicaria decipiens</i>			

Portulacaceae

1216.	44184 <i>Calandrinia baccata</i>			
1217.	2846 <i>Calandrinia calyptata</i> (Pink Purslane)			
1218.	2847 <i>Calandrinia composita</i>			
1219.	2848 <i>Calandrinia corrigioloides</i> (Strap Purslane)			
1220.	2860 <i>Calandrinia polyandra</i> (Parakeelya)			
1221.	2861 <i>Calandrinia polypetala</i>			
1222.	16365 <i>Calandrinia</i> sp. Kenwick (G.J. Keighery 10905)			

Primulaceae

1223.	36375 <i>Lysimachia arvensis</i> (Pimpernel)	Y		
1224.	6483 <i>Samolus junceus</i>			
1225.	6484 <i>Samolus repens</i> (Creeping Brookweed)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
Proteaceae				
1226.	1775 <i>Adenanthos cygnorum</i> (Common Woollybush)			
1227.	11837 <i>Adenanthos cygnorum</i> subsp. <i>cygnorum</i> (Common Woollybush)			
1228.	1779 <i>Adenanthos drummondii</i>			
1229.	1794 <i>Adenanthos sericeus</i> (Woolly Bush)			
1230.	32684 <i>Banksia arctotidis</i>			
1231.	32681 <i>Banksia armata</i> (Prickly Dryandra)			
1232.	32682 <i>Banksia armata</i> var. <i>armata</i>			
1233.	1800 <i>Banksia attenuata</i> (Slender Banksia, Piara)			
1234.	32679 <i>Banksia bipinnatifida</i> subsp. <i>multifida</i>			
1235.	1809 <i>Banksia candolleana</i> (Propeller Banksia)			
1236.	32623 <i>Banksia carlinoides</i> (Pink Dryandra)			
1237.	32622 <i>Banksia catoglypta</i>		T	
1238.	1810 <i>Banksia chamaephyton</i> (Fishbone Banksia)		P4	
1239.	32578 <i>Banksia dallanneyi</i> subsp. <i>media</i>			
1240.	1816 <i>Banksia elegans</i> (Elegant Banksia)		P4	
1241.	32524 <i>Banksia fraseri</i> var. <i>ashbyi</i>			
1242.	32527 <i>Banksia fraseri</i> var. <i>crebra</i>		P3	
1243.	32526 <i>Banksia fraseri</i> var. <i>effusa</i>		P2	Y
1244.	32523 <i>Banksia fraseri</i> var. <i>fraseri</i>			
1245.	32519 <i>Banksia glaucifolia</i>			
1246.	1819 <i>Banksia grandis</i> (Bull Banksia, Pulgarla)			
1247.	1820 <i>Banksia grossa</i>			
1248.	32518 <i>Banksia hewardiana</i>			
1249.	1821 <i>Banksia hookeriana</i> (Hooker's Banksia)			
1250.	1822 <i>Banksia ilicifolia</i> (Holly-leaved Banksia)			
1251.	1823 <i>Banksia incana</i>			
1252.	33398 <i>Banksia incana</i> var. <i>brachyphylla</i>			
1253.	33399 <i>Banksia incana</i> var. <i>incana</i>			
1254.	32214 <i>Banksia kippistiana</i>			
1255.	32215 <i>Banksia kippistiana</i> var. <i>kippistiana</i>			
1256.	32216 <i>Banksia kippistiana</i> var. <i>paenepeccata</i>		P3	
1257.	1825 <i>Banksia lanata</i>			
1258.	1828 <i>Banksia leptophylla</i>			
1259.	11714 <i>Banksia leptophylla</i> var. <i>leptophylla</i>			
1260.	11386 <i>Banksia leptophylla</i> var. <i>melletica</i>			
1261.	1830 <i>Banksia littoralis</i> (Swamp Banksia, Pungura)			
1262.	1834 <i>Banksia menziesii</i> (Firewood Banksia)			
1263.	1835 <i>Banksia micrantha</i>			
1264.	32206 <i>Banksia nana</i> (Dwarf Dryandra)			
1265.	32202 <i>Banksia nivea</i> (Honeypot Dryandra, Pudjarn)			
1266.	32203 <i>Banksia nivea</i> subsp. <i>nivea</i>			
1267.	32201 <i>Banksia nobilis</i> subsp. <i>fragrans</i>		P3	
1268.	32163 <i>Banksia platycarpa</i>			
1269.	1842 <i>Banksia prionotes</i> (Acorn Banksia)			
1270.	32086 <i>Banksia sclerophylla</i>			
1271.	32083 <i>Banksia serratuloides</i> subsp. <i>perissa</i>		T	
1272.	32077 <i>Banksia sessilis</i> var. <i>cygnorum</i>			
1273.	32079 <i>Banksia sessilis</i> var. <i>flabellifolia</i>			
1274.	32074 <i>Banksia shuttleworthiana</i> (Bearded Dryandra)			
1275.	<i>Banksia</i> sp.			
1276.	1851 <i>Banksia sphaerocarpa</i> (Round-fruit Banksia)			
1277.	33401 <i>Banksia sphaerocarpa</i> var. <i>pumilio</i>			
1278.	12111 <i>Banksia sphaerocarpa</i> var. <i>sphaerocarpa</i> (Fox Banksia)			
1279.	32073 <i>Banksia splendida</i> subsp. <i>macrocarpa</i>		P3	
1280.	32043 <i>Banksia stenoprion</i>			
1281.	32042 <i>Banksia strictifolia</i>			
1282.	32037 <i>Banksia subulata</i> (Awled Honeypot)		P3	
1283.	1852 <i>Banksia telmatiaea</i> (Swamp Fox Banksia)			
1284.	32033 <i>Banksia tortifolia</i>			
1285.	1853 <i>Banksia tricuspis</i> (Pine Banksia)		P4	
1286.	32032 <i>Banksia tridentata</i> (Yellow Honeypot)			
1287.	1857 <i>Conospermum acerosum</i> (Needle-leaved Smokebush)			
1288.	15511 <i>Conospermum boreale</i>			
1289.	15512 <i>Conospermum boreale</i> subsp. <i>ascendens</i>			
1290.	15513 <i>Conospermum boreale</i> subsp. <i>boreale</i>			
1291.	1859 <i>Conospermum brachyphyllum</i>			
1292.	1861 <i>Conospermum brownii</i> (Blue-eyed Smokebush)			
1293.	15041 <i>Conospermum canaliculatum</i>			
1294.	15517 <i>Conospermum canaliculatum</i> subsp. <i>apiculatum</i>			

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1295.	15516 <i>Conospermum canaliculatum</i> subsp. <i>canaliculatum</i>			
1296.	1864 <i>Conospermum crassinervium</i> (Summer Smokebush)			
1297.	1874 <i>Conospermum glumaceum</i> (Hooded Smokebush)			
1298.	1876 <i>Conospermum incurvum</i> (Plume Smokebush)			
1299.	1878 <i>Conospermum nervosum</i>			
1300.	1881 <i>Conospermum scaposum</i>		P3	
1301.	<i>Conospermum</i> sp.			
1302.	1882 <i>Conospermum stoechadis</i> (Common Smokebush)			
1303.	15520 <i>Conospermum stoechadis</i> subsp. <i>sclerophyllum</i>			
1304.	15611 <i>Conospermum stoechadis</i> subsp. <i>stoechadis</i> (Common Smokebush)			
1305.	1885 <i>Conospermum triplinervium</i> (Tree Smokebush)			
1306.	15521 <i>Conospermum unilaterale</i>			
1307.	15523 <i>Conospermum wycherleyi</i>			
1308.	15524 <i>Conospermum wycherleyi</i> subsp. <i>glabrum</i>			
1309.	15522 <i>Conospermum wycherleyi</i> subsp. <i>wycherleyi</i>			
1310.	1948 <i>Grevillea acrobotrya</i>			
1311.	1956 <i>Grevillea argyrophylla</i> (Silvery-leaved Grevillea)			
1312.	1960 <i>Grevillea batrachioides</i>		T	Y
1313.	15763 <i>Grevillea biformis</i> subsp. <i>biformis</i>			
1314.	15815 <i>Grevillea delta</i>		P2	Y
1315.	2001 <i>Grevillea eriostachya</i> (Flame Grevillea, Kaliny-kalinynga)			
1316.	19567 <i>Grevillea florida</i>		P3	
1317.	15987 <i>Grevillea humifusa</i>		T	
1318.	17440 <i>Grevillea metamorpha</i>		P1	Y
1319.	2054 <i>Grevillea olivacea</i> (Olive Grevillea)		P4	
1320.	8838 <i>Grevillea pinaster</i>			
1321.	8839 <i>Grevillea preissii</i>			
1322.	15838 <i>Grevillea preissii</i> subsp. <i>glabrilimba</i>			
1323.	15839 <i>Grevillea preissii</i> subsp. <i>preissii</i>			
1324.	2086 <i>Grevillea rudis</i>		P4	
1325.	2087 <i>Grevillea saccata</i> (Pouched Grevillea)		P4	
1326.	17745 <i>Grevillea shuttleworthiana</i> subsp. <i>canarina</i>			
1327.	<i>Grevillea</i> sp.			
1328.	2101 <i>Grevillea synapheae</i> (Catkin Grevillea)			
1329.	14420 <i>Grevillea synapheae</i> subsp. <i>pachyphylla</i>			
1330.	37180 <i>Grevillea thelemanniana</i> subsp. <i>Cooljarloo</i> (B.J. Keighery 28 B)		P1	
1331.	14422 <i>Grevillea thyrsoides</i> subsp. <i>pustulata</i>		P3	
1332.	14423 <i>Grevillea thyrsoides</i> subsp. <i>thyrsoides</i>		P3	
1333.	2115 <i>Grevillea umbellulata</i>			
1334.	2116 <i>Grevillea uncinulata</i> (Hook-leaf Grevillea)			
1335.	19231 <i>Grevillea uncinulata</i> subsp. <i>Coomallo</i> (S.J. Patrick 719)			
1336.	<i>Grevillea uncinulata</i> subsp. <i>coomallo</i> (s.j.patrick 719)			
1337.	13900 <i>Grevillea uniformis</i>		P3	
1338.	12824 <i>Grevillea vestita</i> subsp. <i>vestita</i>			
1339.	17670 <i>Hakea anadenia</i>			
1340.	2131 <i>Hakea auriculata</i>			
1341.	12225 <i>Hakea brownii</i>			
1342.	2140 <i>Hakea circumalata</i>			
1343.	2143 <i>Hakea conchifolia</i> (Shell-leaved Hakea)			
1344.	2146 <i>Hakea costata</i> (Ribbed Hakea)			
1345.	16908 <i>Hakea eneabba</i>			
1346.	2158 <i>Hakea erinacea</i> (Hedge-hog Hakea)			
1347.	2161 <i>Hakea flabellifolia</i> (Fan-leaved Hakea)			
1348.	2164 <i>Hakea gilbertii</i>			
1349.	2166 <i>Hakea incrassata</i> (Marble Hakea)			
1350.	2175 <i>Hakea lissocarpha</i> (Honey Bush)			
1351.	12230 <i>Hakea longiflora</i>		P3	
1352.	2179 <i>Hakea marginata</i>			
1353.	2180 <i>Hakea megalosperma</i> (Lesueur Hakea)		T	
1354.	45333 <i>Hakea neospathulata</i>			
1355.	2186 <i>Hakea neurophylla</i>		P4	
1356.	2197 <i>Hakea prostrata</i> (Harsh Hakea)			
1357.	12233 <i>Hakea psilorhyncha</i>			
1358.	2203 <i>Hakea ruscifolia</i> (Candle Hakea)			
1359.	2205 <i>Hakea smilacifolia</i>			
1360.	<i>Hakea</i> sp.			
1361.	2206 <i>Hakea stenocarpa</i> (Narrow-fruited Hakea)			
1362.	2214 <i>Hakea trifurcata</i> (Two-leaf Hakea)			
1363.	2216 <i>Hakea varia</i> (Variable-leaved Hakea)			
1364.	2219 <i>Isopogon adenanthoides</i> (Spider Coneflower)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
1365.	2221 <i>Isopogon asper</i>			
1366.	2227 <i>Isopogon divergens</i> (Spreading Coneflower)			
1367.	2228 <i>Isopogon drummondii</i>		P3	
1368.	2229 <i>Isopogon dubius</i> (Pincushion Coneflower)			
1369.	16873 <i>Isopogon inconspicuus</i>			
1370.	2232 <i>Isopogon linearis</i>			
1371.	37881 <i>Isopogon panduratus</i> subsp. <i>panduratus</i>			
1372.	2237 <i>Isopogon sphaerocephalus</i> (Drumstick Isopogon)			
1373.	14439 <i>Isopogon teretifolius</i> subsp. <i>teretifolius</i> (Nodding Coneflower)			
1374.	2239 <i>Isopogon tridens</i> (Three-toothed Coneflower)			
1375.	2249 <i>Lambertia multiflora</i> (Many-flowered Honeysuckle)			
1376.	15528 <i>Lambertia multiflora</i> var. <i>multiflora</i>			
1377.	2258 <i>Persoonia comata</i>			
1378.	14563 <i>Persoonia filiformis</i>		P2	
1379.	2271 <i>Persoonia rudis</i>		P3	
1380.	2272 <i>Persoonia rufiflora</i>			
1381.	2281 <i>Persoonia trinervis</i>			
1382.	14368 <i>Petrophile aculeata</i>			
1383.	20368 <i>Petrophile axillaris</i>			
1384.	2286 <i>Petrophile brevifolia</i>			
1385.	2288 <i>Petrophile chrysantha</i>			
1386.	2299 <i>Petrophile linearis</i> (Pixie Mops)			
1387.	2301 <i>Petrophile macrostachya</i>			
1388.	2303 <i>Petrophile megalostegia</i>			
1389.	19769 <i>Petrophile nivea</i>		T	Y
1390.	29208 <i>Petrophile pilostyla</i> subsp. <i>austrina</i>			
1391.	16874 <i>Petrophile recurva</i>			
1392.	2306 <i>Petrophile rigida</i>			
1393.	10784 <i>Petrophile scabriuscula</i>			
1394.	2308 <i>Petrophile seminuda</i>			
1395.	2309 <i>Petrophile serruriae</i>			
1396.	2310 <i>Petrophile shuttleworthiana</i>			
1397.	<i>Petrophile</i> sp.			
1398.	2312 <i>Petrophile striata</i>			
1399.	12856 <i>Stirlingia abrotanoides</i>			
1400.	2316 <i>Stirlingia latifolia</i> (Blueboy)			
1401.	2317 <i>Stirlingia simplex</i>			
1402.	<i>Stirlingia</i> sp.			
1403.	2319 <i>Strangea cynanchicarpa</i> (Heath Strangea)			
1404.	16882 <i>Synaphea aephyrsa</i>			
1405.	16858 <i>Synaphea endoctrinx</i>		P3	
1406.	15530 <i>Synaphea lesueurensis</i>		P2	
1407.	2329 <i>Synaphea spinulosa</i>			
1408.	15532 <i>Synaphea spinulosa</i> subsp. <i>spinulosa</i>			
1409.	30452 <i>Synaphea xela</i>		P2	
1410.	2330 <i>Xylomelum angustifolium</i> (Sandplain Woody Pear)			
Pteridaceae				
1411.	29 <i>Anogramma leptophylla</i> (Annual Fern)			
1412.	31 <i>Cheilanthes austrotenuifolia</i>			
1413.	12818 <i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>			
Ranunculaceae				
1414.	10804 <i>Clematis linearifolia</i>			
1415.	2932 <i>Ranunculus colonorum</i> (Common Buttercup)			
Restionaceae				
1416.	1056 <i>Alexgeorgea nitens</i>			
1417.	1057 <i>Alexgeorgea subterranea</i>			
1418.	17685 <i>Chaetanthus aristatus</i>			
1419.	17827 <i>Chordifex chaunocoleus</i>		P4	
1420.	17833 <i>Chordifex microcodon</i>			
1421.	17706 <i>Chordifex sinuosus</i>			
1422.	<i>Chordifex</i> sp.			
1423.	17826 <i>Chordifex stenandrus</i>			
1424.	17663 <i>Desmocladius asper</i>			
1425.	15831 <i>Desmocladius castaneus</i>			
1426.	15828 <i>Desmocladius elongatus</i>		P4	
1427.	17691 <i>Desmocladius fasciculatus</i>			
1428.	16595 <i>Desmocladius flexuosus</i>			
1429.	17662 <i>Desmocladius lateriticus</i>			
1430.	17846 <i>Desmocladius parthenicus</i>			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
1431.	17712 <i>Desmocladus semiplanus</i>			
1432.	16455 <i>Desmocladus virgatus</i>			
1433.	1068 <i>Harperia lateriflora</i>			
1434.	1070 <i>Hypolaena exsulca</i>			
1435.	17622 <i>Hypolaena robusta</i>		P4	
1436.	1073 <i>Lepidobolus chaetocephalus</i> (Bristle-headed Chaff Rush)			
1437.	1075 <i>Lepidobolus preissianus</i>			
1438.	18074 <i>Lepidobolus preissianus</i> subsp. <i>preissianus</i>			
1439.	13775 <i>Lepidobolus quadratus</i>		P3	
1440.	<i>Lepidobolus quadratus</i> MS			
1441.	<i>Lepidobolus</i> sp.			
1442.	19241 <i>Lepyrodia curvescens</i>		P2	
1443.	<i>Lepyrodia curvescens</i> MS			
1444.	17837 <i>Loxocarya gigas</i>		P2	
1445.	17683 <i>Meeboldina cana</i>			
1446.	17679 <i>Meeboldina coangustata</i>			

Rhamnaceae

1447.	31571 <i>Cryptandra intermedia</i>			
1448.	9076 <i>Cryptandra myriantha</i>			
1449.	4804 <i>Cryptandra nutans</i>			
1450.	4809 <i>Cryptandra pungens</i>			
1451.	4810 <i>Cryptandra scoparia</i>			
1452.	<i>Cryptandra</i> sp.			
1453.	4811 <i>Cryptandra spyridioides</i>			
1454.	29919 <i>Polianthion wichurae</i>			
1455.	<i>Pomaderris</i> sp.			
1456.	4828 <i>Spyridium globulosum</i> (Basket Bush)			
1457.	<i>Spyridium</i> sp.			
1458.	13475 <i>Stenanthemum humile</i>			
1459.	14236 <i>Stenanthemum limitatum</i>		P2	
1460.	16182 <i>Stenanthemum notiale</i>			
1461.	15065 <i>Stenanthemum notiale</i> subsp. <i>notiale</i>			
1462.	14240 <i>Stenanthemum reissekii</i>			
1463.	<i>Stenanthemum</i> sp.			
1464.	4839 <i>Trymalium angustifolium</i>			
1465.	11665 <i>Trymalium ledifolium</i> var. <i>ledifolium</i>			
1466.	13479 <i>Trymalium ledifolium</i> var. <i>rosmarinifolium</i>			
1467.	33418 <i>Trymalium odoratissimum</i> subsp. <i>odoratissimum</i>			
1468.	15757 <i>Trymalium spatulatum</i>			

Rubiaceae

1469.	7323 <i>Galium murale</i> (Small Goosegrass)	Y		
1470.	18255 <i>Opercularia vaginata</i> (Dog Weed)			

Rutaceae

1471.	4397 <i>Asterolasia drummondii</i> (Gairdner Range Starbush)		P4	
1472.	4400 <i>Asterolasia pallida</i>			
1473.	4406 <i>Boronia busselliana</i>			
1474.	4409 <i>Boronia coerulescens</i>			
1475.	4411 <i>Boronia crassifolia</i>			
1476.	4414 <i>Boronia cymosa</i> (Granite Boronia)			
1477.	4438 <i>Boronia ramosa</i>			
1478.	11381 <i>Boronia ramosa</i> subsp. <i>anethifolia</i>			
1479.	16625 <i>Boronia ramosa</i> subsp. <i>lesueurana</i>		P2	Y
1480.	11564 <i>Boronia ramosa</i> subsp. <i>ramosa</i>			
1481.	16637 <i>Boronia scabra</i> subsp. <i>condensata</i>		P2	
1482.	16639 <i>Boronia scabra</i> subsp. <i>scabra</i>			
1483.	4443 <i>Boronia subsessilis</i>			
1484.	4453 <i>Diplolaena angustifolia</i> (Yanchep Rose)			
1485.	15272 <i>Diplolaena cinerea</i>			
1486.	4454 <i>Diplolaena dampieri</i> (Southern Diplolaena)			
1487.	15271 <i>Diplolaena eneabbensis</i>			
1488.	4455 <i>Diplolaena ferruginea</i>			
1489.	15275 <i>Diplolaena obovata</i>			
1490.	4483 <i>Geleznovia verrucosa</i>			
1491.	18535 <i>Philothea pinoides</i>			
1492.	18529 <i>Philothea spicata</i> (Pepper and Salt)			

Santalaceae

1493.	10765 <i>Exocarpos sparteus</i> (Broom Ballart, Djuk)			
1494.	2344 <i>Leptomeria empetriformis</i>			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
1495.	2352 <i>Leptomeria preissiana</i>			
1496.	2356 <i>Santalum acuminatum</i> (Quandong, Warrga)			
Sapindaceae				
1497.	4746 <i>Diplopeltis huegelii</i>			
1498.	18541 <i>Diplopeltis huegelii</i> subsp. <i>huegelii</i>			
1499.	18589 <i>Diplopeltis huegelii</i> subsp. <i>lehmannii</i>			
1500.	18542 <i>Diplopeltis huegelii</i> subsp. <i>subintegra</i>			
1501.	4754 <i>Dodonaea aptera</i> (Coast Hop-bush)			
1502.	4761 <i>Dodonaea ericoides</i>			
1503.	<i>Dodonaea</i> sp.			
Scrophulariaceae				
1504.	7055 <i>Dischisma capitatum</i> (Woolly-headed <i>Dischisma</i>)	Y		
1505.	17175 <i>Eremophila glabra</i> subsp. <i>albicans</i>			
1506.	7289 <i>Myoporum caprarioides</i> (Slender <i>Myoporum</i>)			
1507.	7291 <i>Myoporum insulare</i> (Blueberry Tree, boobialla)			
1508.	7113 <i>Zaluzianskya divaricata</i> (Spreading Night Phlox)	Y		
Selaginellaceae				
1509.	6 <i>Selaginella gracillima</i> (Tiny Clubmoss)			
Solanaceae				
1510.	11725 <i>Anthocercis ilicifolia</i> subsp. <i>ilicifolia</i>			
1511.	6949 <i>Anthocercis littorea</i> (Yellow Tailflower)			
1512.	7013 <i>Solanum hoplopetalum</i> (Thorny Solanum)			
1513.	7018 <i>Solanum lasiophyllum</i> (Flannel Bush, Mindjulu)			
1514.	7022 <i>Solanum nigrum</i> (Black Berry Nightshade)	Y		
1515.	7034 <i>Solanum simile</i> (Ondoroo)			
1516.	<i>Solanum</i> sp.			
1517.	7037 <i>Solanum symonii</i>			
Stylidiaceae				
1518.	39820 <i>Levenhookia murfetii</i>			
1519.	7672 <i>Levenhookia octomaculata</i> (Eight-spotted Stylewort)			
1520.	7676 <i>Levenhookia pusilla</i> (Midget Stylewort)			
1521.	7677 <i>Levenhookia stipitata</i> (Common Stylewort)			
1522.	7679 <i>Stylidium adpressum</i> (Trigger-on-stilts)			
1523.	7680 <i>Stylidium aeonioides</i>		P4	
1524.	12846 <i>Stylidium albolilacinum</i>			
1525.	30278 <i>Stylidium androsaceum</i>			
1526.	25831 <i>Stylidium araeophyllum</i> (Stilt Walker)			
1527.	30276 <i>Stylidium bicolor</i>			
1528.	7693 <i>Stylidium brunonianum</i> (Pink Fountain Triggerplant)			
1529.	17187 <i>Stylidium burbidgeanum</i>			
1530.	7696 <i>Stylidium calcaratum</i> (Book Triggerplant)			
1531.	7699 <i>Stylidium carnosum</i> (Fleshy-leaved Triggerplant)			
1532.	30715 <i>Stylidium carnosum</i> subsp. <i>Narrow leaves</i> (J.A. Wege 490)		P1	
1533.	7709 <i>Stylidium crossocephalum</i> (Posy Triggerplant)			
1534.	7710 <i>Stylidium cygnorum</i>			
1535.	40944 <i>Stylidium decipiens</i>			
1536.	7712 <i>Stylidium despectum</i> (Dwarf Triggerplant)			
1537.	7713 <i>Stylidium dichotomum</i> (Pins-and-needles)			
1538.	20531 <i>Stylidium diplotrichum</i>		P2	
1539.	11808 <i>Stylidium diuroides</i> subsp. <i>diuroides</i>			
1540.	12848 <i>Stylidium diuroides</i> subsp. <i>paucifoliatum</i>			
1541.	7719 <i>Stylidium ecome</i> (Foot Triggerplant)			
1542.	7720 <i>Stylidium elongatum</i> (Tall Triggerplant)			
1543.	19251 <i>Stylidium eriopodium</i>			
1544.	18420 <i>Stylidium flagellum</i>			
1545.	25801 <i>Stylidium hesperium</i>			
1546.	7742 <i>Stylidium inundatum</i> (Hundreds and Thousands)			
1547.	7743 <i>Stylidium inversiflorum</i>		P4	
1548.	7745 <i>Stylidium junceum</i> (Reed Triggerplant)			
1549.	17412 <i>Stylidium kalbarriense</i>			
1550.	7749 <i>Stylidium leptophyllum</i> (Needle-leaved Triggerplant)			
1551.	7760 <i>Stylidium maitlandianum</i> (Fountain Triggerplant)			
1552.	13127 <i>Stylidium maritimum</i>		P3	
1553.	7762 <i>Stylidium miniatum</i> (Pink Butterfly Triggerplant)			
1554.	7766 <i>Stylidium nonscandens</i>		P3	
1555.	7768 <i>Stylidium obtusatum</i> (Pinafore Triggerplant)			
1556.	7771 <i>Stylidium periscelanthum</i> (Pantaloon Triggerplant)		P3	
1557.	7774 <i>Stylidium piliferum</i> (Common Butterfly Triggerplant)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
1558.	25837 <i>Stylidium purpureum</i> (Purple Fountain Triggerplant)			
1559.	<i>Stylidium purpureum</i> MS			
1560.	7783 <i>Stylidium pycnostachyum</i> (Downy Triggerplant)			
1561.	7785 <i>Stylidium repens</i> (Matted Triggerplant)			
1562.	20521 <i>Stylidium rigidulum</i>			
1563.	7790 <i>Stylidium roseoalatum</i> (Pink-wing Triggerplant)			
1564.	25806 <i>Stylidium scariosum</i>			
1565.	7798 <i>Stylidium schoenoides</i> (Cow Kicks)			
1566.	<i>Stylidium</i> sp.			
1567.	30275 <i>Stylidium</i> sp. Banovich Road (F. & J. Hort 1884)		P1	Y
1568.	20608 <i>Stylidium stenosepalum</i>			
1569.	17414 <i>Stylidium torticarpum</i>		P3	
1570.	17578 <i>Stylidium udusicola</i>			

Surianaceae

1571.	3181 <i>Stylobasium australe</i>			
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Thymelaeaceae

1572.	5231 <i>Pimelea angustifolia</i> (Narrow-leaved Pimelea)			
1573.	5232 <i>Pimelea argentea</i> (Silvery Leaved Pimelea)			
1574.	5244 <i>Pimelea floribunda</i>			
1575.	11402 <i>Pimelea imbricata</i> var. <i>piligera</i>			
1576.	5254 <i>Pimelea leucantha</i>			
1577.	<i>Pimelea ligustrina</i> subsp. <i>ligustrina</i>			
1578.	<i>Pimelea</i> sp.			
1579.	5266 <i>Pimelea suaveolens</i> (Scented Banjine)			
1580.	12041 <i>Pimelea suaveolens</i> subsp. <i>suaveolens</i>			
1581.	5268 <i>Pimelea sulphurea</i> (Yellow Banjine)			
1582.	5272 <i>Pimelea villifera</i>			

Typhaceae

1583.	98 <i>Typha domingensis</i> (Bulrush, Djandjidi)			
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Urticaceae

1584.	1762 <i>Parietaria debilis</i> (Pellitory)			
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Violaceae

1585.	5216 <i>Hybanthus calycinus</i> (Wild Violet)			
1586.	5221 <i>Hybanthus floribundus</i>			
1587.	15553 <i>Hybanthus floribundus</i> subsp. <i>Hill River</i> (E.M. Bennett 2252)			
1588.	12007 <i>Hybanthus floribundus</i> subsp. <i>floribundus</i>			

Vitaceae

1589.	4853 <i>Clematicissus angustissima</i>			
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Xanthorrhoeaceae

1590.	1249 <i>Xanthorrhoea acanthostachya</i>			
1591.	1256 <i>Xanthorrhoea preissii</i> (Grass tree, Palga)			
1592.	<i>Xanthorrhoea</i> sp.			
1593.	20658 <i>Xanthorrhoea</i> sp. <i>Lesueur</i> (G.J. Keighery 16404)			Y

Zamiaceae

1594.	18119 <i>Macrozamia fraseri</i>			
1595.	85 <i>Macrozamia riedlei</i> (<i>Zamia</i> , Djiridji)			

Conservation Codes

T - Rare or likely to become extinct
 X - Presumed extinct
 IA - Protected under international agreement
 S - Other specially protected fauna
 1 - Priority 1
 2 - Priority 2
 3 - Priority 3
 4 - Priority 4
 5 - Priority 5

¹ For NatureMap's purposes, species flagged as endemic are those whose records are wholly contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

Hill River Fauna NatureMap Species Report

Created By Guest user on 20/07/2016

Kingdom Animalia
Current Names Only Yes
Core Datasets Only Yes
Method 'By Circle'
Centre 115° 14' 11" E, 30° 11' 31" S
Buffer 20km
Group By Species Group

Species Group	Species	Records
Amphibian	11	140
Bird	137	2193
Fish	6	76
Invertebrate	152	260
Mammal	17	451
Reptile	50	1026
TOTAL	373	4146

Name ID	Species Name	Naturalised	Conservation Code	Endemic To Query Area
Amphibian				
1.	25401 <i>Crinia pseudinsignifera</i> (Bleating Froglet)			
2.	25408 <i>Heleioporus albopunctatus</i> (Western Spotted Frog)			
3.	25410 <i>Heleioporus eyrei</i> (Moaning Frog)			
4.	25412 <i>Heleioporus psammophilus</i> (Sand Frog)			
5.	<i>Heleioporus</i> sp.			
6.	25415 <i>Limnodynastes dorsalis</i> (Western Banjo Frog)			
7.	25378 <i>Litoria adelaidensis</i> (Slender Tree Frog)			
8.	25388 <i>Litoria moorei</i> (Motorbike Frog)			
9.	25420 <i>Myobatrachus gouldii</i> (Turtle Frog)			
10.	25426 <i>Neobatrachus pelobatoides</i> (Humming Frog)			
11.	25433 <i>Pseudophryne guentheri</i> (Crawling Toadlet)			
Bird				
12.	24559 <i>Acanthagenys rufogularis</i> (Spiny-cheeked Honeyeater)			
13.	24260 <i>Acanthiza apicalis</i> (Broad-tailed Thornbill, Inland Thornbill)			
14.	24261 <i>Acanthiza chrysorrhoa</i> (Yellow-rumped Thornbill)			
15.	24262 <i>Acanthiza inornata</i> (Western Thornbill)			
16.	24265 <i>Acanthiza uropygialis</i> (Chestnut-rumped Thornbill)			
17.	24560 <i>Acanthorhynchus superciliosus</i> (Western Spinebill)			
18.	25536 <i>Accipiter fasciatus</i> (Brown Goshawk)			
19.	24310 <i>Anas castanea</i> (Chestnut Teal)			
20.	24312 <i>Anas gracilis</i> (Grey Teal)			
21.	24315 <i>Anas rhynchos</i> (Australasian Shoveler)			
22.	24316 <i>Anas superciliosa</i> (Pacific Black Duck)			
23.	24561 <i>Anthochaera carunculata</i> (Red Wattlebird)			
24.	24562 <i>Anthochaera lunulata</i> (Western Little Wattlebird)			
25.	<i>Aquila (Uroaetus) audax</i>			
26.	24285 <i>Aquila audax</i> (Wedge-tailed Eagle)			
27.	41324 <i>Ardea modesta</i> (Eastern Great Egret)		IA	
28.	24341 <i>Ardea pacifica</i> (White-necked Heron)			
29.	24610 <i>Ardeotis australis</i> (Australian Bustard)			
30.	25566 <i>Artamus cinereus</i> (Black-faced Woodswallow)			
31.	24353 <i>Artamus cyanopterus</i> (Dusky Woodswallow)			
32.	24356 <i>Artamus personatus</i> (Masked Woodswallow)			
33.	<i>Barnardius zonarius</i>			
34.	<i>Barnardius zonarius</i> subsp. <i>semitorquatus</i>			
35.	24319 <i>Biziura lobata</i> (Musk Duck)			
36.	<i>Cacatua (Licmetis) pastinator</i>			
37.	<i>Cacatua (Licmetis) pastinator</i> subsp. <i>derbyi</i>			
38.	<i>Cacatua (Licmetis) sanguinea</i> subsp. <i>sanguinea</i>			
39.	25714 <i>Cacatua pastinator</i> (Western Long-billed Corella)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
40.	24723 <i>Cacatua pastinator</i> subsp. <i>butleri</i> (Butler's Corella)			
41.	24725 <i>Cacatua roseicapilla</i> subsp. <i>assimilis</i> (Galah)			
42.	25716 <i>Cacatua sanguinea</i> (Little Corella)			
43.	<i>Cacatua</i> sp.			
44.	25598 <i>Cacomantis flabelliformis</i> (Fan-tailed Cuckoo)			
45.	42307 <i>Cacomantis pallidus</i> (Pallid Cuckoo)			
46.	<i>Calamanthus</i> (<i>Calamanthus</i>) <i>campestris</i> subsp. <i>montanellus</i>			
47.	24269 <i>Calamanthus campestris</i> (Rufous Fieldwren)			
48.	24779 <i>Calidris acuminata</i> (Sharp-tailed Sandpiper)		IA	
49.	24780 <i>Calidris alba</i> (Sanderling)		IA	
50.	<i>Calyptorhynchus</i> (<i>Zanda</i>) <i>baudinii</i>			
51.	<i>Calyptorhynchus</i> (<i>Zanda</i>) <i>latirostris</i>			
52.	24734 <i>Calyptorhynchus latirostris</i> (Carnaby's Cockatoo (short-billed black-cockatoo), Carnaby's Cockatoo)		T	
53.	<i>Calyptorhynchus</i> sp.			
54.	24377 <i>Charadrius ruficapillus</i> (Red-capped Plover)			
55.	24321 <i>Chenonetta jubata</i> (Australian Wood Duck, Wood Duck)			
56.	<i>Cheramoeca leucosterna</i>			
57.	<i>Chroicocephalus novaehollandiae</i>			
58.	24833 <i>Cincloramphus cruralis</i> (Brown Songlark)			
59.	24834 <i>Cincloramphus mathewsi</i> (Rufous Songlark)			
60.	24288 <i>Circus approximans</i> (Swamp Harrier)			
61.	25675 <i>Colluricincla harmonica</i> (Grey Shrike-thrush)			
62.	24613 <i>Colluricincla harmonica</i> subsp. <i>rufiventris</i> (Grey Shrike-thrush)			
63.	24399 <i>Columba livia</i> (Domestic Pigeon)	Y		
64.	25568 <i>Coracina novaehollandiae</i> (Black-faced Cuckoo-shrike)			
65.	24416 <i>Corvus bennetti</i> (Little Crow)			
66.	25592 <i>Corvus coronoides</i> (Australian Raven)			
67.	<i>Corvus coronoides</i> subsp. <i>coronoides</i>			
68.	<i>Corvus</i> sp.			
69.	24671 <i>Coturnix pectoralis</i> (Stubble Quail)			
70.	24420 <i>Cracticus nigrogularis</i> (Pied Butcherbird)			
71.	25595 <i>Cracticus tibicen</i> (Australian Magpie)			
72.	25596 <i>Cracticus torquatus</i> (Grey Butcherbird)			
73.	30901 <i>Dacelo novaeguineae</i> (Laughing Kookaburra)	Y		
74.	25673 <i>Daphoenositta chrysoptera</i> (Varied Sittella)			
75.	25607 <i>Dicaeum hirundinaceum</i> (Mistletoebird)			
76.	24470 <i>Dromaius novaehollandiae</i> (Emu)			
77.	<i>Egretta novaehollandiae</i>			
78.	<i>Elanus axillaris</i>			
79.	<i>Euseyornis melanops</i>			
80.	<i>Eolophus roseicapillus</i>			
81.	24652 <i>Eopsaltria georgiana</i> (White-breasted Robin)			
82.	24567 <i>Epthianura albiglans</i> (White-fronted Chat)			
83.	24570 <i>Epthianura tricolor</i> (Crimson Chat)			
84.	25621 <i>Falco berigora</i> (Brown Falcon)			
85.	25622 <i>Falco cenchroides</i> (Australian Kestrel)			
86.	25623 <i>Falco longipennis</i> (Australian Hobby)			
87.	25624 <i>Falco peregrinus</i> (Peregrine Falcon)		S	
88.	25727 <i>Fulica atra</i> (Eurasian Coot)			
89.	25530 <i>Gerygone fusca</i> (Western Gerygone)			
90.	24443 <i>Grallina cyanoleuca</i> (Magpie-lark)			
91.	24293 <i>Haliaeetus leucogaster</i> (White-bellied Sea-Eagle)		IA	
92.	24295 <i>Haliastur sphenurus</i> (Whistling Kite)			
93.	24491 <i>Hirundo neoxena</i> (Welcome Swallow)			
94.	<i>Hydroprogne caspia</i>			
95.	24557 <i>Leipoa ocellata</i> (Malleefowl)		T	
96.	25661 <i>Lichmera indistincta</i> (Brown Honeyeater)			
97.	<i>Lophoictinia isura</i>			
98.	24326 <i>Malacorhynchus membranaceus</i> (Pink-eared Duck)			
99.	25651 <i>Malurus lamberti</i> (Variegated Fairy-wren)			
100.	24544 <i>Malurus lamberti</i> subsp. <i>assimilis</i> (Variegated Fairy-wren)			
101.	25652 <i>Malurus leucopterus</i> (White-winged Fairy-wren)			
102.	24551 <i>Malurus pulcherrimus</i> (Blue-breasted Fairy-wren)			
103.	<i>Malurus</i> sp.			
104.	25654 <i>Malurus splendens</i> (Splendid Fairy-wren)			
105.	24583 <i>Manorina flavigula</i> (Yellow-throated Miner)			
106.	25663 <i>Melithreptus brevirostris</i> (Brown-headed Honeyeater)			
107.	24736 <i>Melopsittacus undulatus</i> (Budgerigar)			
108.	24598 <i>Merops ornatus</i> (Rainbow Bee-eater)		IA	

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109.	<i>Microcarbo melanoleucos</i>			
110.	25693 <i>Microeca fascians</i> (Jacky Winter)			
111.	25747 <i>Ninox connivens</i> (Barking Owl)			
112.	25748 <i>Ninox novaeseelandiae</i> (Boobook Owl)			
113.	24820 <i>Ninox novaeseelandiae</i> subsp. <i>boobook</i> (Boobook Owl)			
114.	24407 <i>Ocyphaps lophotes</i> (Crested Pigeon)			
115.	24618 <i>Oreoica gutturalis</i> (Crested Bellbird)			
116.	25679 <i>Pachycephala pectoralis</i> (Golden Whistler)			
117.	24623 <i>Pachycephala pectoralis</i> subsp. <i>fuliginosa</i> (Golden Whistler)			
118.	25680 <i>Pachycephala rufiventris</i> (Rufous Whistler)			
119.	25681 <i>Pardalotus punctatus</i> (Spotted Pardalote)			
120.	25682 <i>Pardalotus striatus</i> (Striated Pardalote)			
121.	24659 <i>Petroica goodenovii</i> (Red-capped Robin)			
122.	41348 <i>Pezoporus flaviventris</i> (Western Ground Parrot)		T	
123.	25697 <i>Phalacrocorax carbo</i> (Great Cormorant)			
124.	24667 <i>Phalacrocorax sulcirostris</i> (Little Black Cormorant)			
125.	24409 <i>Phaps chalcoptera</i> (Common Bronzewing)			
126.	25587 <i>Phaps elegans</i> (Brush Bronzewing)			
127.	24596 <i>Phylidonyris novaehollandiae</i> (New Holland Honeyeater)			
128.	24383 <i>Pluvialis squatarola</i> (Grey Plover)		IA	
129.	24681 <i>Poliiocephalus poliocephalus</i> (Hoary-headed Grebe)			
130.	30854 <i>Polytelis anthopeplus</i> subsp. <i>westralis</i> (Regent Parrot)			
131.	25731 <i>Porphyrio porphyrio</i> (Purple Swamphen)			
132.	24771 <i>Porzana tabuensis</i> (Spotless Crane)			
133.	24716 <i>Puffinus pacificus</i> (Wedge-tailed Shearwater)		IA	
134.	25614 <i>Rhipidura leucophrys</i> (Willie Wagtail)			
135.	25534 <i>Sericornis frontalis</i> (White-browed Scrubwren)			
136.	30948 <i>Smicronis brevirostris</i> (Weebill)			
137.	25655 <i>Stipiturus malachurus</i> (Southern Emu-wren)			
138.	25597 <i>Strepera versicolor</i> (Grey Currawong)			
139.	25590 <i>Streptopelia senegalensis</i> (Laughing Turtle-Dove)	Y		
140.	24331 <i>Tadorna tadornoides</i> (Australian Shelduck, Mountain Duck)			
141.	<i>Thalasseus bergii</i>			
142.	24845 <i>Threskiornis spinicollis</i> (Straw-necked Ibis)			
143.	25549 <i>Todiramphus sanctus</i> (Sacred Kingfisher)			
144.	24309 <i>Todiramphus sanctus</i> subsp. <i>sanctus</i> (Sacred Kingfisher)			
145.	<i>Tribonyx ventralis</i>			
146.	24806 <i>Tringa glareola</i> (Wood Sandpiper)		IA	
147.	24386 <i>Vanellus tricolor</i> (Banded Lapwing)			
148.	25765 <i>Zosterops lateralis</i> (Grey-breasted White-eye, Silvereye)			

Fish

149.	<i>Bostockia porosa</i>			
150.	<i>Carcharhinus brevipinna</i>			
151.	<i>Carcharhinus obscurus</i>			
152.	34028 <i>Galaxias occidentalis</i> (Western Minnow)			
153.	<i>Negaprion</i> sp.			Y
154.	<i>Pseudogobius olorum</i>			

Invertebrate

155.	<i>Aedes</i> sp. 4			Y
156.	<i>Aedes</i> sp. 4 (SAP)			Y
157.	<i>Agraptocorixa eurynome</i>			
158.	<i>Agriopocoscelis elongatus</i>			Y
159.	<i>Alboa worooa</i>			
160.	<i>Alona rectangula novaeseelandiae</i>			
161.	<i>Amblyomma triguttatum</i>			
162.	<i>Amitermes conformis</i>			
163.	<i>Amitermes germanus</i>			
164.	<i>Amphidelus</i> sp.			
165.	<i>Aname tepperi</i>			
166.	<i>Anatonchus</i> sp.			
167.	<i>Anisops hyperion</i>			
168.	<i>Anisops thienemanni</i>			
169.	<i>Antichiropus sulcatus</i>			
170.	<i>Araneus cyphoxis</i>			
171.	<i>Archargiolestes pusillus</i>			
172.	<i>Austracantha minax</i>			
173.	<i>Australocamptus near</i> sp. 5 (SAP)			
174.	<i>Australothis rubescens</i>			
175.	<i>Austrolestes analis</i>			

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176.	<i>Austrolestes annulosus</i>			
177.	<i>Austrosimulium furiosum</i>			Y
178.	<i>Austrotrombella sp. nov.</i>			
179.	<i>Austrotrombella sp. nov. (SAP)</i>			
180.	<i>Ballarra longipalpus</i>			
181.	<i>Bassianobdella sp.</i>			Y
182.	<i>Berosus sp.</i>			
183.	<i>Bezzia sp. 2</i>			
184.	<i>Bezzia sp. 2 (SAP)</i>			
185.	<i>Candonocypris novaezealandiae</i>			
186.	<i>Castiarina bucolica</i>			
187.	<i>Castiarina gravis</i>			
188.	<i>Catasarcus pallidiventris</i>			Y
189.	<i>Cephalodella gibba</i>			
190.	<i>Cercophonius granulatus</i>			
191.	<i>Cercophonius sulcatus</i>			
192.	<i>Chironomus aff. alternans (V24)</i>			
193.	<i>Chironomus aff. alternans (V24) (CB)</i>			
194.	<i>Clynotis albobarbatus</i>			
195.	<i>Coccus hesperidum subsp. hesperidum</i>			Y
196.	<i>Copelatus ater</i>			
197.	<i>Coptotermes acinaciformis subsp. raffrayi</i>			
198.	<i>Coptotermes frenchi</i>			
199.	<i>Cormocephalus novaehollandiae</i>			
200.	<i>Cormocephalus strigosus</i>			
201.	<i>Corynoneura sp. (V49)</i>			
202.	<i>Corynoneura sp. (V49) (SAP)</i>			
203.	<i>Cryptochironomus griseidorsum</i>			
204.	<i>Culicoides sp.</i>			
205.	<i>Cypretta baylyi</i>			
206.	<i>Dexerra turpis</i>			
207.	<i>Enchytraeidae sp.</i>			
208.	<i>Eretes australis</i>			
209.	<i>Ethmostigmus rubripes</i>			
210.	<i>Euhesma sp.</i>			
211.	<i>Eulimnadia sp.</i>			
212.	<i>Exocelina ater</i>			
213.	<i>Eylais sp.</i>			
214.	<i>Geogarypus taylori</i>			
215.	<i>Gymnometriocnemus spp. (not V44 or V45)</i>			
216.	<i>Helicotylenchus sp.</i>			
217.	<i>Hemicordulia tau</i>			
218.	<i>Hemicriconemoides sp.</i>			
219.	<i>Hemisaga denticulata</i>			
220.	<i>Henicops dentatus</i>			
221.	<i>Heterocypris tatei</i>			
222.	<i>Hyderodes sp.</i>			
223.	33977 <i>Hylaeus globuliferus (bee)</i>		P3	
224.	<i>Hyphydrys elegans</i>			
225.	<i>Hypomegalopsalis tanisphyros</i>			
226.	<i>Idiommatia blackwalli</i>			
227.	<i>Isopeda leishmani</i>			
228.	<i>Kawanaphila gidya</i>			
229.	<i>Kawanaphila goolwa</i>			
230.	<i>Kawanaphila narree</i>			
231.	<i>Laryngodus cervantes</i>			
232.	<i>Latrodectus hasseltii</i>			
233.	<i>Lepidoptera (non-pyralid) sp. 3 (SAP)</i>			
234.	<i>Leptus minno</i>			Y
235.	<i>Limbodessus inornatus</i>			
236.	<i>Liodessus inornatus</i>			
237.	<i>Lynceus tatei</i>			
238.	<i>Megachile (Austrochile) resinifera</i>			
239.	<i>Megachile sp.</i>			
240.	<i>Megachile speluncarum</i>			
241.	<i>Melobasis sp.</i>			
242.	<i>Mesocyclops brooksi</i>			
243.	<i>Mesostigmata sp.</i>			
244.	<i>Metaballus frontalis</i>			
245.	<i>Metaballus litus</i>			

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246.	<i>Metaballus mucronatus</i>			
247.	<i>Metacyclops</i> sp. 434 (<i>arnaudi sensu Sars</i>)			
248.	<i>Metacyclops</i> sp. 434 (<i>arnaudi sensu Sars</i>) (CB)			
249.	<i>Missulena hoggi</i>			
250.	<i>Monohelea</i> sp. 3			
251.	<i>Monohelea</i> sp. 3 (SAP)			
252.	<i>Myrmecia elegans</i>			
253.	<i>Myrmecia gratiosa</i>			
254.	<i>Naididae</i> (ex <i>Tubificidae</i>)			
255.	<i>Necterosoma darwini</i>			
256.	<i>Necterosoma penicillatus</i>			
257.	<i>Neotemnopteryx douglasi</i>			
258.	<i>Onthophagus ferox</i>			
259.	<i>Onthophagus rupicapra</i>			
260.	<i>Opisthopsis</i> sp.			
261.	<i>Oribatida</i> sp.			
262.	<i>Orthetrum caledonicum</i>			
263.	<i>Orthocladinae</i> SO3 sp. A (SAP)			
264.	<i>Paracyclops chiltoni</i>			
265.	<i>Paramerina levidensis</i>			
266.	<i>Paranacaena littoralis</i>			
267.	<i>Parastenocarididae</i> sp.			
268.	<i>Parentia</i> sp.			
269.	<i>Phasmodes ranatriliformis</i>			
270.	<i>Philosciidae</i> sp.			
271.	<i>Pinkfloydia harveii</i>			
272.	<i>Platynectes aenescens</i>			
273.	<i>Platynectes decempunctatus</i> var. <i>polygrammus</i>			
274.	<i>Platynectes decempunctatus</i> var. <i>polygrammus</i>			
275.	<i>Procladius paludicola</i>			
276.	<i>Protocheilifer cavernarum</i>			
277.	<i>Psacadonotus diurnus</i>			
278.	<i>Radopholus</i> sp.			
279.	<i>Raveniella cirrata</i>			
280.	<i>Rhantus suturalis</i>			
281.	S03 S03 sp. A			
282.	<i>Sarscypridopsis aculeata</i>			
283.	<i>Sauertylenchus</i> sp.			
284.	<i>Scirtidae</i> sp.			
285.	<i>Simulium ornatipes</i>			
286.	<i>Stigmodera roei</i>			
287.	33992 <i>Synemon gratiosa</i> (<i>Graceful Sunmoth</i>)		P4	
288.	<i>Synemon</i> sp.			
289.	<i>Syrphidae</i> sp.			
290.	<i>Tamopsis circumvidens</i>			
291.	<i>Tanytarsus fuscithorax/semibarbitarsus</i>			
292.	<i>Tasmanicosa leuckartii</i>			
293.	<i>Temognatha reichei</i>			
294.	<i>Temognatha</i> sp.			
295.	<i>Thereuopoda lesueurii</i>			
296.	<i>Thienemanniella</i> sp. (V19)			
297.	<i>Thienemanniella</i> sp. (V19) (SAP)			
298.	<i>Tipulidae</i> type I (SAP)			
299.	<i>Tripyla</i> sp.			
300.	<i>Trombidioidea</i> sp.			
301.	<i>Tumulitermes westraliensis</i>			
302.	<i>Tylenchorhynchus</i> sp.			
303.	<i>Tylodorus</i> sp.			Y
304.	<i>Venator immansueta</i>			
305.	<i>Venator koyuga</i>			
306.	<i>Xanthagrion erythroneurum</i>			

Mammal

307.	24186	<i>Chalinolobus gouldii</i> (<i>Gould's Wattled Bat</i>)		
308.	24187	<i>Chalinolobus morio</i> (<i>Chocolate Wattled Bat</i>)		
309.	24041	<i>Felis catus</i> (<i>Cat</i>)	Y	
310.	25478	<i>Isodon obesulus</i> (<i>Southern Brown Bandicoot</i>)		P5
311.	24180	<i>Macroderma gigas</i> (<i>Ghost Bat</i>)		P4
312.	24132	<i>Macropus fuliginosus</i> (<i>Western Grey Kangaroo</i>)		
313.	24133	<i>Macropus irma</i> (<i>Western Brush Wallaby</i>)		P4
314.	24223	<i>Mus musculus</i> (<i>House Mouse</i>)		

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		Y		
315.	24230 <i>Pseudomys albocinereus</i> (Ash-grey Mouse)			
316.	24173 <i>Pteropus scapulatus</i> (Little Red Flying-fox)			
317.	24243 <i>Rattus fuscipes</i> (Western Bush Rat)			
318.	24108 <i>Sminthopsis crassicaudata</i> (Fat-tailed Dunnart)			
319.	24112 <i>Sminthopsis granulipes</i> (White-tailed Dunnart)			
320.	25515 <i>Sminthopsis griseoventer</i> (Grey-bellied Dunnart)			
321.	24167 <i>Tarsipes rostratus</i> (Honey Possum, Noolbenger)			
322.	24206 <i>Vespadelus regulus</i> (Southern Forest Bat)			
323.	24040 <i>Vulpes vulpes</i> (Red Fox)	Y		
Reptile				
324.	25241 <i>Antaresia stimsoni</i> subsp. <i>stimsoni</i> (Stimson's Python)			
325.	24980 <i>Christinus marmoratus</i> (Marbled Gecko)			
326.	24918 <i>Crenadactylus ocellatus</i> subsp. <i>ocellatus</i> (Clawless Gecko)			
327.	30893 <i>Cryptoblepharus buchananii</i>			
328.	30899 <i>Ctenophorus adelaidensis</i> (Southern Heath Dragon, Western Heath Dragon)			
329.	25460 <i>Ctenophorus maculatus</i> (Spotted Military Dragon)			
330.	24881 <i>Ctenophorus maculatus</i> subsp. <i>maculatus</i> (Spotted Military Dragon)			
331.	25027 <i>Ctenotus australis</i>			
332.	25039 <i>Ctenotus fallens</i>			
333.	25047 <i>Ctenotus impar</i>			
334.	25065 <i>Ctenotus pantherinus</i> subsp. <i>pantherinus</i> (Leopard Ctenotus)			
335.	25086 <i>Cyclodomorphus branchialis</i> (Gilled Slender Blue-tongue Skink)		T	
336.	25087 <i>Cyclodomorphus celatus</i> (Western Slender Blue-tongue)			
337.	30905 <i>Delma concinna</i> subsp. <i>concinna</i> (Javelin Legless Lizard)			
338.	25766 <i>Delma fraseri</i> (Fraser's Legless Lizard)			
339.	24999 <i>Delma grayii</i>			
340.	25296 <i>Demansia psammophis</i> subsp. <i>reticulata</i> (Yellow-faced Whipsnake)			
341.	24938 <i>Diplodactylus ornatus</i>			
342.	24939 <i>Diplodactylus polyophthalmus</i>			
343.	<i>Diplodactylus</i> sp.			
344.	25251 <i>Echiopsis curta</i> (Bardick)			
345.	25100 <i>Egernia napoleonis</i>			
346.	25107 <i>Egernia stokesii</i> subsp. <i>badia</i> (Western Spiny-tailed Skink (interior WA & Shark Bay), Gidgee Skink)		T	
347.	24959 <i>Gehyra variegata</i>			
348.	25131 <i>Lerista distinguenda</i>			
349.	25133 <i>Lerista elegans</i>			
350.	25148 <i>Lerista lineopunctulata</i>			
351.	25160 <i>Lerista planiventralis</i> subsp. <i>decora</i>			
352.	25165 <i>Lerista praepedita</i>			
353.	25005 <i>Lialis burtonis</i>			
354.	41413 <i>Liopholis multiscutata</i> (Bull Skink)			
355.	42414 <i>Lucasium alboguttatum</i>			
356.	25184 <i>Menetia greyii</i>			
357.	25191 <i>Morethia lineocellata</i>			
358.	25192 <i>Morethia obscura</i>			
359.	<i>Morethia</i> sp.			
360.	25248 <i>Neelaps bimaculatus</i> (Black-naped Snake)			
361.	25253 <i>Parasuta gouldii</i>			
362.	25007 <i>Pletholax gracilis</i> subsp. <i>gracilis</i> (Keeled Legless Lizard)			
363.	24907 <i>Pogona minor</i> subsp. <i>minor</i> (Dwarf Bearded Dragon)			
364.	25261 <i>Pseudechis australis</i> (Mulga Snake)			
365.	42416 <i>Pseudonaja mengdeni</i> (Western Brown Snake)			
366.	25008 <i>Pygopus lepidopodus</i> (Common Scaly Foot)			
367.	25267 <i>Simoselaps littoralis</i> (West Coast Banded Snake)			
368.	24942 <i>Strophurus spinigerus</i> subsp. <i>spinigerus</i>			
369.	25203 <i>Tiliqua occipitalis</i> (Western Bluetongue)			
370.	25207 <i>Tiliqua rugosa</i> subsp. <i>rugosa</i>			
371.	24983 <i>Underwoodisaurus milii</i> (Barking Gecko)			
372.	25218 <i>Varanus gouldii</i> (Bungarra or Sand Monitor)			
373.	25526 <i>Varanus tristis</i> (Racehorse Monitor)			

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

Name ID Species Name

Naturalised

Conservation Code

¹Endemic To Query
Area

¹ For NatureMap's purposes, species flagged as endemic are those whose records are wholly contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

Appendix D – Flora Data

Flora species list

Flora Likelihood of Occurrence assessment guidelines

Flora Likelihood of Occurrence assessment

Quadrat data

TPFL Forms

Flora species list for survey area

Family	Taxon	Status
Amaranthaceae	<i>Ptilotus polystachyus</i>	
Anarthriaceae	Anarthriaceae sp.	
Anarthriaceae	<i>Lyginia barbata</i>	
Anarthriaceae	<i>Lyginia imberbis</i>	
Anarthriaceae	<i>Lyginia</i> sp.	
Apiaceae	Apiaceae sp.	
Apiaceae	? <i>Centella asiatica</i>	
Apiaceae	<i>Daucus glochidiatus</i>	
Araliaceae	<i>Hydrocotyle</i> ? <i>alata</i>	
Araliaceae	? <i>Hydrocotyle alata</i>	
Araliaceae	<i>Trachymene pilosa</i>	
Asparagaceae	<i>Chamaescilla corymbosa</i>	
Asparagaceae	? <i>Chamaescilla corymbosa</i>	
Asparagaceae	<i>Laxmannia sessiliflora</i>	
Asparagaceae	<i>Lomandra hastilis</i>	
Asparagaceae	<i>Lomandra sericea</i>	
Asparagaceae	<i>Lomandra</i> sp.	
Asparagaceae	<i>Sowerbaea laxiflora</i>	
Asparagaceae	<i>Thysanotus</i> ? <i>patersonii</i>	
Asparagaceae	<i>Thysanotus</i> sp.	
Asteraceae	<i>Arctotheca calendula</i>	*
Asteraceae	? <i>Craspedia</i> sp.	
Asteraceae	<i>Hypochaeris glabra</i>	*
Asteraceae	<i>Lagenophora huegelii</i>	
Asteraceae	<i>Olearia</i> sp.	
Asteraceae	<i>Olearia</i> sp. Kennedy Range (G. Byrne 66)	
Asteraceae	<i>Podolepis</i> ? <i>lessonii</i>	
Asteraceae	<i>Quinetia urvillei</i>	
Asteraceae	<i>Senecio</i> sp.	
Asteraceae	? <i>Senecio</i> sp.	
Asteraceae	? <i>Siloxerus</i> sp.	
Asteraceae	<i>Sonchus oleraceus</i>	*
Asteraceae	<i>Ursinia anthemoides</i>	*
Boryaceae	<i>Borya sphaerocephala</i>	
Brassicaceae	<i>Brassica tournefortii</i>	*
Brassicaceae	<i>Raphanus raphanistrum</i>	*
Casuarinaceae	<i>Allocasuarina fraseriana</i>	
Casuarinaceae	<i>Allocasuarina humilis</i>	
Casuarinaceae	<i>Allocasuarina microstachya</i>	
Celastraceae	<i>Stackhousia monogyna</i>	
Celastraceae	<i>Stackhousia</i> sp.	
Celastraceae	<i>Tripterococcus brunonis</i>	

Family	Taxon	Status
Colchicaceae	<i>Burchardia</i> sp.	
Colchicaceae	<i>Wurmbea</i> sp.	
Cupressaceae	<i>Callitris</i> ? <i>acuminata</i>	
Cyperaceae	<i>Caustis dioica</i>	
Cyperaceae	<i>Ficinia nodosa</i>	
Cyperaceae	<i>Lepidosperma gladiatum</i>	
Cyperaceae	<i>Lepidosperma</i> ? <i>squamatum</i>	
Cyperaceae	<i>Lepidosperma</i> sp.	
Cyperaceae	<i>Mesomelaena pseudostygia</i>	
Cyperaceae	<i>Mesomelaena tetragona</i>	
Cyperaceae	<i>Schoenus</i> ? <i>brevisetis</i>	
Cyperaceae	<i>Schoenus</i> ? <i>clandestinus</i>	
Cyperaceae	<i>Schoenus</i> ? <i>nanus/latitans</i>	
Cyperaceae	<i>Schoenus</i> sp.	
Cyperaceae	<i>Schoenus subflavus</i>	
Cyperaceae	<i>Tetraria octandra</i>	
Dasygogonaceae	<i>Calectasia narragara</i>	
Dasygogonaceae	<i>Dasygogon bromeliifolius</i>	
Dasygogonaceae	<i>Dasygogon obliquifolius</i>	
Dasygogonaceae	<i>Kingia australis</i>	
Dilleniaceae	<i>Hibbertia acerosa</i>	
Dilleniaceae	<i>Hibbertia hypericoides</i>	
Dilleniaceae	<i>Hibbertia hypericoides</i> subsp. <i>septentrionalis</i>	
Dilleniaceae	<i>Hibbertia</i> sp.	
Dilleniaceae	<i>Hibbertia subvaginata</i>	
Droseraceae	<i>Drosera erythrorhiza</i> subsp. <i>erythrorhiza</i>	
Droseraceae	<i>Drosera</i> ? <i>glanduligera</i>	
Droseraceae	<i>Drosera</i> ? <i>macrantha</i>	
Droseraceae	<i>Drosera</i> ? <i>menziesii</i>	
Droseraceae	<i>Drosera porrecta</i>	
Droseraceae	<i>Drosera</i> sp.	
Ecdeiocoleaceae	<i>Ecdeiocolea monostachya</i>	
Elaeocarpaceae	<i>Tetratheca paucifolia</i>	
Ericaceae	<i>Andersonia lehmanniana</i> subsp. <i>lehmanniana</i>	
Ericaceae	<i>Astroloma</i> ? <i>serratifolium</i>	
Ericaceae	<i>Astroloma</i> sp.	
Ericaceae	<i>Astroloma xerophyllum</i>	
Ericaceae	<i>Conostephium pendulum</i>	
Ericaceae	<i>Conostephium preissii</i>	
Ericaceae	Ericaceae sp.	
Ericaceae	<i>Leucopogon</i> ? <i>oldfieldii</i>	
Ericaceae	<i>Leucopogon polymorphus</i>	
Ericaceae	<i>Leucopogon</i> sp.	
Ericaceae	<i>Lysinema ciliatum</i>	

Family	Taxon	Status
Ericaceae	<i>Lysinema pentapetalum</i>	
Fabaceae	<i>Acacia ?alata</i> var. <i>tetrantha</i>	
Fabaceae	<i>Acacia ?ericifolia</i>	
Fabaceae	<i>Acacia auronitens</i>	
Fabaceae	<i>Acacia cochlearis</i>	
Fabaceae	<i>Acacia dilatata</i>	
Fabaceae	<i>Acacia incrassata</i>	
Fabaceae	<i>Acacia lasiocarpa</i> var. <i>lasiocarpa</i>	
Fabaceae	<i>Acacia moirii</i> subsp. <i>recurvistipula</i>	
Fabaceae	<i>Acacia pulchella</i>	
Fabaceae	<i>Acacia retrorsa</i>	P2
Fabaceae	<i>Acacia saligna</i>	
Fabaceae	<i>Acacia stenoptera</i>	
Fabaceae	<i>Bossiaea eriocarpa</i>	
Fabaceae	? <i>Bossiaea eriocarpa</i>	
Fabaceae	<i>Chorizema cordatum</i>	
Fabaceae	<i>Daviesia decurrens</i>	
Fabaceae	<i>Daviesia divaricata</i>	
Fabaceae	<i>Daviesia nudiflora</i>	
Fabaceae	<i>Daviesia pedunculata</i>	
Fabaceae	<i>Daviesia physodes</i>	
Fabaceae	<i>Daviesia podophylla</i>	
Fabaceae	<i>Daviesia preissii</i>	
Fabaceae	<i>Gastrolobium capitatum</i>	
Fabaceae	<i>Gastrolobium plicatum</i>	
Fabaceae	<i>Gastrolobium polystachyum</i>	
Fabaceae	<i>Gastrolobium</i> sp.	
Fabaceae	<i>Gastrolobium spinosum</i>	
Fabaceae	<i>Gompholobium knightianum</i>	
Fabaceae	<i>Gompholobium marginatum</i>	
Fabaceae	<i>Gompholobium preissii</i>	
Fabaceae	<i>Gompholobium tomentosum</i>	
Fabaceae	<i>Hovea</i> sp.	
Fabaceae	<i>Hovea stricta</i>	
Fabaceae	<i>Isotropis ?cuneifolia</i>	
Fabaceae	? <i>Isotropis</i> sp.	
Fabaceae	<i>Isotropis</i> sp.	
Fabaceae	<i>Jacksonia floribunda</i>	
Fabaceae	<i>Jacksonia hakeoides</i>	
Fabaceae	<i>Jacksonia sternbergiana</i>	
Fabaceae	<i>Kennedia prostrata</i>	
Fabaceae	<i>Mirbelia floribunda</i>	
Fabaceae	<i>Sphaerolobium drummondii</i>	
Fabaceae	<i>Sphaerolobium macranthum</i>	

Family	Taxon	Status
Fabaceae	<i>Sphaerolobium medium</i>	
Fabaceae	? <i>Sphaerolobium</i> sp.	
Geraniaceae	<i>Pelargonium capitatum</i>	*
Goodeniaceae	<i>Dampiera</i> sp.	
Goodeniaceae	<i>Dampiera spicigera</i>	
Goodeniaceae	<i>Lechenaultia biloba</i>	
Goodeniaceae	<i>Lechenaultia floribunda</i>	
Goodeniaceae	<i>Scaevola canescens</i>	
Goodeniaceae	<i>Scaevola</i> sp.	
Goodeniaceae	? <i>Scaevola</i> sp.	
Goodeniaceae	<i>Verreauxia ?reinwardtii</i>	
Haemodoraceae	<i>Anigozanthos ?manglesii</i>	
Haemodoraceae	<i>Anigozanthos humilis</i>	
Haemodoraceae	<i>Anigozanthos</i> sp.	
Haemodoraceae	<i>Blancoa canescens</i>	
Haemodoraceae	<i>Conostylis aculeata</i> subsp. <i>rhpidion</i>	
Haemodoraceae	<i>Conostylis androstemma</i>	
Haemodoraceae	<i>Conostylis aurea</i>	
Haemodoraceae	<i>Conostylis ?crassinervia</i>	
Haemodoraceae	<i>Conostylis crassinervia</i> ?subsp. <i>crassinervia</i>	
Haemodoraceae	<i>Conostylis setigera</i>	
Haemodoraceae	<i>Conostylis ?hiemalis</i>	
Haemodoraceae	<i>Conostylis</i> sp.	
Haemodoraceae	<i>Conostylis ?teretiuscula</i>	
Haemodoraceae	<i>Haemodorum</i> sp.	
Haemodoraceae	<i>Haemodorum spicatum</i>	
Haemodoraceae	<i>Haemodorum ?venosum</i>	
Haemodoraceae	<i>Macropidia fuliginosa</i>	
Haemodoraceae	<i>Tribonanthes ?australis</i>	
Haloragaceae	? <i>Glischrocaryon aureum</i>	
Haloragaceae	<i>Glischrocaryon</i> sp.	
Hemerocallidaceae	<i>Arnocrinum preissii</i>	
Hemerocallidaceae	<i>Corynotheca micrantha</i> var. <i>micrantha</i>	
Hemerocallidaceae	<i>Dianella revoluta</i>	
Hemerocallidaceae	Hemerocallidaceae sp.	
Hemerocallidaceae	<i>Hensmania stoniella</i>	P3
Hemerocallidaceae	<i>Johnsonia pubescens</i> subsp. <i>pubescens</i>	
Hemerocallidaceae	<i>Tricoryne elatior</i>	
Iridaceae	<i>Orthrosanthus laxus</i>	
Iridaceae	<i>Patersonia occidentalis</i>	
Iridaceae	<i>Romulea rosea</i>	*
Juncaginaceae	? <i>Triglochin striata</i>	
Lamiaceae	<i>Hemiandra</i> sp.	
Lamiaceae	<i>Hemiandra</i> sp. Jurien (B.J. Conn & M.E. Tozer BJC 3885)	

Family	Taxon	Status
Lamiaceae	<i>Hemigenia diplanthera</i>	
Lamiaceae	<i>Hemigenia incana</i>	
Lamiaceae	<i>Hemiphora bartlingii</i>	
Lamiaceae	<i>Lachnostachys albicans</i>	
Lauraceae	<i>Cassytha</i> sp.	
Loranthaceae	<i>Amyema miquelii</i>	
Loranthaceae	<i>Nuytsia floribunda</i>	
Lythraceae	Lythraceae sp.	
Malvaceae	<i>Lasiopetalum floribundum</i>	
Malvaceae	<i>Malva parviflora</i>	*
Malvaceae	<i>Thomasia</i> ? <i>grandiflora</i>	
Myrtaceae	? <i>Baeckea</i> sp.	
Myrtaceae	<i>Baeckea</i> sp.	
Myrtaceae	<i>Calothamnus quadrifidus</i>	
Myrtaceae	<i>Calothamnus sanguineus</i>	
Myrtaceae	<i>Calothamnus torulosus</i>	
Myrtaceae	<i>Calytrix</i> sp.	
Myrtaceae	? <i>Calytrix</i> sp.	
Myrtaceae	<i>Conothamnus trinervis</i>	
Myrtaceae	<i>Corymbia calophylla</i>	
Myrtaceae	<i>Darwinia neildiana</i>	
Myrtaceae	<i>Darwinia sanguinea</i>	
Myrtaceae	<i>Eremaea asterocarpa</i>	
Myrtaceae	<i>Eremaea beaufortioides</i>	
Myrtaceae	<i>Eremaea</i> sp.	
Myrtaceae	<i>Eucalyptus drummondii</i>	
Myrtaceae	<i>Eucalyptus gittinsii</i> subsp. <i>illucida</i>	
Myrtaceae	<i>Eucalyptus marginata</i>	
Myrtaceae	<i>Eucalyptus rudis</i>	
Myrtaceae	<i>Eucalyptus todtiana</i>	
Myrtaceae	<i>Eucalyptus wandoo</i> subsp. <i>pulverea</i>	
Myrtaceae	<i>Hypocalymma angustifolium</i>	
Myrtaceae	<i>Hypocalymma xanthopetalum</i>	
Myrtaceae	<i>Leptospermum erubescens</i>	
Myrtaceae	<i>Leptospermum laevigatum</i>	*
Myrtaceae	<i>Leptospermum spinescens</i>	
Myrtaceae	<i>Melaleuca</i> ? <i>concreta</i>	
Myrtaceae	<i>Melaleuca</i> ? <i>delta</i>	
Myrtaceae	<i>Melaleuca</i> ? <i>longistaminea</i>	
Myrtaceae	<i>Melaleuca platycalyx</i>	
Myrtaceae	<i>Melaleuca preissiana</i>	
Myrtaceae	<i>Melaleuca raphiophylla</i>	
Myrtaceae	<i>Melaleuca</i> sp.	
Myrtaceae	<i>Melaleuca</i> ? <i>tinkeri</i>	

Family	Taxon	Status
Myrtaceae	<i>Melaleuca ?trichophylla</i>	
Myrtaceae	<i>Melaleuca viminea</i>	
Myrtaceae	<i>Scholtzia</i> sp.	
Myrtaceae	? <i>Scholtzia</i> sp.	
Myrtaceae	<i>Verticordia grandis</i>	
Myrtaceae	<i>Verticordia</i> sp.	
Orchidaceae	? <i>Leporella fimbriata</i>	
Orchidaceae	<i>Caladenia ?exilis</i>	
Orchidaceae	<i>Caladenia flava</i>	
Orchidaceae	<i>Caladenia longicauda</i> subsp. <i>borealis</i>	
Orchidaceae	<i>Caladenia lorea</i>	
Orchidaceae	<i>Caladenia</i> sp.	
Orchidaceae	<i>Leporella fimbriata</i>	
Orchidaceae	Orchidaceae sp.	
Orchidaceae	<i>Pheladenia deformis</i>	
Orchidaceae	? <i>Pheladenia deformis</i>	
Orchidaceae	<i>Prasophyllum parvifolium</i>	
Orchidaceae	<i>Pterostylis sanguinea</i>	
Orchidaceae	<i>Thelymitra variegata</i>	P2
Oxalidaceae	<i>Oxalis</i> sp.	*
Poaceae	<i>Neurachne alopecuroidea</i>	
Poaceae	Poaceae sp.	*
Poaceae	<i>Rytidosperma</i> sp.	
Polygalaceae	? <i>Comesperma</i> sp.	
Polygalaceae	<i>Comesperma ?acerosum</i>	
Polygalaceae	<i>Comesperma scoparium</i>	
Polygalaceae	<i>Comesperma</i> sp.	
Polygonaceae	<i>Muehlenbeckia adpressa</i>	
Primulaceae	<i>Lysimachia arvensis</i>	*
Proteaceae	<i>Adenanthos cygnorum</i> subsp. <i>cygnorum</i>	
Proteaceae	<i>Banksia armata</i>	
Proteaceae	<i>Banksia attenuata</i>	
Proteaceae	<i>Banksia bipinnatifida</i> subsp. <i>multifida</i>	
Proteaceae	<i>Banksia candolleana</i>	
Proteaceae	<i>Banksia dallanneyi</i> subsp. <i>media</i>	
Proteaceae	<i>Banksia ?dallanneyi</i> subsp. <i>media</i>	
Proteaceae	<i>Banksia grandis</i>	
Proteaceae	<i>Banksia grossa</i>	
Proteaceae	<i>Banksia ?leptophylla</i> var. <i>melletica</i>	
Proteaceae	<i>Banksia littoralis</i>	
Proteaceae	<i>Banksia menziesii</i>	
Proteaceae	<i>Banksia micrantha</i>	
Proteaceae	<i>Banksia prionotes</i>	
Proteaceae	<i>Banksia ?sclerophylla</i>	

Family	Taxon	Status
Proteaceae	<i>Banksia sessilis</i> var. <i>cygnorum</i>	
Proteaceae	<i>Banksia shuttleworthiana</i>	
Proteaceae	<i>Conospermum ?nervosum</i>	
Proteaceae	<i>Conospermum</i> sp.	
Proteaceae	<i>Conospermum triplinervium</i>	
Proteaceae	<i>Grevillea delta</i>	P2
Proteaceae	<i>Grevillea synapheae</i> subsp. <i>pachyphylla</i>	
Proteaceae	<i>Hakea anadenia</i>	
Proteaceae	<i>Hakea auriculata</i>	
Proteaceae	<i>Hakea conchifolia</i>	
Proteaceae	<i>Hakea costata</i>	
Proteaceae	<i>Hakea eneabba</i>	
Proteaceae	<i>Hakea erinacea</i>	
Proteaceae	<i>Hakea flabellifolia</i>	
Proteaceae	<i>Hakea incrassata</i>	
Proteaceae	<i>Hakea lissocarpha</i>	
Proteaceae	<i>Hakea megalosperma</i>	T
Proteaceae	<i>Hakea neospathulata</i>	
Proteaceae	<i>Hakea neurophylla</i>	P4
Proteaceae	<i>Hakea obliqua</i>	
Proteaceae	<i>Hakea prostrata</i>	
Proteaceae	<i>Hakea ruscifolia</i>	
Proteaceae	<i>Hakea smilacifolia</i>	
Proteaceae	<i>Hakea stenocarpa</i>	
Proteaceae	<i>Hakea trifurcata</i>	
Proteaceae	<i>Hakea varia</i>	
Proteaceae	<i>Isopogon asper</i>	
Proteaceae	<i>Isopogon drummondii</i>	
Proteaceae	<i>Isopogon dubius</i>	
Proteaceae	<i>Isopogon inconspicuus</i>	
Proteaceae	<i>Isopogon</i> sp.	
Proteaceae	<i>Lambertia multiflora</i>	
Proteaceae	<i>Petrophile ?brevifolia</i>	
Proteaceae	<i>Petrophile chrysantha</i>	
Proteaceae	<i>Petrophile ?drummondii</i>	
Proteaceae	<i>Petrophile linearis</i>	
Proteaceae	<i>Petrophile macrostachya</i>	
Proteaceae	<i>Petrophile seminuda</i>	
Proteaceae	<i>Petrophile shuttleworthiana</i>	
Proteaceae	<i>Stirlingia latifolia</i>	
Proteaceae	<i>Strangea cynanchicarpa</i>	
Proteaceae	<i>Synaphea aephynsa</i>	
Proteaceae	<i>Synaphea</i> sp.	
Proteaceae	<i>Synaphea spinulosa</i>	

Family	Taxon	Status
Pteridaceae	<i>Cheilanthes austrotenuifolia</i>	
Restionaceae	<i>Alexgeorgea subterranea</i>	
Restionaceae	<i>Desmocladus ?lateriticus</i>	
Restionaceae	<i>Lepidobolus quadratus</i>	P3
Restionaceae	<i>Lepidobolus</i> sp.	
Restionaceae	? <i>Lepidobolus</i> sp.	
Restionaceae	? <i>Leptocarpus</i> sp.	
Restionaceae	Restionaceae sp.	
Rhamnaceae	<i>Cryptandra myriantha</i>	
Rhamnaceae	<i>Cryptandra pungens</i>	
Rhamnaceae	<i>Cryptandra spyridioides</i>	
Rhamnaceae	<i>Stenanthemum humile</i>	
Rhamnaceae	<i>Trymalium odoratissimum</i>	
Rubiaceae	<i>Opercularia vaginata</i>	
Rutaceae	<i>Boronia cymosa</i>	
Rutaceae	<i>Boronia ramosa</i>	
Rutaceae	<i>Boronia ramosa</i> subsp. <i>anethifolia</i>	
Rutaceae	<i>Diplolaena ferruginea</i>	
Rutaceae	<i>Diplolaena</i> sp.	
Rutaceae	<i>Philotheca spicata</i>	
Rutaceae	Rutaceae sp.	
Santalaceae	<i>Leptomeria empetriformis</i>	
Santalaceae	<i>Santalum acuminatum</i>	
Stylidiaceae	<i>Levenhookia</i> sp.	
Stylidiaceae	<i>Stylidium ?hymenocraspedum</i>	P3
Stylidiaceae	<i>Stylidium ?piliferum</i>	
Stylidiaceae	<i>Stylidium ?repens</i>	
Stylidiaceae	<i>Stylidium ?torticarum</i>	P3
Stylidiaceae	<i>Stylidium</i> sp.	
Thymelaeaceae	<i>Pimelea ?angustifolia</i>	
Thymelaeaceae	<i>Pimelea argentea</i>	
Thymelaeaceae	<i>Pimelea floribunda</i>	
Thymelaeaceae	<i>Pimelea</i> sp.	
Xanthorrhoeaceae	<i>Xanthorrhoea drummondii</i>	
Xanthorrhoeaceae	<i>Xanthorrhoea preissii</i>	
Xanthorrhoeaceae	<i>Xanthorrhoea</i> sp.	
Zamiaceae	<i>Macrozamia fraseri</i>	

Refer to Appendix A for conservation codes; * denotes introduced species

Flora Likelihood of Occurrence assessment guidelines

Likelihood of Occurrence	Guideline
Known	Species recorded within study area from field survey results.
Likely	Species previously recorded within 10 km and large areas of suitable habitat occur in the study area.
Possible	Species previously recorded within 10 km and areas of suitable habitat occur/may occur in the study area.
Unlikely	Species previously recorded within 10 km, but suitable habitat does not occur in the study area.
Highly unlikely	Species not previously recorded within 10 km, suitable habitat does not occur in the study area and/or the study area is outside the natural distribution of the species.
Other considerations	Intensity of survey, availability of access, growth form type, recorded flowering times, cryptic nature of species

Definitions

Study area = a 20 km buffer around the survey area

Source information - desktop searches

PMST – DotE Protected Matters Search Tool (PMST) to identify flora listed under the EPBC Act potentially occurring within the study area (accessed July 2016)

DPaW – DPaW (2007-2016) records of threatened flora, database search within the study area (accessed July 2016)

NM – DPaW NatureMap (accessed July 2016)

Survey – recorded within the survey area during the 2016 assessment

References

Davis, RW, Hammer, T and Thiele, KR 2014, Two new and rare species of *Ptilotus* (Amaranthaceae) from the Eneabba sandplains, Western Australia, *Nuytsia* 24: 123–129.

Thompson, IR 2010, A revision of *Cristonia* (Fabaceae: Brongniartieae), *Muelleria* 28(1): 66-73.

Flora Likelihood of Occurrence assessment

Family	Taxon	Status		Description	Habitat	Flowering	Likelihood of Occurrence	Source
		EPBC Act	WC Act /DPaW					
Amaranthaceae	<i>Ptilotus clivicola</i>	-	P2	Prostrate to ascending perennial herb to 0.1 m high with reddish purple flowers (Davis <i>et al.</i> 2014).	Kwongan heath on gently sloping gravelly rises with a shallow covering of coarse sand.	Late October and early November.	Possible – suitable habitat present within survey area.	NM
Amaranthaceae	<i>Ptilotus falcatus</i>	-	P1	Prostrate to ascending perennial herb to 0.1 m high with greenish brown flowers becoming white on the apex (Davis <i>et al.</i> 2014).	North-east facing slope in low heath on gravelly, grey to light brown, sandy loam soils.	Mid to late October.	Possible – suitable habitat present within survey area.	DPaW
Anarthriaceae	<i>Lyginia excelsa</i>	-	P1	Dioecious rhizomatous, erect, tufted herb, 0.6-1.5 m high with rhizomes on surface.	Sand with dry heath and <i>Banksia</i> woodland.	March to November.	Possible – suitable habitat present within survey area.	NM
Apiaceae	<i>Platysace ramosissima</i>	-	P3	Perennial herb to 0.3 m high with white-cream flowers.	Sandy soils.	October to November.	Possible – suitable habitat present within survey area.	NM
Apiaceae	<i>Xanthosia tomentosa</i>	-	P4	Prostrate to ascending perennial herb, 0.2-0.5 m high to 2 m wide with white-cream-pink flowers.	Lateritic gravelly soils.	September to December.	Possible – suitable habitat present within survey area.	NM
Asparagaceae	<i>Thysanotus anceps</i>	-	P3	Rhizomatous, leafless perennial herb to 0.4 m high with purple flowers.	White or grey sand, lateritic gravel or laterite.	October to December.	Possible – suitable habitat present within survey area.	NM DPaW

Family	Taxon	Status		Description	Habitat	Flowering	Likelihood of Occurrence	Source
		EPBC Act	WC Act /DPaW					
Asparagaceae	<i>Thysanotus glaucus</i>	-	P4	Caespitose, glaucose perennial herb, 0.1-0.2 m high with purple flowers.	White, grey or yellow sand, sandy gravel.	October to December or January to March.	Possible – suitable habitat present within survey area.	NM DPaW
Asparagaceae	<i>Thysanotus</i> sp. Badgingarra (E.A. Griffin 2511)	-	P2	Perennial herb to 0.35 m high with blue flowers.	Grey sand with lateritic gravel.	December.	Possible – suitable habitat present within survey area.	NM DPaW
Asparagaceae	<i>Thysanotus vernalis</i>	-	P3	Perennial herb to 0.3 m high with purple flowers.	Sandy loam.	September to October.	Possible – suitable habitat present within survey area.	NM DPaW
Asteraceae	<i>Rhadinocarpus suffruticosa</i>	-	P1	Woody perennial herb to 0.8 m high with white-cream flowers.	Red-brown loamy clay, gravelly loam or clay loam over laterite. Slopes and small ridges.	November to December	Unlikely – limited habitat present within the survey area.	DPaW
Brassicaceae	<i>Lepidium pseudotasmanicum</i>	-	P4	Erect annual or biennial herb, 0.2-0.4 m high with white-green flowers.	Loam or sand.	February or December.	Possible – suitable habitat present within survey area.	NM
Byblidaceae	<i>Byblis gigantea</i>	-	P3	Small, branched perennial herb to 0.45 m high with pink-purple/white flowers.	Sandy-peat swamps. Seasonally wet areas	September to December or January.	Highly Unlikely – No sandy peat swamps recorded within the survey area.	NM
Casuarinaceae	<i>Allocasuarina grevilleoides</i>	-	P3	Dioecious, lignotuberous shrubs, 0.15-0.4 m high.	Sand over laterite, gravel.	No information available.	Possible – suitable habitat present within survey area.	NM
Casuarinaceae	<i>Allocasuarina ramosissima</i>	-	P3	Dioecious, somewhat divaricate shrub, 0.3-1.2 m high.	Lateritic soils, gravel.	No information available.	Possible – suitable habitat present within survey area.	NM DPaW
Celastraceae	<i>Stackhousia</i> sp. Red-blotched corolla (A. Markey 911)	-	P3	Perennial, erect herb with yellow flowers.	Sandy clay.	No information available.	Possible – suitable habitat present within survey area.	NM DPaW

Family	Taxon	Status		Description	Habitat	Flowering	Likelihood of Occurrence	Source
		EPBC Act	WC Act /DPaW					
Centrolepidaceae	<i>Centrolepis milleri</i>	-	P3	Annual herb to 0.06 m tall.	White sand or grey-brown sandy clay.	No information available.	Possible – suitable habitat present within survey area.	NM
Cyperaceae	<i>Caustis gigas</i>	-	P2	Rhizomatous, robust perennial sedge to 2 m high.	White or grey sand.	May.	Possible – suitable habitat present within survey area.	NM
Cyperaceae	<i>Eleocharis keigheryi</i>	VU	VU	Rhizomatous, clumped perennial sedge to 0.4 m high with green flowers.	Clay, sandy loam. Emergent in freshwater creeks or claypans.	August to November.	Unlikely – minimal suitable habitat present within the survey area.	NM PMST DPaW
Dasypogonaceae	<i>Calectasia browneana</i>	-	P2	Spreading, caespitose perennial herb, 0.2-0.5 m high to 0.4 m wide with blue-purple flowers.	White-grey sand, laterite. Adjacent to wet areas of creek line.	June to August.	Possible – suitable habitat present within survey area.	NM DPaW
Dasypogonaceae	<i>Calectasia cyanea</i>	CR	CR	Rhizomatous, clump forming, woody perennial herb, 0.1-0.6 m high to 0.3 m high with blue/purple flowers.	White, grey or yellow sand, gravel.	June to October.	Possible – suitable habitat present within survey area.	NM
Dasypogonaceae	<i>Calectasia palustris</i>	-	P2	Stilt-rooted herb, stems to 0.7 m high with blue flowers.	White or grey sand. Seasonally inundated swamplands.	July to October.	Unlikely – minimal to no suitable seasonally inundated swamplands present within survey area.	DPaW
Dilleniaceae	<i>Hibbertia helianthemoides</i>	-	P4	Spreading to erect, low or prostrate shrub to 0.3 m high with yellow flowers.	Clayey sand over sandstone or loam over quartzite. Hill and scree slopes.	July or September to October.	Highly Unlikely – Species records are 100 km north of Albany, not within the same Bioregion.	NM
Dilleniaceae	<i>Hibbertia propinqua</i>	-	P4	Spreading shrub to 0.5 m high with yellow flowers.	Gravelly sand on slopes.	August to October.	Possible – suitable habitat present within survey area.	NM DPaW

Family	Taxon	Status		Description	Habitat	Flowering	Likelihood of Occurrence	Source
		EPBC Act	WC Act /DPaW					
Droseraceae	<i>Drosera allantostigma</i>	-	P1	Fibrous-rooted, rosette perennial herb to 0.08 m high with white flowers.	Loam, silica sand or peaty soils. Margins of winter-wet depressions.	November to December.	Unlikely – minimal suitable habitat present within the survey area.	NM DPaW
Droseraceae	<i>Drosera marchantii</i> subsp. <i>prophylla</i>	-	P3	Erect, tuberous, perennial herb, 0.1-0.3 m high with white flowers.	Laterite-silica sand soils on hilltops.	June to July.	Possible – suitable habitat present within survey area.	NM DPaW
Elaeocarpaceae	<i>Tetratheca angulata</i>	-	P3	Lax to erect, slender shrub, 0.2-0.3 m high with pink/purple flowers.	Sandy to gravelly laterite soils. Low hill crests, breakaways with massive laterite boulders.	September to December.	Unlikely – minimal suitable habitat present within the survey area.	NM DPaW
Elaeocarpaceae	<i>Tetratheca nephelioides</i>	CR	EN	Caespitose, dwarf shrub, to 0.3 m high with purple flowers.	White-grey sand, yellow-brown clayey sand, gravel, laterite. Outcrops, undulating hills, ridges.	September.	Possible – suitable habitat present within survey area.	NM PMST
Elaeocarpaceae	<i>Tetratheca remota</i>	-	P1	Small, slender shrub to 0.4 m high with pink flowers.	Sandy gravel.	November.	Possible – suitable habitat present within survey area.	NM DPaW
Ericaceae	<i>Andersonia gracilis</i>	EN	VU	Slender erect or open straggly shrub, 0.1-0.5 m high with white-pink-purple flowers.	White/grey sand, sandy clay, gravelly loam. Winter-wet areas, near swamps.	September to November.	Possible – suitable habitat present within survey area.	PMST DPaW
Ericaceae	<i>Andersonia</i> sp. Mt Lesueur (E.A. Griffin 5536)	-	P2	Open, straggly shrub to 0.6 m high with cream flowers.	Sandy clay over sandstone. Breakaway slope.	March to May.	Possible – suitable habitat present within survey area.	NM DPaW

Family	Taxon	Status		Description	Habitat	Flowering	Likelihood of Occurrence	Source
		EPBC Act	WC Act /DPaW					
Ericaceae	<i>Conostephium magnum</i>	-	P4	Erect, compact shrub to 2 m high with pint-purple flowers.	White-grey sands sometimes associated with laterite gravels. Sand dunes, swampland, disturbed roadside, drainage channels, open woodland.	July to September.	Possible – suitable habitat present within survey area.	NM DPaW
Ericaceae	<i>Leucopogon obtectus</i>	EN	EN	Erect shrub, 0.5-1.7 m high with cream-yellow flowers.	Grey sand.	August to October.	Possible – suitable habitat present within survey area.	NM PMST
Ericaceae	<i>Leucopogon ozothamnoides</i>	-	P1	Shrub to 0.2 m high with white flowers.	Gravelly soils, sandy clay loam.	October.	Highly Unlikely – Species records are 150 km north of Albany, not within the same Bioregion.	NM
Ericaceae	<i>Leucopogon plumuliflorus</i>	-	P2	Slender, multi-stemmed shrub, 0.1-0.4 m high with white/white-pink flowers.	Lateritic sandy soils. Amongst lateritic boulders, hillslopes.	April or July to November.	Unlikely – minimal suitable habitat present within the survey area.	NM DPaW
Ericaceae	<i>Leucopogon</i> sp. Badgingarra (R. Davis 421)	-	P2	Open, erect shrub, 0.7-1 m high with white flowers.	Grey sand, dry white sand. Hills and plains.	December.	Possible – suitable habitat present within survey area.	DPaW
Euphorbiaceae	<i>Beyeria cinerea</i> subsp. <i>cinerea</i>	-	P3	Shrub.	Sand or sandy loam.	No information available.	Possible – suitable habitat present within survey area.	NM
Euphorbiaceae	<i>Beyeria gardneri</i>	-	P3	Shrub, 0.25-0.5 m high with yellow flowers.	Yellow sand.	August to September.	Unlikely – no yellow sand observed within the survey area.	DPaW
Euphorbiaceae	<i>Beyeria similis</i>	-	P2	Erect, compact shrub, 0.25-0.7 m high with yellow flowers.	Yellow or red clayey sand. Sandplains.	August to September.	Unlikely – no suitable habitat present within the survey area.	NM DPaW

Family	Taxon	Status		Description	Habitat	Flowering	Likelihood of Occurrence	Source
		EPBC Act	WC Act /DPaW					
Fabaceae	<i>Acacia carens</i>	-	P2	Open, broom-like shrub, 0.35-0.6 m high with yellow flowers.	Gravel or sandy gravel. Lateritic uplands.	April to June.	Possible – suitable habitat present within survey area.	NM
Fabaceae	<i>Acacia cummingiana</i>	-	P3	Sprawling, straggly shrub, 0.3-0.5 m high with yellow flowers.	Grey or yellow sand, lateritic gravel. Sandplains, lateritic breakaways.	May to June or August.	Possible – suitable habitat present within survey area.	NM DPaW
Fabaceae	<i>Acacia epacantha</i>	-	P3	Dense, bushy, spiny shrub, 0.2-0.5 m high with yellow flowers.	Lateritic gravelly loam or clay.	July to August.	Possible – suitable habitat present within survey area.	NM DPaW
Fabaceae	<i>Acacia forrestiana</i>	VU	VU	Erect, open, prickly shrub, 0.4-1 m high with yellow flowers.	Lateritic gravelly soils, clay loam over sandstone. Gullies, hills, breakaways.	November to December.	Possible – suitable habitat present within survey area.	NM PMST DPaW
Fabaceae	<i>Acacia lasiocarpa</i> var. <i>lasiocarpa</i> Cockleshell Gully variant (E.A. Griffin 2039)	-	P2	Shrub, 0.35-0.5 m high with yellow flowers.	Grey-yellow sand with laterite. Low open heath.	August.	Possible – suitable habitat present within survey area.	NM DPaW
Fabaceae	<i>Acacia plicata</i>	-	P3	Erect shrub, 0.9-2 m high with yellow flowers.	Loamy and clayey soils, often over sandstone or siltstone. Along drainage lines.	August to October.	Unlikely – suitable habitat not present within the survey area.	NM DPaW
Fabaceae	<i>Acacia retrorsa</i>	-	P2	Prostrate, sprawling shrub, 0.05-0.5 m high with yellow flowers.	Grey sand and lateritic gravel, sandy loam.	August to September.	Known – species recorded within the survey area.	NM DPaW
Fabaceae	<i>Acacia tayloriana</i>	-	P4	Prostrate shrub with cream-white flowers.	Grey or yellow/orange sandy soils, lateritic gravel, clay loam. Winter-wet areas.	January.	Highly Unlikely – Not recorded within the same Bioregion. Recorded along the south coast.	NM
Fabaceae	<i>Acacia wilsonii</i>	-	EN	Low, spreading, wiry shrub, 0.2-0.5 m high with yellow flowers.	White/yellow sand and lateritic gravel, sandy clay over laterite.	December to February.	Possible – suitable habitat present within survey area.	NM DPaW

Family	Taxon	Status		Description	Habitat	Flowering	Likelihood of Occurrence	Source
		EPBC Act	WC Act /DPaW					
Fabaceae	<i>Cristonia biloba</i> subsp. <i>pubescens</i>	-	P2	Shrub to 0.5 m high with purple-brown flowers (Thompson 2010).	Brown sandy loam over laterite and grey and white sands over clay, in shrubland and heathland.	June to August.	Possible – suitable habitat present within survey area.	DPaW
Fabaceae	<i>Daviesia debilior</i> subsp. <i>debilior</i>	-	P2	Straggling shrub, 0.3-0.6 m high with yellow and red/purple flowers.	Sand over lateritic gravel.	May to July.	Possible – suitable habitat present within survey area.	NM DPaW
Fabaceae	<i>Daviesia pteroclada</i>	-	P3	Erect, broom-like shrub, 0.6-1.8 m high with orange and red flowers.	Sandy or clay gravelly soils over laterite. Hills.	July to August.	Possible – suitable habitat present within survey area.	NM DPaW
Fabaceae	<i>Gastrolobium hamulosum</i>	EN	CR	Low shrub, 0.2-0.45 m high with yellow, orange, red and purple flowers.	Sandy, often gravelly soils or clay. Flats, slopes and ridges.	August to October.	Possible – suitable habitat present within survey area.	NM
Fabaceae	<i>Gompholobium gairdnerianum</i>	-	P3	Erect, slender, multi-stemmed shrub to 0.5 m high with yellow flowers.	White, cream or brown sandy clay, white sand over sandstone, brown or grey sand over laterite, gravel. Hill summits and slopes, ridges.	September to November.	Possible – suitable habitat present within survey area.	NM DPaW
Fabaceae	<i>Jacksonia anthoclada</i>	-	P3	Erect shrub, 1.5-2.5 m high with yellow and red flowers.	White or grey sand. Sandplains.	April.	Possible – suitable habitat present within survey area.	NM DPaW
Fabaceae	<i>Jacksonia carduacea</i>	-	P3	Bushy shrub, 0.2-0.5 m high with yellow and red flowers.	Grey sand, sandy clay.	August to December.	Possible – suitable habitat present within survey area.	DPaW
Fabaceae	<i>Jacksonia rubra</i>	-	P2	Tangled dwarf shrub, to 0.2 m high with orange flowers.	Clayey sand.	October.	Possible – suitable habitat present within survey area.	DPaW

Family	Taxon	Status		Description	Habitat	Flowering	Likelihood of Occurrence	Source
		EPBC Act	WC Act /DPaW					
Goodeniaceae	<i>Dampiera</i> sp. Jurien (G. Lullfitz s.n. 10/7/1986)	-	P2	Erect, open shrub, 0.27-0.5 m high with blue flowers.	Brown sand over limestone or yellow sandy clay. Open shrubland.	August.	Possible – suitable habitat present within survey area.	NM
Goodeniaceae	<i>Dampiera tephrea</i>	-	P2	Ascending to erect perennial, herb or shrub, 0.3-0.6 m high with blue flowers.	Sand, gravelly loam.	July.	Possible – suitable habitat present within survey area.	NM
Goodeniaceae	<i>Goodenia xanthotricha</i>	-	P2	Viscid shrub to 0.5 m high with blue flowers.	Sandy soils. Gravelly hills.	November to February.	Possible – suitable habitat present within survey area.	NM DPaW
Gyrostemonaceae	<i>Walteranthus erectus</i>	-	P2	Erect shrub, to 2 m high with orange-brown flowers.	Sand over limestone. Coastal limestone ridges.	February.	Possible – suitable habitat present within survey area.	NM
Haemodoraceae	<i>Anigozanthos viridis</i> subsp. <i>terraspectans</i>	VU	VU	Rhizomatous perennial herb, 0.05-0.2 m high with green/yellow-green flowers.	Grey sand, clay loam. Winter-wet depressions.	August to September	Possible – suitable habitat present within survey area.	PMST
Haemodoraceae	<i>Haemodorum loratum</i>	-	P3	Bulbaceous, perennial herb, 0.45-1.2 m high with black/brown-black/green flowers.	Grey or yellow sand, gravel.	November.	Possible – suitable habitat present within survey area.	NM
Haemodoraceae	<i>Phlebocarya pilosissima</i> subsp. <i>pilosissima</i>	-	P3	Shortly rhizomatous, compactly tufted perennial herb, 0.15-0.4 m high with cream-white flowers.	White or grey sand, lateritic gravel.	August to October.	Possible – suitable habitat present within survey area.	NM DPaW
Haemodoraceae	<i>Phlebocarya pilosissima</i> subsp. <i>teretifolia</i>	-	P2	Shortly rhizomatous, loosely tufted perennial herb, 0.15-0.4 m high with cream-white flowers.	White or grey sand.	August to October.	Possible – suitable habitat present within survey area.	NM

Family	Taxon	Status		Description	Habitat	Flowering	Likelihood of Occurrence	Source
		EPBC Act	WC Act /DPaW					
Haloragaceae	<i>Haloragis foliosa</i>	-	P3	Perennial herb or shrub, 0.2-0.5 m high.	White/grey sand over limestone.	-	Possible – suitable habitat present within survey area.	DPaW
Hemerocallidaceae	<i>Arnocrinum gracillimum</i>	-	P2	Rhizomatous, perennial herb, 0.2-0.4 m high with purple flowers.	White, grey, yellow or lateritic sand.	October to November.	Possible – suitable habitat present within survey area.	NM DPaW
Hemerocallidaceae	<i>Hensmania stoniella</i>	-	P3	Tufted, stilt-rooted perennial herb, 0.1-0.2 m high with yellow-cream-white flowers.	White, grey or lateritic sand, often winter-wet.	September to November.	Known – species was recorded from within the survey area.	NM DPaW
Iridaceae	<i>Patersonia argyrea</i>	-	P3	Rhizomatous, tufted perennial herb to 0.4 m high with violet-purple flowers.	Grey sand and lateritic gravel.	September to November.	Possible – suitable habitat present within survey area.	NM DPaW
Iridaceae	<i>Patersonia spirifolia</i>	EN	EN	Spreading, woody, tussock-forming rhizomatous herb growing to 0.3 m high and 0.4 m across with blue-violet flowers.	Sand over laterite. Low hills.	-	Possible – suitable habitat present within survey area.	DPaW
Lamiaceae	<i>Hemiandra gardneri</i>	EN	CR	Prostrate, pungent shrub, 0.1-0.2 m high, to 1 m wide with red/pink-red flowers.	Grey or yellow sand, clayey sand. Sandplains.	August to October.	Possible – suitable habitat present within survey area.	NM PMST
Lamiaceae	<i>Hemiandra</i> sp. Watheroo (S. Hancocks 4)	-	P4	Shrub to 0.5 m high with red/orange/purple flowers.	White, yellow or grey sand on sandplains or slopes.	December.	Possible – suitable habitat present within survey area.	NM
Lamiaceae	<i>Hemigenia curvifolia</i>	-	P2	Shrub, 0.2-0.7 m high with blue flowers.	Sandy soils.	September to October.	Possible – suitable habitat present within survey area.	NM

Family	Taxon	Status		Description	Habitat	Flowering	Likelihood of Occurrence	Source
		EPBC Act	WC Act /DPaW					
Malvaceae	<i>Guichenotia alba</i>	-	P3	Slender, lax, few-branched shrub, 0.1-0.45 m high with white flowers.	Sandy and gravelly soils. Low-lying flats, depressions.	July to August.	Possible – suitable habitat present within survey area.	NM DPaW
Malvaceae	<i>Lasiopetalum ogilvieanum</i>	-	P1	Shrub, 0.45-1.5 m high with pink-white flowers.	White/grey or yellow sand, stony loam. Undulating plains, lateritic rises.	July to October.	Possible – suitable habitat present within survey area.	NM
Malvaceae	<i>Lasiopetalum</i> sp. Badgingarra (E.A. Griffin 5278)	-	P2	Erect multi-stemmed shrub to 1.5 m high with pink flowers.	Slopes and gullies with dry brown loam, clay gravel over laterite.	October to December.	Possible – suitable habitat present within survey area.	DPaW
Malvaceae	<i>Lasiopetalum</i> sp. Hill River (T.N. Stoate 5)	-	P1	Shrub to 1 m high with lilac flowers.	Dry brown loam over laterite.	September.	Possible – suitable habitat present within survey area.	DPaW
Malvaceae	<i>Lasiopetalum</i> sp. Mount Lesueur (E.A. Griffin 1997)	-	P2	Shrub to 1.1 m high with pink/red/purple flowers.	Slopes, clayey sand and gravelly sand.	September to December.	Possible – suitable habitat present within survey area.	NM DPaW
Malvaceae	<i>Thomasia tenuivestita</i>	-	P3	Shrub, 0.6-2.5 m high with purple-pink flowers.	Granite, loam.	July to October.	Unlikely – No granite was observed within the survey area.	DPaW
Myrtaceae	<i>Babingtonia cherticola</i>	-	P3	Shrub, 1-1.5 m high with white/pink flowers.	Sandy loam, lateritic sand or clay. Flats or slopes at base of hills.	November to December.	Possible – suitable habitat present within survey area.	NM DPaW
Myrtaceae	<i>Beaufortia bicolor</i>	-	P3	Dense shrub, 0.3-1 m high with red and yellow and orange flowers.	White sand over laterite. Sandplains.	November to December.	Possible – suitable habitat present within survey area.	NM
Myrtaceae	<i>Beaufortia eriocephala</i>	-	P3	Erect, compact shrub, 0.3-0.6 m high with red flowers.	Lateritic sandy soils. Slopes.	September to November.	Possible – suitable habitat present within survey area.	NM DPaW
Myrtaceae	<i>Calytrix chrysantha</i>	-	P4	Shrub, 0.3-1.3 m high with yellow flowers.	White, grey or yellow/brown sand. Flats.	December to February.	Possible – suitable habitat present within survey area.	NM

Family	Taxon	Status		Description	Habitat	Flowering	Likelihood of Occurrence	Source
		EPBC Act	WC Act /DPaW					
Myrtaceae	<i>Calytrix ecalycata</i> subsp. <i>brevis</i>	-	P3	Upright shrub, to 1 m high with yellow flowers.	Dry yellow sand. Sandplains, low rises.	August to September.	Possible – suitable habitat present within survey area.	NM DPaW
Myrtaceae	<i>Darwinia pimelioides</i>	-	P4	Erect shrub, 0.25-0.5 m high with red/pink and green flowers.	Loam, sandy loam. Granite outcrops.	September to October.	Unlikely – No granite was observed within the survey area.	NM
Myrtaceae	<i>Eucalyptus abdita</i>	-	P2	Mallee or shrub, 2-3 m high, bark smooth, grey.	Laterite, sandy clay with gravel over laterite. Slopes, breakaways.	No information available.	Possible – suitable habitat present within survey area.	NM
Myrtaceae	<i>Eucalyptus absita</i>	EN	CR	Mallee or tree, 2.3-10 m high with fibrous rough bark and white flowers.	White lateritic sand. Paddocks.	April to July.	Possible – suitable habitat present within survey area.	PMST DPaW
Myrtaceae	<i>Eucalyptus angularis</i>	-	P2	Mallee to 3 m high, bark rough or flaky.	Lateritic breakaways.	No information available.	Possible – suitable habitat present within survey area.	NM DPaW
Myrtaceae	<i>Eucalyptus argutifolia</i>	VU	VU	Mallee, 1.5-4 m high, bark smooth with white flowers.	Shallow soils over limestone. Slopes or gullies of limestone ridges, outcrops.	March to April.	Unlikely – Records occur greater than 100 km south of survey area.	NM
Myrtaceae	<i>Eucalyptus balanites</i>	EN	CR	Mallee, to 5 m high with flaky rough bark and white flowers.	Sandy soils with lateritic gravel.	October to December or January to February.	Possible – suitable habitat present within survey area.	PMST
Myrtaceae	<i>Eucalyptus beardiana</i>	VU	EN	Mallee, 3-5 m high, bark smooth with cream-white flowers.	Red or yellow sand. Sand dunes and ridges.	August to September.	Highly Unlikely – Records occur north of Geraldton.	NM
Myrtaceae	<i>Eucalyptus crispata</i>	VU	EN	Mallee, 3-7 m high, bark rough on the trunk in partly decorticated curls with yellow-cream flowers.	Sand, loam with lateritic gravel. Lateritic breakaways.	March to June.	Possible – suitable habitat present within survey area.	NM PMST

Family	Taxon	Status		Description	Habitat	Flowering	Likelihood of Occurrence	Source
		EPBC Act	WC Act /DPaW					
Myrtaceae	<i>Eucalyptus exilis</i>	-	P4	Whipstick mallee, 2-6 m high, bark smooth with white flowers.	Grey sand, gravelly loam. Lateritic ridges.	August to October.	Possible – suitable habitat present within survey area.	NM DPaW
Myrtaceae	<i>Eucalyptus impensa</i>	EN	EN	Straggly mallee to 1.5 m high, bark smooth with pink flowers.	Yellow sand. Lateritic hills.	June to July.	Unlikely – yellow sand was not observed within the survey area.	NM PMST
Myrtaceae	<i>Eucalyptus johnsoniana</i>	VU	VU	Mallee, forming dense clumps, 1-3.5 m high, bark flaky to 0.5 m then smooth with white-cream flowers.	White/grey sand with lateritic gravel. Sandplain, lateritic breakaways.	July to August or December to May.	Possible – suitable habitat present within survey area.	NM PMST
Myrtaceae	<i>Eucalyptus lateritica</i>	VU	EN	Mallee, 2-3 m high, bark rough at base with white flowers.	White or grey sand with gravel. Lateritic breakaways and mesas.	August to October.	Possible – suitable habitat present within survey area.	NM PMST
Myrtaceae	<i>Eucalyptus leprophloia</i>	EN	EN	Mallee, 2-5 m high, bark rough, loose and flaky to 1 m with cream-white flowers.	White or grey sand over laterite. Valley slopes.	August to October.	Possible – suitable habitat present within survey area.	NM PMST
Myrtaceae	<i>Eucalyptus macrocarpa</i> subsp. <i>elachantha</i>	-	P4	Spreading or sprawling mallee, 0.8-4 m high, bark smooth, grey over salmon pink with red-pink flowers.	White or grey sand over laterite. Hillslopes, ridges and sandplains.	August to September or November to December.	Possible – suitable habitat present within survey area.	NM DPaW
Myrtaceae	<i>Eucalyptus pendens</i>	-	P4	Slender, pendulous mallee, 2-5 m high, bark smooth with white flowers.	White or grey sand with lateritic gravel. Hillsides, breakaways, sandplains.	August to November.	Possible – suitable habitat present within survey area.	NM DPaW

Family	Taxon	Status		Description	Habitat	Flowering	Likelihood of Occurrence	Source
		EPBC Act	WC Act /DPaW					
Myrtaceae	<i>Eucalyptus pruiniramis</i>	EN	EN	Mallee or tree, 2.5-7 m high, often with straggly, tumbledown crown; bark rough and ribbon at base, smooth above with cream flowers.	Skeletal soils over sandstone or laterite. Rocky hillsides.	December.	Unlikely – skeletal soils not observed in survey area.	NM PMST
Myrtaceae	<i>Eucalyptus rhodantha</i> .	VU	VU	Spreading mallee, 1.5-4 m high, bark smooth, with red/cream-white flowers.	Grey/yellow/red sand over laterite. Undulating country, hill slopes.	July or September to January.	Highly Unlikely – Nearest record is located approximately 60 km to the north of the survey area.	PMST
Myrtaceae	<i>Eucalyptus suberea</i>	VU	VU	Mallee, 1-4 m high, bark rough and flaky with white flowers.	Grey sand. Near or on lateritic breakaways.	November to January.	Possible – suitable habitat present within survey area.	NM PMST
Myrtaceae	<i>Eucalyptus x balanites</i>	-	CR	Mallee to 5 m high, bark rough, flaky with white flowers.	Sandy soils with lateritic gravel.	October to February.	Possible – suitable habitat present within survey area.	DPaW
Myrtaceae	<i>Eucalyptus zopherophloia</i>	-	P4	Spreading mallee, 2.5-4 m high, bark rough, fibrous with cream-white flowers.	Grey/white sand with limestone rubble. Coastal areas.	October to January.	Unlikely – little to no limestone rubble was observed within the survey area.	DPaW
Myrtaceae	<i>Hypocalymma gardneri</i>	-	P3	Shrub to 0.3 m high with yellow flowers.	Grey-brown sand, laterite. Sandplains, upper slopes, heathland.	August to September.	Possible – suitable habitat present within survey area.	NM DPaW
Myrtaceae	<i>Hypocalymma serrulatum</i>	-	P3	Erect shrub, 0.45-1.7 m high with white-pink flowers.	Grey or white sand along drainage lines.	April to May.	Possible – suitable habitat present within survey area.	DPaW
Myrtaceae	<i>Hypocalymma</i> sp. Cataby (G.J. Keighery 5151)	-	P2	Erect, spreading shrub, 0.5-1 m high.	Grey sand.	August.	Possible – suitable habitat present within survey area.	DPaW
Myrtaceae	<i>Hypocalymma</i> sp. Dandaragan (C.A. Gardner 9014)	-	P1	Multi-stemmed shrub to 0.3 m high with yellow flowers.	Grey sand with lateritic pebbles.	September.	Possible – suitable habitat present within survey area.	DPaW

Family	Taxon	Status		Description	Habitat	Flowering	Likelihood of Occurrence	Source
		EPBC Act	WC Act /DPaW					
Myrtaceae	<i>Hypocalymma</i> sp. Gairdner Range (C.A. Gardner 9091)	-	P2	Yellow flowers.	Stony soil.	August.	Possible – suitable habitat present within survey area.	NM DPaW
Myrtaceae	<i>Hypocalymma tenuatum</i>	-	P2	Shrub, 0.2-0.35 m high with cream-yellow flowers.	Sandy loam over sandstone. Outcrops, ridges.	July to August.	Possible – suitable habitat present within survey area.	NM DPaW
Myrtaceae	<i>Hypocalymma tetrapterum</i>	-	P3	Shrub, 0.4-0.9 m high with white flowers.	Grey sand, loam, lateritic gravel on riverbanks and breakaways.	August.	Possible – suitable habitat present within survey area.	DPaW
Myrtaceae	<i>Verticordia amphigia</i>	-	P3	Shrub, 0.6-1.3 m high with yellow flowers.	Sandy loam, clay and rocky loam. Winter-wet depressions.	October to November.	Possible – suitable habitat present within survey area.	NM
Myrtaceae	<i>Verticordia argentea</i>	-	P2	Erect, open shrub, 0.9-2 m high with pink and white flowers.	White, grey or yellow sand. Sand ridges, undulating plains.	November to April.	Possible – suitable habitat present within survey area.	DPaW
Myrtaceae	<i>Verticordia aurea</i>	-	P4	Shrub, 0.6-1.5 m high with yellow-orange flowers.	Deep sand. Sandplains.	September to December.	Possible – suitable habitat present within survey area.	NM
Myrtaceae	<i>Verticordia fragrans</i>	-	P3	Openly branched shrub, 1-3 m high with pink-white flowers.	White, grey or yellow sand, clay loam. Low-lying areas, sandplains.	September to November.	Possible – suitable habitat present within survey area.	NM DPaW
Myrtaceae	<i>Verticordia insignis</i> subsp. <i>eomagis</i>	-	P3	Erect shrub, 0.2-1 m high with white-pink/white flowers.	Sandy soils over laterite. Sandplains, rocky rises.	August to November.	Possible – suitable habitat present within survey area.	NM
Myrtaceae	<i>Verticordia luteola</i> var. <i>rosea</i>	-	P1	Slender shrub, 0.3-2 m high with pink/green-cream-brown flowers.	White sand. Flats.	December or January.	Possible – suitable habitat present within survey area.	NM

Family	Taxon	Status		Description	Habitat	Flowering	Likelihood of Occurrence	Source
		EPBC Act	WC Act /DPaW					
Myrtaceae	<i>Verticordia muelleriana</i> subsp. <i>muelleriana</i>	-	P3	Spindly shrub, 0.45-2 m high with pink-purple-red/brown flowers.	White/grey or yellow sand. Sandplains.	September to January.	Possible – suitable habitat present within survey area.	NM
Myrtaceae	<i>Verticordia rutilastra</i>	-	P3	Shrub, 0.2-0.9 m high with yellow flowers.	Sand and lateritic gravel. Hills.	September to November.	Possible – suitable habitat present within survey area.	NM
Myrtaceae	<i>Verticordia venusta</i>	-	P3	Erect, spreading shrub, 0.2-2 m high with pink-purple/red-brown flowers.	Yellow sand, sandy gravel. Sandplains.	September to January.	Possible – suitable habitat present within survey area.	NM
Orchidaceae	<i>Caladenia hoffmanii</i>	EN	EN	Tuberous, perennial herb, 0.13-0.3 m high with green and yellow and red flowers.	Clay, loam, laterite, granite. Rocky outcrops and hillsides, ridges, swamps and gullies.	August to October.	Highly Unlikely – Records show this species occurs north of the survey area around Geraldton.	PMST
Orchidaceae	<i>Caladenia huegelii</i>	EN	CR	Tuberous, perennial herb, 0.25-0.6 m high with green and cream and red flowers.	Grey or brown sand, clay loam.	September to October.	Highly Unlikely – Records show this species occurs south of the survey area along the coast south of Perth.	PMST
Orchidaceae	<i>Calandrinia oraria</i>	-	P3	Annual herb to 0.3 m high with pink flowers.	Grey sand, sand dunes over limestone.	August to October.	Possible – suitable habitat present within survey area.	DPaW
Orchidaceae	<i>Drakaea elastica</i>	EN	CR	Tuberous, perennial herb, 0.12-0.3 m high with red and green and yellow flowers.	White or grey sand. Low lying situations adjoining winter-wet swamps.	October to November.	Highly Unlikely – Majority of records show this species occurs south of the survey area along the coast south of Perth.	PMST
Orchidaceae	<i>Paracaleana dixonii</i>	EN	VU	Tuberous, perennial herb, 0.09-0.2 m high with yellow-brown flowers.	Grey sand over granite.	October to January.	Unlikely – No granite observed within the survey area.	NM PMST DPaW

Family	Taxon	Status		Description	Habitat	Flowering	Likelihood of Occurrence	Source
		EPBC Act	WC Act /DPaW					
Orchidaceae	<i>Thelymitra apiculata</i>	-	P4	Tuberous, perennial herb, 0.2-0.35 m high with purple and yellow flowers.	Grey sand, lateritic gravel.	May to July.	Possible – suitable habitat present within survey area.	NM DPaW
Orchidaceae	<i>Thelymitra pulcherrima</i>	-	P2	Tuberous perennial herb to 0.15 m high.	Sand. Gravel.	August.	Possible – suitable habitat present within survey area.	NM DPaW
Orchidaceae	<i>Thelymitra stellata</i>	EN	EN	Tuberous, perennial herb, 0.15-0.25 m high with yellow and brown flowers.	Sand, gravel, lateritic loam.	October to November.	Possible – suitable habitat present within survey area.	NM PMST DPaW
Orchidaceae	<i>Thelymitra variegata</i>	-	P2	Tuberous, perennial herb, 0.1-0.35 m high with orange and red and purple and pink flowers.	Sandy clay, sand, laterite.	June to September.	Known – species was recorded from within the survey area.	NM
Poaceae	<i>Austrostipa</i> sp. Cairn Hill (M.E. Trudgen 21176)	-	P3	Perennial grass to 0.6 m high.	Yellow sand, sandy loam. Flats and slopes.	September.	Unlikely – No yellow sand observed within the survey area.	NM DPaW
Proteaceae	<i>Banksia catoglypta</i>	-	VU	Non-lignotuberous shrub to 1 m high, to 1 m wide with orange-brown flowers.	Lateritic breakaways.	June to July.	Possible – suitable habitat present within survey area.	NM DPaW
Proteaceae	<i>Banksia chamaephyton</i>	-	P4	Low, lignotuberous shrub, to 0.4 m high, up to 2 m wide with cream and brown flowers.	Grey or white sand over laterite.	October to December.	Possible – suitable habitat present within survey area.	NM DPaW
Proteaceae	<i>Banksia elegans</i>	-	P4	Shrub, 1-4 m high with yellow/green-yellow flowers.	Yellow, white or red sand. Sandplains, low consolidated dunes.	October to November.	Unlikely – suitable habitat not present within survey area.	NM
Proteaceae	<i>Banksia fraseri</i> var. <i>crebra</i>	-	P3	Shrub to 0.7 m high with yellow-brown flowers.	Sand, sandy gravel, lateritic soils. Slopes.	July to August.	Possible – suitable habitat present within survey area.	NM DPaW

Family	Taxon	Status		Description	Habitat	Flowering	Likelihood of Occurrence	Source
		EPBC Act	WC Act /DPaW					
Proteaceae	<i>Banksia fraseri</i> var. <i>effusa</i>	-	P2	Sprawling shrub to 0.3 m high pink/cream flowers.	Laterite, gravelly loam on slopes.	July to August.	Possible – suitable habitat present within survey area.	NM DPaW
Proteaceae	<i>Banksia kippistiana</i> var. <i>paenepeccata</i>	-	P3	Erect, prickly, lignotuberous shrub, 0.3-1.2 m high with yellow-cream flowers.	Lateritic gravelly soils.	October to November.	Possible – suitable habitat present within survey area.	NM DPaW
Proteaceae	<i>Banksia nobilis</i> subsp. <i>fragrans</i>	-	P3	Erect, non-lignotuberous shrub, 0.6-2 m high with yellow-green/pink flowers.	Lateritic rises.	July to September.	Possible – suitable habitat present within survey area.	NM DPaW
Proteaceae	<i>Banksia serratuloides</i> subsp. <i>perissa</i>	CR	EN	Bushy, lignotuberous shrub to 1 m high with yellow flowers.	Gravelly lateritic soils.	August to September.	Possible – suitable habitat present within survey area.	NM PMST DPaW
Proteaceae	<i>Banksia serratuloides</i> subsp. <i>serratuloides</i>	VU	VU	Low, bushy, lignotuberous shrub, 0.3-1 m high with yellow flowers.	Loam or clay loam over laterite, sandy gravel.	July to September.	Highly Unlikely – Majority of records show this species occurs south east of the survey area in a different Bioregion.	DPaW
Proteaceae	<i>Banksia splendida</i> subsp. <i>macrocarpa</i>	-	P3	Bushy, non-lignotuberous shrub, 0.3-1.5 m high with yellow/orange-red flowers.	Lateritic gravel.	July to August.	Possible – suitable habitat present within survey area.	NM DPaW
Proteaceae	<i>Banksia subulata</i>	-	P3	Bushy, non-lignotuberous shrub, to 0.35 m high with yellow flowers.	White/grey or yellow sand over laterite, gravelly laterite.	September.	Possible – suitable habitat present within survey area.	NM DPaW
Proteaceae	<i>Banksia tricuspis</i>	-	P4	Stunted tree or shrub, 1.2-4 m high with epicormics buds and yellow-orange flowers.	Lateritic rocky soils. Sides and hilltops, breakaway edges.	March to July.	Possible – suitable habitat present within survey area.	NM DPaW

Family	Taxon	Status		Description	Habitat	Flowering	Likelihood of Occurrence	Source
		EPBC Act	WC Act /DPaW					
Proteaceae	<i>Conospermum scaposum</i>	-	P3	Erect shrub, 0.2-0.45 m high with blue flowers.	White-grey sand, sandy clay. Low swampy areas, road verges.	October to February.	Possible – suitable habitat present within survey area.	NM DPaW
Proteaceae	<i>Grevillea batrachioides</i>	EN	CR	Shrub, 0.5-1.5 m high with orange-red flowers.	Sandy loam. Sandstone outcrops.	October.	Possible – suitable habitat present within survey area.	NM PMST DPaW
Proteaceae	<i>Grevillea delta</i>	-	P2	Shrub, 0.3-1.8 m high with red flowers.	Sandy clay, loam, gravelly soils, often over sandstone. Sandstone outcrops, creek beds.	June to October.	Known – species was recorded within the survey area.	NM DPaW
Proteaceae	<i>Grevillea florida</i>	-	P3	Erect shrub, to 0.9 m high with cream-yellow flowers.	Sand, sandy clay, gravel, laterite. Sandplain, slopes, road verges.	July to September.	Possible – suitable habitat present within survey area.	NM
Proteaceae	<i>Grevillea humifusa</i>	EN	CR	Prostrate to decumbent, lignotuberous shrub with red flowers.	Gravelly loam over laterite.	September to November.	Possible – suitable habitat present within survey area.	NM PMST
Proteaceae	<i>Grevillea metamorpha</i>	-	P1	Erect, spindly shrub to 1.5 m high with white flowers.	White sand. Along creek line.	September.	Possible – suitable habitat present within survey area.	NM DPaW
Proteaceae	<i>Grevillea olivacea</i>	-	P4	Erect, non-lignotuberous shrub, 1 -4.5 m high with red/red-pink flowers.	White or grey sand. Coastal dunes, limestone rocks.	June to September.	Possible – suitable habitat present within survey area.	NM DPaW
Proteaceae	<i>Grevillea rudis</i>	-	P4	Loose, spreading to erect shrub, 0.2-1.2 m high with white-cream/cream-yellow flowers.	White, grey, yellow or red sand, often with gravel and over laterite.	January or April or June to December.	Possible – suitable habitat present within survey area.	NM
Proteaceae	<i>Grevillea saccata</i>	-	P4	Diffuse scrambling or trailing shrub, 0.25-0.5 m high, 1-2 m wide with red flowers.	Yellow or brown sand, often with lateritic gravel.	April or June to November.	Possible – suitable habitat present within survey area.	NM DPaW

Family	Taxon	Status		Description	Habitat	Flowering	Likelihood of Occurrence	Source
		EPBC Act	WC Act /DPaW					
Proteaceae	<i>Grevillea thelemanniana</i> subsp. Cooljarloo (B.J. Keighery 28 B)	-	P1	Spreading shrub to 0.6 m with red flowers.	Seasonally wet area with clay, sandy clay or loam soil.	July to November.	Possible – suitable habitat present within survey area.	NM DPaW
Proteaceae	<i>Grevillea thyrsoides</i> subsp. <i>pustulata</i>	-	P3	Spreading or procumbent shrub, 0.3-0.7 m high with red-pink flowers.	Sand or sandy gravel.	March or July to September.	Possible – suitable habitat present within survey area.	NM
Proteaceae	<i>Grevillea thyrsoides</i> subsp. <i>thyrsoides</i>	-	P3	Spreading or procumbent shrub, 0.3-0.7 m high with red-pink flowers.	Sand or sandy lateritic gravel.	February or August to September.	Possible – suitable habitat present within survey area.	NM DPaW
Proteaceae	<i>Grevillea uniformis</i>	-	P3	Shrub 0.8-1.8 m high with white-cream flowers.	Sand or sandy loam on sandstone, lateritic gravel. Sandstone outcrops, creeklines.	July or September to November.	Unlikely – sandstone outcropping not observed within survey area.	NM DPaW
Proteaceae	<i>Hakea longiflora</i>	-	P3	Erect, pungent shrub, 0.6-0.75 m high with yellow flowers.	White sand, loam, gravel, laterite. Breakaways.	June to September.	Possible – suitable habitat present within survey area.	NM DPaW
Proteaceae	<i>Hakea megalosperma</i>	VU	VU	Spreading, lignotuberous shrub, 1-2 m high with white-cream/pink flowers.	Grey sand, loam. Lateritic hills and rocks.	May to June.	Known – species was recorded from within the survey area.	NM PMST
Proteaceae	<i>Hakea neurophylla</i>	-	P4	Erect shrub, 0.3-2 m high with pink-red flowers.	Lateritic sandy soils. Hillsides.	August.	Known – species was recorded from within the survey area.	NM DPaW
Proteaceae	<i>Isopogon drummondii</i>	-	P3	Erect, lignotuberous shrub, 0.4-1 m high with yellow/cream-yellow flowers.	White, grey or yellow sand, often over laterite.	February to June.	Possible – suitable habitat present within survey area.	NM DPaW

Family	Taxon	Status		Description	Habitat	Flowering	Likelihood of Occurrence	Source
		EPBC Act	WC Act /DPaW					
Proteaceae	<i>Persoonia filiformis</i>	-	P2	Erect, spreading, lignotuberous shrub, 0.07-0.4 m high with yellow flowers.	Yellow or white sand over laterite.	November to December.	Possible – suitable habitat present within survey area.	NM DPaW
Proteaceae	<i>Persoonia rudis</i>	-	P3	Erect, often spreading shrub, 0.2-1 m high with yellow flowers.	White, grey or yellow sand, often over laterite.	September to January.	Possible – suitable habitat present within survey area.	NM DPaW
Proteaceae	<i>Petrophile nivea</i>	-	VU	Erect, rigid shrub to 0.6 m high with white flowers.	Dry bare white sand over gravel over laterite. Uplands.	May or July.	Possible – suitable habitat present within survey area.	NM DPaW
Proteaceae	<i>Petrophile septemfida</i>	-	P3	Erect, prickly shrub to 1.2 m high with pale cream-yellow flowers.	Grey/white sand over laterite. Sandy plain between hills.	March to June or August to September.	Possible – suitable habitat present within survey area.	DPaW
Proteaceae	<i>Synaphea endothis</i>	-	P3	Erect, clumped shrub, to 0.6 m high with yellow flowers.	Gravelly loam, sand. Lateritic rises.	August to September.	Possible – suitable habitat present within survey area.	NM DPaW
Proteaceae	<i>Synaphea lesueurensis</i>	-	P2	Shrub, 0.25-0.6 m high with yellow flowers.	Laterite, sandy soils over laterite or sandstone. Hillslopes.	August to October.	Possible – suitable habitat present within survey area.	NM DPaW
Proteaceae	<i>Synaphea xela</i>	-	P2	Sprawling shrub, to 0.4 m high with yellow flowers.	Red-brown gravelly sand, white-pink, grey-brown clayey sand and loam, over laterite. Undulating sites.	August.	Possible – suitable habitat present within survey area.	NM DPaW
Restionaceae	<i>Catacolea enodis</i>	-	P2	Rhizomatous, perennial herb, 0.1-0.3 m high with brown flowers.	Depp white sand over laterite. Tall heath.	-	Possible – suitable habitat present within survey area.	DPaW
Restionaceae	<i>Chordifex chaunocoleus</i>	-	P4	Rhizomatous, erect perennial herb, 0.15-0.5 m high with frown flowers.	Grey, siliceous or peaty sand, well to poorly drained. Drainage lines, depressions.	September.	Possible – suitable habitat present within survey area.	NM DPaW

Family	Taxon	Status		Description	Habitat	Flowering	Likelihood of Occurrence	Source
		EPBC Act	WC Act /DPaW					
Restionaceae	<i>Chordifex reseminans</i>	-	P2	Rhizomatous, erect, tufted herb, 0.6-0.9 m high.	Dry sand. Heath.	March to May.	Possible – suitable habitat present within survey area.	DPaW
Restionaceae	<i>Desmocladius biformis</i>	-	P3	Rhizomatous, densely tufted perennial herb, 0.1-0.2 m high.	Sand, sandy clay, lateritic soils. Dry sites.	September to October.	Possible – suitable habitat present within survey area.	DPaW
Restionaceae	<i>Desmocladius elongatus</i>	-	P4	Rhizomatous, perennial herb, 0.25-0.5 m high.	White or grey sand. Dry kwongan.	August to December.	Possible – suitable habitat present within survey area.	NM
Restionaceae	<i>Desmocladius microcarpus</i>	-	P2	Small clumping herb to 0.06 m.	White/grey sandy soils over lateritic gravel.	-	Possible – suitable habitat present within survey area.	DPaW
Restionaceae	<i>Desmocladius nodatus</i>	-	P3	Small herb to 0.1 m high.	Grey and brown sand, sandy loam. Rocky plain, wetland area.	-	Possible – suitable habitat present within survey area.	DPaW
Restionaceae	<i>Hypolaena robusta</i>	-	P4	Dioecious rhizomatous, perennial herb to 0.5 m high.	White sand. Sandplains.	September to October.	Possible – suitable habitat present within survey area.	NM DPaW
Restionaceae	<i>Lepidobolus quadratus</i>	-	P3	Rhizomatous, caespitose perennial herb, 0.15-0.3 m high with brown/red flowers.	Lateritic gravel, grey/white sand. Dry kwongan.	August to September.	Known – species was recorded from within the survey area.	NM DPaW
Restionaceae	<i>Lepyrodia curvescens</i>	-	P2	Dioecious, shortly creeping, tufted rhizomatous herb, 0.24-0.4 m high.	Sand, laterite. Seasonally inundated swampland.	September to November.	Possible – suitable habitat present within survey area.	NM DPaW
Restionaceae	<i>Loxocarya gigas</i>	-	P2	Rhizomatous, clumped perennial herb, 0.8-2 m high.	Sandy gravelly lateritic soils. Low hills and ridges, sandplains.	No information available.	Possible – suitable habitat present within survey area.	NM DPaW
Rhamnaceae	<i>Stenanthemum limitatum</i>	-	P2	Erect or decumbent shrub, 0.15-1 m high with white/cream flowers.	Sand and lateritic gravel, sandstone.	October to November.	Possible – suitable habitat present within survey area.	NM DPaW

Family	Taxon	Status		Description	Habitat	Flowering	Likelihood of Occurrence	Source
		EPBC Act	WC Act /DPaW					
Rutaceae	<i>Asterolasia drummondii</i>	-	P4	Slender erect shrub, 0.2-0.5 m high with white flowers.	Lateritic gravel and sand or loam. Lateritic hills and sandplains, breakaways.	July to September.	Possible – suitable habitat present within survey area.	NM
Rutaceae	<i>Boronia ramosa</i> subsp. <i>lesueurana</i>	-	P2	Compact, woody perennial herb, 0.15-0.3 m high with white flowers.	Sand or gravel over laterite.	July to August.	Possible – suitable habitat present within survey area.	NM DPaW
Rutaceae	<i>Boronia scabra</i> subsp. <i>condensata</i>	-	P2	Erect shrub, 0.25-0.7 m high with pink flowers.	Sandy clay or gravel. Upper slopes, edges of lateritic breakaways.	August.	Possible – suitable habitat present within survey area.	NM DPaW
Stylidiaceae	<i>Stylidium aeonioides</i>	-	P4	Rosetted, perennial herb, 0.05-0.4 m high with cream-yellow flowers.	Sandy clay loam over laterite. Hillsides and breakaways. Low heath, open woodland.	September to November.	Possible – suitable habitat present within survey area.	NM DPaW
Stylidiaceae	<i>Stylidium carnosum</i> subsp. <i>Narrow leaves</i> (J.A. Wege 490)	-	P1	Tall, perennial herb to 0.8 m high with white flowers.	White/grey sand. Lateritic soils. Slopes of laterite hill.	September to November.	Possible – suitable habitat present within survey area.	NM
Stylidiaceae	<i>Stylidium cornuatum</i>	-	P2	Herb to 0.08 m high with pale-dark pink flowers.	Moist soils, orange-brown clay loam or brown sandy clay.	September.	Possible – suitable habitat present within survey area.	DPaW
Stylidiaceae	<i>Stylidium diplotrichum</i>	-	P2	Rosetted perennial herb, 0.15-0.4 m high with white flowers.	Clayey sand or clay loam over laterite. Hillslopes and gullies. <i>Acacia</i> and myrtaceous shrubland, low heath.	September to November.	Possible – suitable habitat present within survey area.	NM DPaW
Stylidiaceae	<i>Stylidium hymenocraspedum</i>	-	P3	Rosetted, perennial herb, 0.7 m high with yellow flowers.	Sand over laterite. Hillslopes. Heath, <i>Banksia</i> and <i>Eucalyptus</i> low open woodland.	September to October.	Likely – infertile specimen of this species was potentially recorded from within the survey area.	DPaW
Stylidiaceae	<i>Stylidium inversiflorum</i>	-	P4	Rosetted perennial herb, 0.08-0.25 m high with yellow flowers.	White or grey sand over laterite. Sandplains, hillslopes and gullies. Heath, open woodland.	September to November.	Possible – suitable habitat present within survey area.	NM DPaW

Family	Taxon	Status		Description	Habitat	Flowering	Likelihood of Occurrence	Source
		EPBC Act	WC Act /DPaW					
Stylidiaceae	<i>Stylidium maritimum</i>	-	P3	Caespitose perennial herb, 0.3-0.7 m high with white/purple flowers.	Sand over limestone. Dune slopes and flats. Coastal heath and shrubland, open <i>Banksia</i> woodland.	September to November.	Possible – suitable habitat present within survey area.	NM DPaW
Stylidiaceae	<i>Stylidium nonscandens</i>	-	P3	Erect perennial herb, 0.18-0.46 m high with pink flowers.	Sand over laterite. Hillslopes and crests. <i>Banksia</i> woodland, heath, mallee shrubland.	September to November.	Possible – suitable habitat present within survey area.	NM DPaW
Stylidiaceae	<i>Stylidium periscelianthum</i>	-	P3	Bulb-forming perennial herb, 0.07-0.15 m high with pink flowers.	Loamy clay, moist soil pockets. Wet flats, low granitic hills.	September to October.	Possible – suitable habitat present within survey area.	NM DPaW
Stylidiaceae	<i>Stylidium</i> sp. Banovich Road (F. & J. Hort 1884)	-	P1	Rosetted perennial herb to 0.2 m high with pink/yellow flowers.	Gravelly sand, clayey sand, sandy loam and sand over laterite on slopes and near creeklines.	September to November.	Possible – suitable habitat present within survey area.	NM DPaW
Stylidiaceae	<i>Stylidium torticarpum</i>	-	P3	Caespitose perennial herb, 0.12-0.27 m high with pink flowers.	Sandy clay and clay loam over laterite. Adjacent to creeklines, depressions, and beneath breakaways. Heaths or mallee shrubland.	September to November.	Likely – infertile specimen of this species was potentially recorded from within the survey area.	NM DPaW

Site:	HR01	Project: Hill River Offset Property	
Type:	Quadrat	Size:	10 x 10 m
Date:	01/08/2016	Described by:	MG/JF
Co-ordinates:	MGA 50J	331527 mE	6659221 mN
Location:	Lot 1, 1395 Banovich Road, Hill River		
Landform and slope:	Mid slope, gentle slope		
Drainage:	Good drainage		
Soil colour & type:	Brown loamy clay		
Vegetation condition:	1		
Fire age & intensity:	Old, no damage		
Disturbances:	None		
Leaf litter:	Sparse	Wood litter:	Sparse
Coarse gravel/pebbles 2-6 cm (%):	<2	Humus/Litter (%):	2-10



Species List

Species	Status	Stratum	% Cover	Height (cm)
<i>?Craspedia</i> sp.		G2	2-10%	20
<i>Allocasuarina humilis</i>		M1	<2%T	120
<i>Allocasuarina microstachya</i>		M1	30-70%	130
<i>Anigozanthos</i> sp.		G1	<2%T	30
<i>Astroloma</i> sp.		M2	<2%T	40
<i>Banksia armata</i>		M1	<2%T	130
<i>Borya nitida</i>		G1	10-30%	15
<i>Caladenia</i> sp.		G2	<2%T	5
<i>Calytrix</i> sp.		M2	<2%T	35
<i>Cassytha</i> sp.		G2	<2%T	C
<i>Conostylis ?crassinervia</i>		G1	<2%T	15
<i>Conostylis androstemma</i>		G1	<2%N	15

Species	Status	Stratum	% Cover	Height (cm)
<i>Cryptandra pungens</i>		M2	<2%T	40
<i>Diplolaena ferruginea</i>		M2	<2%T	50
<i>Drosera ?macrantha</i>		G2	<2%N	80
<i>Drosera erythrorhiza</i> subsp. <i>erythrorhiza</i>		G2	<2%N	10
<i>Haemodorum ?venosum</i>		G1	<2%T	30
<i>Hakea incrassata</i>		M2	<2%T	50
<i>Hakea neospathulata</i>		M2	<2%T	20
<i>Hibbertia acerosa</i>		M2	<2%T	20
<i>Hibbertia hypericoides</i>		M2	2-10%	50
<i>Hibbertia</i> sp.		M2	<2%T	45
<i>Hypocalymma xanthopetalum</i>		M2	<2%N	50
<i>Lepidobolus quadratus</i>	P3	G1	<2%T	15
<i>Lepidosperma</i> sp.		G1	<2%N	65
<i>Leporella fimbriata</i>		G2	<2%N	2
<i>Melaleuca ?trichophylla</i>		M2	<2%T	80
<i>Neurachne alopecuroidea</i>		G1	<2%N	20
<i>Opercularia vaginata</i>		M2	<2%T	15
<i>Petrophile chrysantha</i>		M2	<2%T	85
<i>Schoenus ?nanus/latitans</i>		G1	30-70%	5
<i>Schoenus subflavus</i>		G2	<2%T	10
<i>Stylidium ?repens</i>		G2	<2%T	10
<i>Stylidium</i> sp.		G2	<2%N	30
<i>Tetralochea paucifolia</i>		M2	<2%T	40
<i>Thomasia ?grandiflora</i>		M2	<2%T	30
<i>Verticordia</i> sp.		M2	<2%T	90
<i>Xanthorrhoea drummondii</i>		G1	<2%T	110

Site:	HR02	Project: Hill River Offset Property	
Type:	Quadrat	Size:	10 x 10 m
Date:	01/08/2016	Described by:	MG/JF
Co-ordinates:	MGA 50J	330757 mE	6659587 mN
Location:	Lot 1, 1395 Banovich Road, Hill River		
Landform and slope:	Drainage line, negligible slope		
Drainage:	Seasonal wet		
Soil colour & type:	Grey sand		
Vegetation condition:	2		
Fire age & intensity:	Nil, no damage		
Disturbances:	Weeds		
Leaf litter:	Moderate	Wood litter:	Sparse
Humus/Litter (%):	11-30		



Species List

Species	Status	Stratum	% Cover	Height (cm)
? <i>Hydrocotyle alata</i>		G2	<2%T	1
? <i>Pheladenia deformis</i>		G2	<2%N	15
? <i>Siloxerus</i> sp.		G2	<2%T	5
<i>Acacia saligna</i>		M1	<2%T	190
<i>Arctotheca calendula</i>	*	G2	<2%N	10
<i>Caladenia longicauda</i> subsp. <i>borealis</i>		G2	<2%T	30
<i>Calothamnus quadrifidus</i>		M2	<2%T	90
<i>Cassytha</i> sp.		G2	<2%N	C
<i>Chamaescilla corymbosa</i>		G1	<2%N	10
<i>Comesperma scoparium</i>		M2	<2%T	30
<i>Conostylis aculeata</i> subsp. <i>hipidion</i>		G1	<2%T	15
<i>Drosera ?glanduligera</i>		G2	<2%T	1

Species	Status	Stratum	% Cover	Height (cm)
<i>Drosera ?macrantha</i>		G2	2-10%	30
<i>Haemodorum</i> sp.		G1	<2%T	30
<i>Hakea erinacea</i>		M2	<2%T	70
<i>Hakea varia</i>		M1	<2%T	110
<i>Hypochaeris glabra</i>	*	G2	2-10%	5
<i>Lagenophora huegelii</i>		G2	<2%T	30
<i>Lomandra</i> sp.		G1	<2%T	70
<i>Lysimachia arvensis</i>	*	G2	<2%N	10
<i>Melaleuca ?delta</i>		M1	2-10%	170
<i>Melaleuca preissiana</i>		U1	2-10%	400
<i>Neurachne alopecuroidea</i>		G1	<2%T	10
<i>Pheladenia deformis</i>		G2	<2%T	2
<i>Pimelea argentea</i>		M2	<2%T	50
Poaceae sp.	*	G1	<2%N	10
<i>Podolepis ?lessonii</i>		G2	<2%N	10
Restionaceae sp.		G2	2-10%	80
<i>Trachymene pilosa</i>		G2	<2%N	10
<i>Tribonanthes ?australis</i>		G1	<2%N	10
<i>Tricoryne elatior</i>		G2	<2%N	10
<i>Ursinia anthemoides</i>	*	G2	<2%N	20
<i>Verticordia</i> sp.		M1	10-30%	130

Site:	HR03	Project: Hill River Offset Property	
Type:	Quadrat	Size:	10 x 10 m
Date:	01/08/2016	Described by:	MG/JF
Co-ordinates:	MGA 50J	331366 mE	6659859 mN
Location:	Lot 1, 1395 Banovich Road, Hill River		
Landform and slope:	Hillcrest, negligible slope		
Drainage:	Good drainage		
Soil colour & type:	Orange clayey sand		
Vegetation condition:	1		
Fire age & intensity:	Old, no damage		
Disturbances:	None		
Leaf litter:	Moderate	Wood litter:	Sparse
Humus/Litter (%):	2-10	Coarse gravel/pebbles 2-6 cm (%):	2-10
Cobbly/cobbles 6-20 cm (%):	2-10		



Species List

Species	Status	Stratum	% Cover	Height (cm)
? <i>Craspedia</i> sp.		G2	<2%T	10
<i>Acacia lasiocarpa</i> var. <i>lasiocarpa</i>		M2	<2%T	50
<i>Banksia armata</i>		M1	<2%N	40
<i>Borya nitida</i>		G1	<2%T	15
<i>Bossiaea eriocarpa</i>		M1	<2%T	40
<i>Calothamnus sanguineus</i>		M1	<2%N	50
<i>Calothamnus torulosus</i>		M1	<2%T	50
<i>Conostylis androstemma</i>		G1	<2%T	20
<i>Diplolaena ferruginea</i>		M1	<2%T	50
<i>Drosera erythrorhiza</i> subsp. <i>erythrorhiza</i>		G2	<2%N	1
Ericaceae sp.		M2	<2%T	30

Species	Status	Stratum	% Cover	Height (cm)
<i>Eucalyptus wandoo</i>		U1	10-30%	750
<i>Eucalyptus wandoo</i>		U2	<2%T	200
<i>Gastrolobium polystachyum</i>		M1	30-70%	80
<i>Gastrolobium spinosum</i>		M1	<2%N	100
<i>Gompholobium marginatum</i>		M1	<2%T	40
<i>Haemodorum ?venosum</i>		G1	<2%T	30
<i>Hakea incrassata</i>		M1	<2%T	40
<i>Hakea neospathulata</i>		M1	<2%T	70
<i>Hibbertia hypericoides</i>		M1	<2%N	30
<i>Hypocalymma xanthopetalum</i>		M1	<2%T	30
<i>Leucopogon ?oldfieldii</i>		M2	<2%T	50
<i>Neurachne alopecuroidea</i>		G1	2-10%	20
<i>Olearia</i> sp.		M2	<2%T	20
<i>Opercularia vaginata</i>		G2	<2%T	15
Orchidaceae sp.		G2	<2%N	20
<i>Petrophile ?brevifolia</i>		M2	<2%T	40
<i>Schoenus ?nanus/latitans</i>		G1	<2%T	5
<i>Tetralochea paucifolia</i>		M1	<2%N	30
<i>Verticordia</i> sp.		M2	<2%T	50
<i>Xanthorrhoea drummondii</i>		G1	10-30%	110

Site:	HR04	Project: Hill River Offset Property	
Type:	Quadrat	Size:	10 x 10 m
Date:	02/08/2016	Described by:	MG/JF
Co-ordinates:	MGA 50J	329935 mE	6658244 mN
Location:	Lot 1, 1395 Banovich Road, Hill River		
Landform and slope:	Mid slope, gentle slope		
Drainage:	Good drainage		
Soil colour & type:	Grey sandy clay		
Vegetation condition:	1		
Fire age & intensity:	Nil, no damage		
Disturbances:	None		
Leaf litter:	Sparse	Wood litter:	Negligible
Humus/Litter (%):	2-10	Coarse gravel/pebbles 2-6 cm (%):	2-10
Cobbly/cobbles 6-20 cm (%):	2-10		



Species List

Species	Status	Stratum	% Cover	Height (cm)
<i>?Chamaescilla corymbosa</i>		G2	2-10%	30
<i>?Craspedia sp.</i>		G2	<2%N	5
<i>Acacia ?ericifolia</i>		M2	<2%T	80
<i>Acacia incrassata</i>		M2	<2%T	30
<i>Allocasuarina humilis</i>		M2	<2%T	90
<i>Anigozanthos humilis</i>		G1	<2%T	20
<i>Banksia armata</i>		M1	<2%T	120
<i>Borya nitida</i>		G1	<2%T	10
<i>Burchardia sp.</i>		G2	<2%N	60
<i>Calothamnus sanguineus</i>		M2	2-10%	80
<i>Cassytha sp.</i>		G2	<2%T	C

Species	Status	Stratum	% Cover	Height (cm)
<i>Conostylis</i> sp.		G1	<2%T	20
<i>Cryptandra pungens</i>		M2	<2%N	90
<i>Dampiera</i> sp.		M2	<2%T	20
<i>Daviesia nudiflora</i>		M2	2-10%	80
<i>Drosera ?macrantha</i>		G2	<2%N	50
<i>Drosera erythrorhiza</i> subsp. <i>erythrorhiza</i>		G2	<2%N	2
<i>Gastrolobium capitatum</i>		M2	<2%T	90
<i>Hakea anadenia</i>		M2	2-10%	90
<i>Hakea erinacea</i>		M1	<2%N	120
<i>Hibbertia hypericoides</i>		M2	<2%N	60
<i>Hibbertia subvaginata</i>		M2	<2%T	30
<i>Hypocalymma xanthopetalum</i>		M2	<2%N	80
<i>Lepidobolus quadratus</i>	P3	G1	<2%T	20
<i>Lepidosperma ?squamatum</i>		G1	<2%T	30
<i>Lepidosperma</i> sp.		G1	<2%T	60
<i>Melaleuca platycalyx</i>		M2	<2%N	90
<i>Melaleuca</i> sp.		M2	<2%T	90
<i>Mirbelia floribunda</i>		M2	<2%T	90
<i>Neurachne alopecuroidea</i>		G1	<2%N	10
<i>Opercularia vaginata</i>		G2	<2%T	20
<i>Petrophile chrysantha</i>		M2	2-10%	80
<i>Schoenus ?nanus/latitans</i>		G1	10-30%	5
<i>Stenanthemum humile</i>		M2	<2%T	20
<i>Stylidium ?repens</i>		G2	<2%T	10
<i>Tetratheca paucifolia</i>		M2	<2%N	80
<i>Thomasia ?grandiflora</i>		M2	<2%T	80
<i>Verticordia</i> sp.		M1	<2%T	120

Site:	HR05	Project: Hill River Offset Property	
Type:	Quadrat	Size:	10 x 10 m
Date:	02/08/2016	Described by:	MG/JF
Co-ordinates:	MGA 50J	330148 mE	6657081 mN
Location:	Lot 1, 1395 Banovich Road, Hill River		
Landform and slope:	Valley, gentle slope		
Drainage:	Poor drainage		
Soil colour & type:	Brown clay		
Vegetation condition:	3		
Fire age & intensity:	Old, no damage		
Disturbances:	Pigs and weeds		
Leaf litter:	Moderate	Wood litter:	Sparse
Humus/Litter (%):	11-30		



Species List

Species	Status	Stratum	% Cover	Height (cm)
<i>?Bossiaea eriocarpa</i>		M2	<2%T	40
<i>?Craspedia sp.</i>		G2	<2%N	5
<i>?Glischrocaryon aureum</i>		G2	<2%T	40
<i>?Lepidobolus sp.</i>		G1	<2%T	20
<i>Acacia pulchella</i>		M2	<2%T	30
<i>Astroloma ?serratifolium</i>		M2	<2%T	20
<i>Banksia armata</i>		M1	<2%T	120
<i>Banksia armata</i>		M2	<2%N	80
<i>Borya nitida</i>		G1	<2%N	10
<i>Burchardia sp.</i>		G2	<2%N	40
<i>Conospermum sp.</i>		M2	<2%T	10
<i>Conostylis aculeata subsp. rhipidion</i>		G1	2-10%	20
<i>Conostylis sp.</i>		G1	<2%T	30

Species	Status	Stratum	% Cover	Height (cm)
<i>Daviesia nudiflora</i>		M2	<2%T	50
<i>Desmocladius ?lateriticus</i>		G1	<2%N	20
<i>Drosera ?macrantha</i>		G2	<2%N	25
<i>Drosera erythrorhiza</i> subsp. <i>erythrorhiza</i>		G2	<2%N	2
<i>Drosera erythrorhiza</i> subsp. <i>erythrorhiza</i>		G2	<2%T	5
<i>Eucalyptus wandoo</i>		U1	10-30%	1200
<i>Eucalyptus wandoo</i>		U2	2-10%	800
<i>Gompholobium knightianum</i>		M2	<2%T	15
<i>Hakea lissocarpha</i>		M2	<2%T	40
<i>Hemerocallidaceae</i> sp.		G1	<2%T	20
<i>Hypocalymma angustifolium</i>		M2	<2%T	20
<i>Lagenophora huegelii</i>		G2	<2%N	2
<i>Lomandra</i> sp.		G1	<2%T	15
<i>Macrozamia fraseri</i>		G1	<2%T	90
<i>Mirbelia floribunda</i>		M2	<2%T	20
<i>Neurachne alopecuroidea</i>		G1	2-10%	20
<i>Opercularia vaginata</i>		G2	<2%T	15
<i>Romulea rosea</i>	*	G2	2-10%	40
<i>Rytidosperma</i> sp.		G1	<2%T	15
<i>Scaevola</i> sp.		M2	2-10%	30
<i>Stackhousia monogyna</i>		G2	<2%T	30
<i>Tetralochea paucifolia</i>		M2	<2%T	10
<i>Trachymene pilosa</i>		G2	2-10%	5
<i>Wurmbea</i> sp.		G2	<2%T	5
<i>Xanthorrhoea drummondii</i>		G1	2-10%	130

Site:	HR06	Project: Hill River Offset Property	
Type:	Quadrat	Size:	10 x 10 m
Date:	02/08/2016	Described by:	MG/JF
Co-ordinates:	MGA 50J	329128 mE	6657463 mN
Location:	Lot 1, 1395 Banovich Road, Hill River		
Landform and slope:	Mid slope, gentle slope		
Drainage:	Good drainage		
Soil colour & type:	Grey sand		
Vegetation condition:	1		
Fire age & intensity:	Old, minor impact		
Disturbances:	None		
Leaf litter:	Moderate	Wood litter:	Negligible
Humus/Litter (%):	2-10		



Species List

Species	Status	Stratum	% Cover	Height (cm)
? <i>Comesperma</i> sp.		G2	<2%T	40
? <i>Isotropis</i> sp.		M2	<2%T	10
? <i>Leptocarpus</i> sp.		G1	<2%T	50
? <i>Senecio</i> sp.		G2	<2%T	20
<i>Acacia cochlearis</i>		M2	<2%T	90
<i>Acacia pulchella</i>		M2	<2%T	30
<i>Acacia stenoptera</i>		M2	<2%T	50
<i>Allocasuarina humilis</i>		M2	<2%T	100
<i>Anigozanthos humilis</i>		G1	<2%T	40
<i>Arctotheca calendula</i>	*	G2	<2%T	2
<i>Banksia shuttleworthiana</i>		M2	10-30%	30
<i>Burchardia</i> sp.		G2	<2%T	50
<i>Caladenia flava</i>		G2	<2%N	5

Species	Status	Stratum	% Cover	Height (cm)
<i>Caustis dioica</i>		G1	<2%T	50
<i>Conospermum</i> sp.		M1	10-30%	120
<i>Conospermum triplinervium</i>		M2	<2%N	40
<i>Conostephium pendulum</i>		M2	<2%T	50
<i>Conostylis aculeata</i> subsp. <i>hipidion</i>		G1	30-70%	20
<i>Conostylis setigera</i>		G1	<2%T	15
<i>Corymbia calophylla</i>		U1	10-30%	1100
<i>Corymbia calophylla</i>		M2	<2%T	30
<i>Drosera ?macrantha</i>		G2	<2%T	40
<i>Drosera erythrorhiza</i> subsp. <i>erythrorhiza</i>		G2	2-10%	2
<i>Gompholobium tomentosum</i>		M2	<2%T	80
<i>Hakea costata</i>		M1	<2%T	130
<i>Hakea costata</i>		M2	2-10%	90
<i>Hemiandra</i> sp. Jurien (B.J. Conn & M.E. Tozer BJC 3885)		M1	<2%T	110
<i>Hemiandra</i> sp. Jurien (B.J. Conn & M.E. Tozer BJC 3885)		M2	<2%T	70
<i>Hibbertia hypericoides</i>		M2	<2%N	40
<i>Hypocalymma xanthopetalum</i>		M2	<2%T	40
<i>Hypochoeris glabra</i>	*	G2	<2%N	2
<i>Lagenophora huegelii</i>		G2	<2%T	5
<i>Lepidobolus</i> sp.		G1	<2%N	40
<i>Lysimachia arvensis</i>	*	G2	<2%N	5
<i>Macrozamia fraseri</i>		G1	<2%T	110
<i>Melaleuca ?trichophylla</i>		M2	<2%T	60
<i>Mesomelaena pseudostygia</i>		G1	2-10%	50
<i>Opercularia vaginata</i>		G2	<2%T	60
<i>Pimelea floribunda</i>		M2	<2%T	60
<i>Ursinia anthemoides</i>	*	G2	<2%N	15
<i>Verticordia</i> sp.		M2	<2%T	80
<i>Xanthorrhoea drummondii</i>		G1	<2%T	140

Site:	HR07	Project: Hill River Offset Property	
Type:	Quadrat	Size:	10 x 10 m
Date:	02/08/2016	Described by:	MG/JF
Co-ordinates:	MGA 50J	328792 mE	6659297 mN
Location:	Lot 1, 1395 Banovich Road, Hill River		
Landform and slope:	Mid slope, gentle slope		
Drainage:	Good drainage		
Soil colour & type:	Orange loamy sand		
Vegetation condition:	1		
Fire age & intensity:	Old, no damage		
Disturbances:	None		
Leaf litter:	Sparse	Wood litter:	Negligible
Humus/Litter (%):	2-10	Fine rocks 2-6 mm (%):	<2



Species List

Species	Status	Stratum	% Cover	Height (cm)
? <i>Baেকেa</i> sp.		M2	<2%T	70
? <i>Craspedia</i> sp.		G2	<2%N	15
? <i>Leporella fimbriata</i>		G2	<2%T	2
<i>Acacia cochlearis</i>		M1	<2%T	110
<i>Acacia cochlearis</i>		M2	<2%T	90
<i>Allocasuarina humilis</i>		M2	2-10%	90
<i>Anigozanthos</i> sp.		G1	<2%T	15
<i>Banksia armata</i>		M1	<2%T	110
<i>Banksia armata</i>		M2	<2%T	70
<i>Borya nitida</i>		G1	<2%T	10
<i>Calothamnus quadrifidus</i>		M1	<2%T	120
<i>Cassytha</i> sp.		G2	<2%N	C
<i>Chamaescilla corymbosa</i>		G1	2-10%	15

Species	Status	Stratum	% Cover	Height (cm)
<i>Comesperma</i> sp.		M2	<2%T	50
<i>Conostephium preissii</i>		M2	<2%N	70
<i>Conostylis</i> sp.		G1	<2%T	15
<i>Cryptandra pungens</i>		M2	2-10%	80
<i>Drosera ?glanduligera</i>		G2	<2%T	1
<i>Drosera ?macrantha</i>		G2	<2%T	40
<i>Drosera erythrorhiza</i> subsp. <i>erythrorhiza</i>		G2	2-10%	2
<i>Gastrolobium capitatum</i>		M2	<2%T	70
<i>Hakea anadenia</i>		M1	<2%T	120
<i>Hakea anadenia</i>		M2	2-10%	90
<i>Hakea neospathulata</i>		M2	<2%T	40
<i>Hibbertia hypericoides</i>		M2	2-10%	70
<i>Hibbertia</i> sp.		M2	<2%N	40
<i>Hypocalymma xanthopetalum</i>		M2	<2%N	50
<i>Isopogon dubius</i>		M2	<2%T	80
<i>Lambertia multiflora</i>		M2	<2%T	70
<i>Lepidosperma</i> sp.		G1	<2%T	40
<i>Leptospermum spinescens</i>		M2	<2%T	70
<i>Melaleuca ?trichophylla</i>		M2	<2%T	80
<i>Neurachne alopecuroidea</i>		G1	<2%N	15
<i>Nuytsia floribunda</i>		M1	<2%T	140
<i>Opercularia vaginata</i>		G2	<2%N	20
<i>Orchidaceae</i> sp.		G2	<2%T	25
<i>Petrophile chrysantha</i>		M2	<2%T	50
<i>Petrophile macrostachya</i>		M2	<2%T	80
<i>Schoenus ?nanus/latitans</i>		G1	2-10%	5
<i>Schoenus</i> sp.		G1	<2%N	15
<i>Stylidium</i> sp.		G2	<2%N	15
<i>Tetratheca paucifolia</i>		M2	<2%T	40
<i>Xanthorrhoea drummondii</i>		G1	2-10%	90

Site:	HR08	Project: Hill River Offset Property	
Type:	Quadrat	Size:	10 x 10 m
Date:	02/08/2016	Described by:	MG/JF
Co-ordinates:	MGA 50J	328113 mE	6659659 mN
Location:	Lot 1, 1395 Banovich Road, Hill River		
Landform and slope:	Gully, negligible slope		
Drainage:	Seasonal wet		
Soil colour & type:	Brown clayey loam		
Vegetation condition:	1		
Fire age & intensity:	Old, no damage		
Disturbances:	None		
Leaf litter:	Moderate	Wood litter:	Sparse
Humus/Litter (%):	2-10		



Species List

Species	Status	Stratum	% Cover	Height (cm)
? <i>Scholtzia</i> sp.		M3	<2%T	50
<i>Acacia retrorsa</i>	P2	M3	<2%T	30
<i>Arnocrinum preissii</i>		G1	<2%N	10
<i>Baeckea</i> sp.		M3	<2%T	70
<i>Bossiaea eriocarpa</i>		M2	<2%T	110
<i>Caladenia</i> sp.		G2	<2%T	10
<i>Calothamnus quadrifidus</i>		M2	<2%N	140
<i>Calothamnus quadrifidus</i>		M3	<2%T	50
<i>Cassytha</i> sp.		G2	2-10%	C
<i>Cheilanthes austrotenuifolia</i>		G2	<2%N	20
<i>Eucalyptus rudis</i>		U1	10-30%	1400
<i>Hakea lissocarpa</i>		M3	<2%T	70
<i>Hypocalymma angustifolium</i>		M3	2-10%	40

Species	Status	Stratum	% Cover	Height (cm)
<i>Hypochaeris glabra</i>	*	G2	<2%N	10
<i>Lagenophora huegelii</i>		G2	<2%N	10
<i>Lysimachia arvensis</i>	*	G2	2-10%	5
Lythraceae sp.		G2	<2%N	15
<i>Melaleuca raphiophylla</i>		M1	10-30%	350
<i>Melaleuca raphiophylla</i>		M2	10-30%	180
<i>Melaleuca raphiophylla</i>		M3	<2%T	50
<i>Muehlenbeckia adpressa</i>		G2	<2%N	C
Orchidaceae sp.		G2	<2%N	20
<i>Orthrosanthus laxus</i>		G1	<2%T	20
<i>Oxalis</i> sp.	*	G2	<2%N	10
<i>Pimelea argentea</i>		M2	<2%N	160
Poaceae sp.		G1	30-70%	20
<i>Ptilotus polystachyus</i>		G2	<2%T	25
<i>Romulea rosea</i>	*	G1	<2%N	20
<i>Senecio</i> sp.		G2	<2%N	20
<i>Sonchus oleraceus</i>	*	G2	2-10%	10
<i>Stylidium</i> sp.		G2	<2%T	10
<i>Thysanotus</i> sp.		G2	<2%T	20
<i>Trachymene pilosa</i>		G2	<2%N	10
<i>Tricoryne elatior</i>		G1	<2%T	10
<i>Trymalium odoratissimum</i>		M2	2-10%	180
<i>Trymalium odoratissimum</i>		M3	<2%N	80
<i>Ursinia anthemoides</i>	*	G2	<2%N	10
<i>Xanthorrhoea</i> sp.		G1	<2%T	110

Site:	HR09	Project: Hill River Offset Property	
Type:	Quadrat	Size:	10 x 10 m
Date:	02/08/2016	Described by:	MG/JF
Co-ordinates:	MGA 50J	328673 mE	6660199 mN
Location:	Lot 1, 1395 Banovich Road, Hill River		
Landform and slope:	Ridge, gentle slope		
Drainage:	Good drainage		
Soil colour & type:	White loamy sand		
Vegetation condition:	1		
Fire age & intensity:	Old, no damage		
Disturbances:	None		
Leaf litter:	Sparse	Wood litter:	Negligible
Humus/Litter (%):	2-10	Coarse gravel/pebbles 2-6 cm (%):	<2



Species List

Species	Status	Stratum	% Cover	Height (cm)
<i>?Craspedia</i> sp.		G2	2-10%	20
<i>Allocasuarina humilis</i>		M1	<2%T	120
Apiaceae sp.		M2	2-10%	20
<i>Banksia ?dallanneyi</i> subsp. <i>media</i>		M2	<2%N	20
<i>Banksia armata</i>		M2	<2%T	90
<i>Borya nitida</i>		G1	<2%N	5
<i>Callitris ?acuminata</i>		M2	2-10%	80
<i>Calothamnus quadrifidus</i>		M2	<2%T	40
<i>Calothamnus sanguineus</i>		M2	2-10%	80
<i>Conostylis androstemma</i>		G1	<2%N	15
<i>Conothamnus trinervis</i>		M2	<2%T	40
<i>Cryptandra pungens</i>		M2	<2%T	50

Species	Status	Stratum	% Cover	Height (cm)
<i>Drosera ?macrantha</i>		G2	<2%T	10
<i>Drosera ?menziesii</i>		G2	<2%N	2
<i>Drosera erythrorhiza</i> subsp. <i>erythrorhiza</i>		G2	2-10%	5
<i>Eremaea</i> sp.		M2	<2%T	80
<i>Hakea anadenia</i>		M1	2-10%	130
<i>Hakea anadenia</i>		M2	10-30%	80
<i>Hakea erinacea</i>		M2	<2%T	70
<i>Hakea ruscifolia</i>		M2	<2%T	40
<i>Hibbertia acerosa</i>		M2	<2%T	30
<i>Hibbertia hypericoides</i>		M2	10-30%	70
<i>Hypocalymma xanthopetalum</i>		M2	2-10%	60
<i>Kingia australis</i>		G1	<2%T	100
<i>Lambertia multiflora</i>		M2	<2%T	50
<i>Leporella fimbriata</i>		G2	<2%N	2
<i>Melaleuca ?trichophylla</i>		M2	<2%T	50
<i>Neurachne alopecuroidea</i>		G1	<2%N	5
Orchidaceae sp.		G2	<2%N	15
<i>Petrophile chrysantha</i>		M2	<2%T	60
<i>Petrophile macrostachya</i>		M2	<2%T	60
Restionaceae sp.		G1	<2%T	10
<i>Schoenus ?nanus/latitans</i>		G1	<2%N	5
<i>Schoenus</i> sp.		G1	<2%T	10
<i>Stylidium ?repens</i>		G2	<2%T	10
<i>Tetraloche paucifolia</i>		M2	<2%T	40
<i>Xanthorrhoea drummondii</i>		G1	<2%N	80

Site:	HR10	Project: Hill River Offset Property	
Type:	Quadrat	Size:	10 x 10 m
Date:	02/08/2016	Described by:	MG/JF
Co-ordinates:	MGA 50J	329633 mE	6659497 mN
Location:	Lot 1, 1395 Banovich Road, Hill River		
Landform and slope:	Plain, negligible slope		
Drainage:	Good drainage		
Soil colour & type:	White sand		
Vegetation condition:	1		
Fire age & intensity:	Old, no damage		
Disturbances:	None		
Leaf litter:	Moderate	Wood litter:	Sparse
Humus/Litter (%):	2-10		



Species List

Species	Status	Stratum	% Cover	Height (cm)
<i>Alexgeorgea subterranea</i>		G1	<2%N	15
<i>Banksia attenuata</i>		U1	<2%T	300
<i>Banksia menziesii</i>		U1	<2%T	200
<i>Blancoa canescens</i>		G1	2-10%	20
<i>Calothamnus sanguineus</i>		M2	2-10%	120
<i>Cassytha</i> sp.		G2	<2%T	C
<i>Conostylis aculeata</i> subsp. <i>rhpidion</i>		G1	<2%T	40
<i>Darwinia sanguinea</i>		M3	<2%T	20
<i>Dasyogon obliquifolius</i>		G1	<2%T	20
<i>Drosera ?glanduligera</i>		G2	<2%T	2
<i>Drosera erythrorhiza</i> subsp. <i>erythrorhiza</i>		G2	<2%T	2
<i>Eremaea beaufortioides</i>		M2	2-10%	120
<i>Eremaea beaufortioides</i>		M3	2-10%	90

Species	Status	Stratum	% Cover	Height (cm)
<i>Eucalyptus todtiana</i>		U1	10-30%	600
<i>Gompholobium tomentosum</i>		M3	<2%T	70
<i>Haemodorum</i> sp.		G1	<2%T	30
<i>Hibbertia hypericoides</i>		M3	2-10%	70
<i>Hibbertia subvaginata</i>		M3	<2%T	20
<i>Hypocalymma xanthopetalum</i>		M2	<2%T	110
<i>Isotropis ?cuneifolia</i>		M3	<2%T	10
<i>Jacksonia floribunda</i>		M3	2-10%	90
<i>Lepidosperma</i> sp.		G1	<2%T	40
<i>Leptospermum spinescens</i>		M3	<2%T	70
<i>Leucopogon polymorphus</i>		M3	<2%T	70
<i>Lomandra</i> sp.		G1	<2%T	20
<i>Lyginia imberbis</i>		G1	<2%T	80
<i>Macrozamia fraseri</i>		G1	<2%T	180
<i>Melaleuca</i> sp.		M2	<2%T	120
<i>Mesomelaena pseudostygia</i>		G1	<2%T	40
<i>Opercularia vaginata</i>		G2	<2%N	15
<i>Pimelea</i> sp.		M3	<2%T	70
<i>Pterostylis sanguinea</i>		G2	<2%T	20
<i>Schoenus ?brevisetis</i>		G1	<2%T	150
<i>Scholtzia</i> sp.		M1	2-10%	230
<i>Scholtzia</i> sp.		M2	<2%N	130
<i>Sphaerolobium macranthum</i>		M3	<2%T	20
<i>Stirlingia latifolia</i>		M3	<2%T	60
<i>Thysanotus</i> sp.		G2	<2%T	C
<i>Verreauxia ?reinwardtii</i>		G2	<2%T	40

Site:	HR11	Project: Hill River Offset Property	
Type:	Quadrat	Size:	10 x 10 m
Date:	02/08/2016	Described by:	MG/JF
Co-ordinates:	MGA 50J	329843 mE	6659663 mN
Location:	Lot 1, 1395 Banovich Road, Hill River		
Landform and slope:	Upper slope, negligible slope		
Drainage:	Good drainage		
Soil colour & type:	Grey sand		
Vegetation condition:	1		
Fire age & intensity:	Old, no damage		
Disturbances:	None		
Leaf litter:	Sparse	Wood litter:	Negligible
Coarse gravel/pebbles 2-6 cm (%):	2-10	Humus/Litter (%):	2-10
Cobbly/cobbles 6-20 cm (%):	<2		



Species List

Species	Status	Stratum	% Cover	Height (cm)
? <i>Calytrix</i> sp.		G1	10-30%	80
<i>Acacia stenoptera</i>		M2	<2%T	40
<i>Banksia ?dallanneyi</i> subsp. <i>media</i>		M2	<2%T	20
<i>Banksia armata</i>		M1	<2%T	110
<i>Banksia armata</i>		M2	10-30%	90
<i>Banksia bipinnatifida</i> subsp. <i>multifida</i>		M2	<2%T	40
<i>Banksia shuttleworthiana</i>		M2	<2%T	60
<i>Blancoa canescens</i>		G1	<2%T	15
<i>Calothamnus sanguineus</i>		M1	<2%T	110
<i>Calothamnus sanguineus</i>		M2	2-10%	90

Species	Status	Stratum	% Cover	Height (cm)
<i>Calothamnus torulosus</i>		M2	2-10%	60
<i>Cassytha</i> sp.		G2	<2%T	C
<i>Caustis dioica</i>		G1	<2%T	80
<i>Conostylis ?hiemalis</i>		G1	<2%T	40
<i>Conostylis ?hiemalis</i>		G2	<2%N	10
<i>Conostylis setigera</i>		G1	<2%T	10
<i>Conothamnus trinervis</i>		M2	<2%T	60
<i>Cryptandra myriantha</i>		M2	<2%T	20
<i>Drosera ?macrantha</i>		G2	<2%N	5
<i>Drosera erythrorhiza</i> subsp. <i>erythrorhiza</i>		G2	<2%N	1
<i>Gastrolobium capitatum</i>		M2	<2%T	30
<i>Gastrolobium polystachyum</i>		M2	2-10%	80
<i>Haemodorum ?venosum</i>		G1	<2%N	40
<i>Hakea incrassata</i>		M2	<2%T	90
<i>Hakea lissocarpha</i>		M2	<2%T	90
<i>Hakea stenocarpa</i>		M2	<2%T	60
<i>Hibbertia acerosa</i>		M2	<2%T	30
<i>Hibbertia hypericoides</i>		M2	2-10%	80
<i>Hovea</i> sp.		M2	<2%T	20
<i>Hypocalymma xanthopetalum</i>		M2	<2%T	40
<i>Isopogon dubius</i>		M1	<2%T	110
<i>Kingia australis</i>		G1	<2%T	140
<i>Lepidosperma</i> sp.		G1	<2%T	50
<i>Leptomeria empetriformis</i>		M2	<2%T	30
<i>Melaleuca ?trichophylla</i>		M2	<2%T	20
<i>Neurachne alopecuroidea</i>		G1	2-10%	10
<i>Opercularia vaginata</i>		G2	<2%T	10
<i>Patersonia occidentalis</i>		G1	<2%T	50
<i>Petrophile ?brevifolia</i>		M2	<2%T	70
<i>Petrophile chrysantha</i>		M2	<2%T	50
<i>Philothea spicata</i>		M2	<2%T	40
<i>Pimelea ?angustifolia</i>		M2	<2%N	40
<i>Scaevola</i> sp.		M2	<2%T	10
<i>Schoenus</i> sp.		G1	<2%T	10
<i>Stackhousia monogyna</i>		G2	<2%T	50
<i>Stylidium ?piliferum</i>		G2	<2%T	5
<i>Thomasia ?grandiflora</i>		M2	<2%T	50
<i>Tricoryne elatior</i>		G1	<2%T	50
<i>Verticordia</i> sp.		M1	<2%T	110
<i>Verticordia</i> sp.		M2	<2%N	70

Site:	HR12	Project: Hill River Offset Property	
Type:	Quadrat	Size:	10 x 10 m
Date:	03/08/2016	Described by:	MG/JF
Co-ordinates:	MGA 50J	330847 mE	6656140 mN
Location:	Lot 1, 1395 Banovich Road, Hill River		
Landform and slope:	Upper slope, negligible slope		
Drainage:	Good drainage		
Soil colour & type:	White sand		
Vegetation condition:	1		
Fire age & intensity:	Old, no damage		
Disturbances:	None		
Leaf litter:	Sparse	Wood litter:	Negligible
Humus/Litter (%):	2-10		



Species List

Species	Status	Stratum	% Cover	Height (cm)
<i>Adenanthos cygnorum</i> subsp. <i>cygnorum</i>		M1	2-10%	300
<i>Alexgeorgea subterranea</i>		G1	<2%N	20
<i>Allocasuarina humilis</i>		M1	<2%T	210
<i>Allocasuarina humilis</i>		M2	<2%T	150
<i>Banksia attenuata</i>		M2	10-30%	130
<i>Banksia attenuata</i>		M3	<2%T	70
<i>Banksia candolleana</i>		M2	2-10%	120
<i>Banksia menziesii</i>		U1	<2%T	300
<i>Blancoa canescens</i>		G1	<2%N	30
<i>Cassytha</i> sp.		G2	<2%T	C
<i>Conostephium pendulum</i>		M3	<2%T	40
<i>Conostylis aculeata</i> subsp. <i>hipidion</i>		G1	<2%T	30
<i>Conostylis crassinervia</i> ?subsp. <i>crassinervia</i>		G1	2-10%	20

Species	Status	Stratum	% Cover	Height (cm)
<i>Conostylis setigera</i>		G1	<2%N	10
<i>Daviesia physodes</i>		M2	<2%T	110
<i>Drosera ?glanduligera</i>		G2	<2%N	2
<i>Drosera ?macrantha</i>		G2	<2%T	50
<i>Drosera erythrorhiza</i> subsp. <i>erythrorhiza</i>		G2	<2%N	2
<i>Drosera porrecta</i>		G2	<2%T	15
<i>Eremaea asterocarpa</i>		M2	10-30%	90
<i>Hakea eneabba</i>		M3	<2%T	90
<i>Hensmania stoniella</i>	P3	G1	<2%T	15
<i>Hibbertia acerosa</i>		M3	<2%T	40
<i>Hibbertia hypericoides</i>		M2	2-10%	70
<i>Hibbertia subvaginata</i>		M2	<2%N	80
<i>Hypocalymma xanthopetalum</i>		M2	<2%T	70
<i>Jacksonia floribunda</i>		M3	<2%T	90
<i>Johnsonia pubescens</i> subsp. <i>pubescens</i>		G1	<2%N	15
<i>Lepidosperma</i> sp.		G1	<2%T	90
<i>Leptospermum spinescens</i>		M3	<2%T	80
<i>Leucopogon polymorphus</i>		M2	<2%T	110
<i>Leucopogon</i> sp.		M3	2-10%	70
<i>Leucopogon</i> sp.		M2	<2%T	110
<i>Lyginia</i> sp.		G1	2-10%	80
<i>Lysinema pentapetalum</i>		M2	<2%T	130
<i>Melaleuca</i> sp.		M3	<2%T	30
<i>Mesomelaena pseudostygia</i>		G1	2-10%	70
<i>Nuytsia floribunda</i>		U1	<2%T	400
<i>Patersonia occidentalis</i>		G1	<2%T	50
<i>Petrophile linearis</i>		M3	<2%T	40
<i>Petrophile macrostachya</i>		M2	<2%T	90
<i>Petrophile seminuda</i>		M3	<2%T	90
<i>Pimelea</i> sp.		M3	<2%T	30
<i>Scaevola</i> sp.		M3	<2%T	30
<i>Schoenus ?brevisetis</i>		G1	<2%N	70
<i>Schoenus ?clandestinus</i>		G1	<2%T	10
<i>Schoenus subflavus</i>		G1	<2%T	20
<i>Scholtzia</i> sp.		M2	<2%T	130
<i>Sphaerolobium macranthum</i>		M3	<2%T	80
<i>Stirlingia latifolia</i>		M2	<2%T	90
<i>Stylidium ?hymenocraspedum</i>	P3	G2	<2%T	10
<i>Stylidium</i> sp.		G2	<2%T	20
<i>Thysanotus ?patersonii</i>		G1	<2%T	C
<i>Xanthorrhoea</i> sp.		G1	<2%T	70

Site:	HR13	Project: Hill River Offset Property	
Type:	Quadrat	Size:	10 x 10 m
Date:	03/08/2016	Described by:	MG/JF
Co-ordinates:	MGA 50J	330740 mE	6655536 mN
Location:	Lot 1, 1395 Banovich Road, Hill River		
Landform and slope:	Mid slope, gentle slope		
Drainage:	Good drainage		
Soil colour & type:	Grey sand		
Vegetation condition:	1		
Fire age & intensity:	Old, minor impact		
Disturbances:	None		
Leaf litter:	Negligible	Wood litter:	Negligible
Humus/Litter (%):	2-10		



Species List

Species	Status	Stratum	% Cover	Height (cm)
? <i>Calytrix</i> sp.		M3	<2%T	40
? <i>Craspedia</i> sp.		G2	<2%T	15
? <i>Sphaerolobium</i> sp.		M3	<2%T	30
<i>Acacia auronitens</i>		M2	<2%T	30
<i>Acacia cochlearis</i>		M2	<2%T	90
<i>Allocasuarina microstachya</i>		M2	2-10%	60
<i>Anigozanthos humilis</i>		G1	<2%N	20
<i>Astroloma ?serratifolium</i>		M3	<2%T	60
<i>Banksia ?dallanneyi</i> subsp. <i>media</i>		M2	<2%N	40
<i>Banksia armata</i>		M2	2-10%	90
<i>Banksia shuttleworthiana</i>		M2	2-10%	90
<i>Boronia cymosa</i>		M2	<2%T	40
<i>Borya nitida</i>		G1	<2%N	15

Species	Status	Stratum	% Cover	Height (cm)
<i>Burchardia</i> sp.		G1	<2%T	20
<i>Calothamnus sanguineus</i>		M1	<2%T	110
<i>Calothamnus torulosus</i>		M2	<2%T	30
<i>Caustis dioica</i>		G1	<2%T	30
<i>Conospermum triplinervium</i>		M2	<2%T	90
<i>Conostylis ?hiemalis</i>		G1	<2%N	15
<i>Conostylis setigera</i>		G1	<2%T	10
<i>Cryptandra pungens</i>		M2	<2%T	70
<i>Daviesia nudiflora</i>		M2	2-10%	80
<i>Drosera ?macrantha</i>		G2	<2%T	30
<i>Drosera ?menziesii</i>		G2	<2%N	20
<i>Drosera erythrorhiza</i> subsp. <i>erythrorhiza</i>		G2	<2%N	5
<i>Drosera porrecta</i>		G2	<2%N	15
<i>Ecdeiocolea monostachya</i>		G1	30-70%	100
<i>Haemodorum ?venosum</i>		G1	<2%T	30
<i>Hakea conchifolia</i>		M2	<2%T	90
<i>Hakea incrassata</i>		M1	<2%T	110
<i>Hakea neospathulata</i>		M3	<2%T	30
<i>Hibbertia hypericoides</i>		M2	2-10%	60
<i>Hypocalymma xanthopetalum</i>		M2	<2%T	40
<i>Leporella fimbriata</i>		G2	<2%T	3
<i>Leptospermum spinescens</i>		M2	<2%T	80
<i>Leucopogon</i> sp.		M2	<2%T	50
<i>Melaleuca</i> sp.		M2	<2%N	30
<i>Mesomelaena pseudostygia</i>		G1	<2%N	30
<i>Opercularia vaginata</i>		G2	2-10%	15
Orchidaceae sp.		G2	<2%T	10
<i>Petrophile chrysantha</i>		M2	<2%T	40
<i>Petrophile macrostachya</i>		M2	<2%T	50
<i>Prasophyllum parvifolium</i>		G2	<2%T	20
<i>Rytidosperma</i> sp.		G1	<2%T	10
<i>Schoenus ?nanus/latitans</i>		G1	2-10%	10
<i>Senecio</i> sp.		G2	<2%T	20
<i>Sphaerolobium drummondii</i>		M2	<2%T	70
<i>Stenanthemum humile</i>		M2	<2%T	20
<i>Stylidium ?hymenocraspedum</i>	P3	G2	<2%T	15
<i>Stylidium</i> sp.		G2	<2%T	15
<i>Tetraria octandra</i>		G1	<2%T	20
<i>Thomasia ?grandiflora</i>		M2	<2%T	80
<i>Verticordia</i> sp.		M2	<2%N	50

Site:	HR14	Project: Hill River Offset Property	
Type:	Quadrat	Size:	10 x 10 m
Date:	03/08/2016	Described by:	MG/JF
Co-ordinates:	MGA 50J	331794 mE	6656778 mN
Location:	Lot 1, 1395 Banovich Road, Hill River		
Landform and slope:	Hill crest, gentle slope		
Drainage:	Good drainage		
Soil colour & type:	Grey sand		
Vegetation condition:	1		
Fire age & intensity:	Old, no damage		
Disturbances:	None		
Leaf litter:	Negligible	Wood litter:	Negligible
Coarse gravel/pebbles 2-6 cm (%):	11-30	Humus/Litter (%):	<2
Fine rocks 2-6 mm (%):	2-10	Stony/stones 20-60 cm (%):	<2



Species List

Species	Status	Stratum	% Cover	Height (cm)
<i>Banksia armata</i>		M1	<2%T	80
<i>Banksia bipinnatifida</i> subsp. <i>multifida</i>		M1	<2%T	20
<i>Calothamnus sanguineus</i>		M1	<2%T	50
<i>Calothamnus torulosus</i>		M1	<2%T	30
<i>Cassylia</i> sp.		G2	<2%T	C
<i>Caustis dioica</i>		G1	<2%T	50
<i>Conostylis androstemma</i>		G1	10-30%	15
<i>Cryptandra myriantha</i>		M1	<2%T	20
<i>Cryptandra pungens</i>		M1	<2%T	50
<i>Daviesia nudiflora</i>		M1	<2%T	50

Species	Status	Stratum	% Cover	Height (cm)
<i>Drosera ?macrantha</i>		G2	<2%T	30
<i>Drosera erythrorhiza</i> subsp. <i>erythrorhiza</i>		G2	<2%N	2
<i>Gastrolobium polystachyum</i>		M1	<2%T	60
<i>Haemodorum</i> sp.		G1	<2%T	30
<i>Hakea conchifolia</i>		M1	<2%T	50
<i>Hakea neospathulata</i>		M1	<2%T	50
<i>Hibbertia acerosa</i>		M1	2-10%	30
<i>Hibbertia hypericoides</i>		M1	10-30%	70
<i>Hypocalymma xanthopetalum</i>		M1	<2%N	30
<i>Hypochoeris glabra</i>	*	G2	<2%T	2
<i>Isopogon asper</i>		M1	<2%T	30
<i>Isopogon drummondii</i>		M1	<2%T	30
<i>Lambertia multiflora</i>		M1	<2%T	20
<i>Lepidosperma</i> sp.		G1	10-30%	50
<i>Melaleuca</i> sp.		M1	<2%N	30
<i>Mesomelaena pseudostygia</i>		G1	<2%T	60
<i>Neurachne alopecuroidea</i>		G1	2-10%	15
<i>Petrophile chrysantha</i>		M1	<2%T	20
<i>Schoenus ?nanus/latitans</i>		G1	2-10%	5
<i>Stackhousia</i> sp.		G2	<2%N	40
<i>Stylidium</i> sp.		G2	2-10%	5
<i>Tetraria octandra</i>		G1	<2%N	30
<i>Trachymene pilosa</i>		G2	<2%T	5
<i>Xanthorrhoea</i> sp.		G1	2-10%	100

Site:	HR15	Project: Hill River Offset Property	
Type:	Quadrat	Size:	10 x 10 m
Date:	03/08/2016	Described by:	MG/JF
Co-ordinates:	MGA 50J	331363 mE	6659059 mN
Location:	Lot 1, 1395 Banovich Road, Hill River		
Landform and slope:	Drainage depression, negligible slope		
Drainage:	Seasonal wet		
Soil colour & type:	Brown clayey loam		
Vegetation condition:	2		
Fire age & intensity:	Moderate, few trees killed		
Disturbances:	Recent fire and weeds		
Leaf litter:	Moderate	Wood litter:	Sparse
Humus/Litter (%):	2-10		



Species List

Species	Status	Stratum	% Cover	Height (cm)
<i>Acacia saligna</i>		M2	<2%T	130
Anarthriaceae sp.		G1	2-10%	30
<i>Caladenia longicauda</i> subsp. <i>borealis</i>		G2	<2%N	30
<i>Calothamnus quadrifidus</i>		M3	2-10%	90
<i>Cassutha</i> sp.		G2	2-10%	C
<i>Daucus glochidiatus</i>		G2	<2%T	5
<i>Dianella revoluta</i>		G1	<2%T	90
<i>Drosera erythrorhiza</i> subsp. <i>erythrorhiza</i>		G2	<2%N	2
<i>Drosera</i> sp.		G2	<2%T	15
<i>Eucalyptus rudis</i>		U1	<2%T	900
<i>Hakea lissocarpha</i>		M3	<2%T	80
<i>Hypocalymma angustifolium</i>		M3	10-30%	90
<i>Hypochaeris glabra</i>	*	G2	<2%T	2

Species	Status	Stratum	% Cover	Height (cm)
<i>Jacksonia sternbergiana</i>		M3	<2%T	90
<i>Lagenophora huegelii</i>		G2	<2%N	5
<i>Lepidosperma</i> sp.		G1	<2%T	40
<i>Melaleuca platycalyx</i>		M2	<2%T	110
<i>Melaleuca platycalyx</i>		M3	2-10%	80
<i>Melaleuca raphiophylla</i>		M1	<2%N	300
<i>Melaleuca viminea</i>		M1	<2%T	210
<i>Melaleuca viminea</i>		M2	2-10%	180
<i>Melaleuca viminea</i>		M3	<2%N	80
<i>Pimelea argentea</i>		M3	<2%T	50
Poaceae sp.		G1	<2%N	10
<i>Quinetia urvillei</i>		G2	<2%N	10
<i>Romulea rosea</i>	*	G1	<2%N	20
<i>Senecio</i> sp.		G2	<2%T	10
<i>Stylidium ?tortricarpum</i>	P3	G2	<2%N	15
<i>Tribonanthes ?australis</i>		G1	<2%N	20

Site:	HR16	Project: Hill River Offset Property	
Type:	Quadrat	Size:	10 x 10 m
Date:	03/08/2016	Described by:	MG/JF
Co-ordinates:	MGA 50J	331982 mE	6659850 mN
Location:	Lot 1, 1395 Banovich Road, Hill River		
Landform and slope:	Mid slope, gentle slope		
Drainage:	Good drainage		
Soil colour & type:	White loamy sand		
Vegetation condition:	1		
Fire age & intensity:	Old, no damage		
Disturbances:	None		
Leaf litter:	Negligible	Wood litter:	Negligible
Humus/Litter (%):	2-10	Coarse gravel/pebbles 2-6 cm (%):	11-30



Species List

Species	Status	Stratum	% Cover	Height (cm)
? <i>Craspedia</i> sp.		G2	<2%N	50
<i>Allocasuarina microstachya</i>		M2	<2%T	30
<i>Anigozanthos</i> sp.		G1	<2%T	10
<i>Banksia armata</i>		M2	2-10%	50
<i>Banksia dallanneyi</i> subsp. <i>media</i>		M2	<2%N	20
<i>Bossiaea eriocarpa</i>		M2	<2%T	70
<i>Calothamnus quadrifidus</i>		M2	<2%T	100
<i>Calothamnus sanguineus</i>		M2	2-10%	40
<i>Calothamnus torulosus</i>		M2	<2%T	30
<i>Cassytha</i> sp.		G2	<2%T	20
<i>Caustis dioica</i>		G1	<2%T	20
<i>Conostylis androstemma</i>		G1	<2%N	10

Species	Status	Stratum	% Cover	Height (cm)
<i>Conostylis setigera</i>		G1	<2%T	10
<i>Conothamnus trinervis</i>		M2	<2%T	50
<i>Cryptandra pungens</i>		M2	<2%N	50
<i>Drosera ?macrantha</i>		G2	<2%N	10
<i>Gastrolobium capitatum</i>		M2	<2%T	60
<i>Gastrolobium polystachyum</i>		M2	2-10%	70
<i>Haemodorum ?venosum</i>		G1	<2%T	10
<i>Hakea conchifolia</i>		M2	<2%T	60
<i>Hakea flabellifolia</i>		M2	<2%T	20
<i>Hakea incrassata</i>		M2	2-10%	100
<i>Hakea neospathulata</i>		M2	<2%T	40
<i>Hibbertia acerosa</i>		M2	<2%N	20
<i>Hibbertia hypericoides</i>		M2	2-10%	40
<i>Hibbertia</i> sp.		M2	<2%T	30
<i>Hypocalymma xanthopetalum</i>		M2	<2%N	40
<i>Isopogon dubius</i>		M2	<2%T	50
<i>Isopogon inconspicuus</i>		M2	2-10%	40
<i>Isopogon</i> sp.		M2	<2%T	15
<i>Lepidobolus</i> sp.		G1	<2%T	15
<i>Leucopogon</i> sp.		M2	<2%T	20
<i>Lomandra sericea</i>		G1	<2%T	40
<i>Mesomelaena pseudostygia</i>		G1	<2%N	30
<i>Neurachne alopecuroidea</i>		G1	<2%N	5
<i>Rytidosperma</i> sp.		G1	<2%T	20
<i>Schoenus ?nanus/latitans</i>		G1	<2%N	5
<i>Schoenus</i> sp.		G1	<2%N	15
<i>Scholtzia</i> sp.		M2	<2%T	30
<i>Stylidium</i> sp.		M2	<2%T	5
<i>Synaphea aephyntsa</i>		G2	<2%T	30
<i>Tetragia octandra</i>		G1	<2%T	20
<i>Verticordia</i> sp.		M2	<2%T	80
<i>Xanthorrhoea drummondii</i>		G1	2-10%	80

Site:	HR17	Project: Hill River Offset Property	
Type:	Quadrat	Size:	10 x 10 m
Date:	04/08/2016	Described by:	MG/JF
Co-ordinates:	MGA 50J	327925 mE	6659958 mN
Location:	Lot 1, 1395 Banovich Road, Hill River		
Landform and slope:	Upper slope, gentle slope		
Drainage:	Poor drainage		
Soil colour & type:	Brown sandy loam		
Vegetation condition:	1		
Fire age & intensity:	Old, no damage		
Disturbances:	None		
Leaf litter:	Sparse	Wood litter:	Negligible
Humus/Litter (%):	2-10	Cobbly/cobbles 6-20 cm (%):	2-10
Stony/stones 20-60 cm (%):	<2		

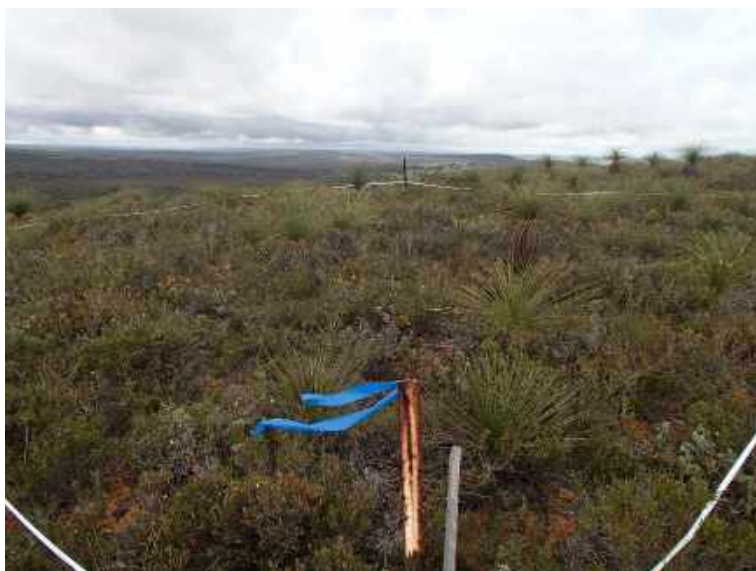


Species List

Species	Status	Stratum	% Cover	Height (cm)
<i>?Craspedia</i> sp.		G2	<2%N	5
<i>Acacia ?ericifolia</i>		M2	<2%T	80
<i>Acacia lasiocarpa</i> var. <i>lasiocarpa</i>		M2	<2%T	30
<i>Baeckea</i> sp.		M2	<2%T	50
<i>Borya nitida</i>		G1	<2%N	5
<i>Calothamnus quadrifidus</i>		M1	10-30%	150
<i>Cassytha</i> sp.		G2	<2%T	C
<i>Chamaescilla corymbosa</i>		G2	<2%T	5
<i>Cryptandra pungens</i>		M2	<2%T	70
<i>Drosera ?macrantha</i>		G2	<2%N	10
<i>Drosera erythrorhiza</i> subsp. <i>erythrorhiza</i>		G2	<2%N	1

Species	Status	Stratum	% Cover	Height (cm)
<i>Ficinia nodosa</i>		G1	<2%N	20
<i>Hakea lissocarpha</i>		M2	2-10%	100
<i>Hibbertia hypericoides</i>		M2	<2%N	50
<i>Hibbertia</i> sp.		M2	<2%T	30
<i>Lagenophora huegelii</i>		G2	<2%T	2
<i>Melaleuca ?concreta</i>		M1	2-10%	170
<i>Melaleuca platycalyx</i>		M1	10-30%	150
<i>Mesomelaena pseudostygia</i>		G1	<2%N	30
<i>Neurachne alopecuroidea</i>		G1	<2%N	2
Orchidaceae sp.		G2	<2%N	1
<i>Petrophile chrysantha</i>		M2	<2%N	80
<i>Senecio</i> sp.		G2	<2%N	5
<i>Stylidium</i> sp.		G2	<2%N	5
<i>Verticordia</i> sp.		M1	10-30%	120

Site:	HR18	Project: Hill River Offset Property	
Type:	Quadrat	Size:	10 x 10 m
Date:	04/08/2016	Described by:	MG/JF
Co-ordinates:	MGA 50J	330115 mE	6660685 mN
Location:	Lot 1, 1395 Banovich Road, Hill River		
Landform and slope:	Ridge, gentle slope		
Drainage:	Good drainage		
Soil colour & type:	Grey sand		
Vegetation condition:	1		
Fire age & intensity:	Old, no damage		
Disturbances:	None		
Leaf litter:	Sparse	Wood litter:	Negligible
Humus/Litter (%):	2-10	Cobbly/cobbles 6-20 cm (%):	2-10
Coarse gravel/pebbles 2-6 cm (%):	2-10	Surface plates/Boulders >60 cm (%):	<2



Species List

Species	Status	Stratum	% Cover	Height (cm)
<i>Acacia moirii</i> subsp. <i>recurvistipula</i>		M3	<2%N	20
<i>Allocasuarina humilis</i>		M2	<2%T	60
<i>Allocasuarina microstachya</i>		M2	<2%T	40
<i>Banksia ?sclerophylla</i>		M3	2-10%	60
<i>Banksia armata</i>		M2	<2%T	40
<i>Banksia dallanneyi</i> subsp. <i>media</i>		G2	<2%N	30
<i>Banksia micrantha</i>		M2	2-10%	50
<i>Calectasia narragara</i>		M3	<2%T	30
<i>Callitris ?acuminata</i>		M3	<2%T	20
<i>Calothamnus sanguineus</i>		M2	2-10%	50

Species	Status	Stratum	% Cover	Height (cm)
<i>Cassytha</i> sp.		G2	<2%T	C
<i>Caustis dioica</i>		G1	<2%N	15
<i>Conostylis ?teretiuscula</i>		G2	<2%N	15
<i>Conostylis aurea</i>		G2	<2%T	20
<i>Conothamnus trinervis</i>		M2	2-10%	50
<i>Dampiera</i> sp.		G2	<2%T	15
<i>Daviesia nudiflora</i>		M3	<2%T	30
<i>Desmocladus ?lateriticus</i>		G1	<2%N	5
<i>Drosera ?macrantha</i>		G2	<2%N	10
<i>Gastrolobium capitatum</i>		M2	<2%T	30
<i>Gastrolobium plicatum</i>		M3	<2%N	20
<i>Gastrolobium polystachyum</i>		M2	<2%T	50
<i>Gastrolobium</i> sp.		M3	<2%T	20
<i>Grevillea synapheae</i> subsp. <i>pachyphylla</i>		M3	<2%T	30
<i>Haemodorum</i> sp.		G2	<2%T	5
<i>Hakea conchifolia</i>		M2	2-10%	50
<i>Hibbertia acerosa</i>		M3	<2%N	30
<i>Hibbertia hypericoides</i>		M2	2-10%	40
<i>Hibbertia hypericoides</i> subsp. <i>septentrionalis</i>		M2	2-10%	30
<i>Hovea stricta</i>		M3	<2%T	20
<i>Hypocalymma xanthopetalum</i>		M2	<2%N	40
<i>Isopogon</i> sp.		G2	<2%T	20
<i>Lambertia multiflora</i>		M2	2-10%	40
<i>Lepidobolus</i> sp.		G1	<2%N	15
<i>Lepidosperma ?squamatum</i>		G1	<2%N	40
<i>Lepidosperma</i> sp.		G1	<2%N	30
<i>Leucopogon</i> sp.		M2	<2%T	30
<i>Melaleuca</i> sp.		M2	2-10%	40
<i>Mesomelaena pseudostygia</i>		G1	<2%N	40
<i>Mesomelaena tetragona</i>		G1	<2%T	40
<i>Neurachne alopecuroidea</i>		G1	<2%T	5
Orchidaceae sp.		G2	<2%T	2
<i>Petrophile ?brevifolia</i>		M3	<2%N	50
<i>Petrophile ?brevifolia</i>		G2	<2%T	50
<i>Petrophile chrysantha</i>		M3	<2%T	40
<i>Petrophile macrostachya</i>		M2	<2%T	70
<i>Philothea spicata</i>		M3	<2%T	40
<i>Pimelea</i> sp.		M3	<2%T	30
<i>Schoenus ?brevisetis</i>		G1	<2%N	10
<i>Stylidium</i> sp.		G2	<2%N	5
<i>Synaphea spinulosa</i>		M3	<2%T	40
<i>Tetragonia octandra</i>		G1	<2%N	20
<i>Xanthorrhoea drummondii</i>		G1	2-10%	100

Site:	HR19	Project: Hill River Offset Property	
Type:	Quadrat	Size:	10 x 10 m
Date:	04/08/2016	Described by:	MG/JF
Co-ordinates:	MGA 50J	330946 mE	6660721 mN
Location:	Lot 1, 1395 Banovich Road, Hill River		
Landform and slope:	Mid slope, gentle slope		
Drainage:	Good drainage		
Soil colour & type:	Grey loamy sand		
Vegetation condition:	1		
Fire age & intensity:	Old, minor impact		
Disturbances:	None		
Leaf litter:	Sparse	Wood litter:	Negligible
Humus/Litter (%):	2-10	Coarse gravel/pebbles 2-6 cm (%):	11-30
Surface plates/Boulders >60 cm (%):	<2		



Species List

Species	Status	Stratum	% Cover	Height (cm)
? <i>Craspedia</i> sp.		G2	<2%N	5
<i>Allocasuarina humilis</i>		M2	<2%T	90
<i>Allocasuarina microstachya</i>		M2	<2%N	40
<i>Andersonia lehmanniana</i> subsp. <i>lehmanniana</i>		M3	<2%T	40
<i>Banksia armata</i>		M2	2-10%	100
<i>Banksia dallanneyi</i> subsp. <i>media</i>		M3	<2%T	15
<i>Calectasia narragara</i>		M3	<2%T	15
<i>Calothamnus quadrifidus</i>		M2	2-10%	70
<i>Calothamnus torulosus</i>		M3	<2%N	15
<i>Cassytha</i> sp.		G2	<2%N	C

Species	Status	Stratum	% Cover	Height (cm)
<i>Conostylis ?teretiuscula</i>		G2	<2%T	10
<i>Conostylis androstemma</i>		G2	<2%N	20
<i>Conostylis setigera</i>		G2	<2%N	15
<i>Conothamnus trinervis</i>		M2	<2%T	60
<i>Cryptandra pungens</i>		M2	<2%T	60
<i>Drosera ?macrantha</i>		G2	<2%N	30
<i>Drosera erythrorhiza</i> subsp. <i>erythrorhiza</i>		G2	<2%N	2
<i>Gastrolobium polystachyum</i>		M2	<2%T	30
<i>Haemodorum</i> sp.		G2	<2%T	10
<i>Hakea conchifolia</i>		M2	<2%T	50
<i>Hakea incrassata</i>		M2	<2%T	70
<i>Hakea neospathulata</i>		M3	<2%T	30
<i>Hibbertia acerosa</i>		M3	<2%N	30
<i>Hibbertia hypericoides</i>		M2	2-10%	40
<i>Hypocalymma xanthopetalum</i>		M2	<2%N	30
<i>Isotropis</i> sp.		G2	<2%T	10
<i>Lagenophora huegelii</i>		G2	<2%T	3
<i>Lambertia multiflora</i>		M2	2-10%	100
<i>Lepidosperma</i> sp.		G1	<2%T	30
<i>Leucopogon</i> sp.		M3	<2%T	20
<i>Melaleuca ?trichophylla</i>		M2	2-10%	50
<i>Mesomelaena pseudostygia</i>		G1	<2%N	30
<i>Neurachne alopecuroidea</i>		G1	<2%N	5
<i>Petrophile chrysantha</i>		M2	<2%T	40
<i>Schoenus ?clandestinus</i>		G1	<2%N	5
<i>Scholtzia</i> sp.		M2	<2%T	80
<i>Sphaerolobium medium</i>		M3	<2%T	40
<i>Stylidium</i> sp.		G2	<2%T	3
<i>Synaphea spinulosa</i>		M3	<2%N	40
<i>Tetragia octandra</i>		G1	<2%T	20
<i>Tetratea paucifolia</i>		M3	<2%T	20
<i>Xanthorrhoea preissii</i>		G1	2-10%	130

Site:	HR20	Project: Hill River Offset Property	
Type:	Quadrat	Size:	10 x 10 m
Date:	05/08/2016	Described by:	MG/JF
Co-ordinates:	MGA 50J	328444 mE	6659245 mN
Location:	Lot 1, 1395 Banovich Road, Hill River		
Landform and slope:	Upper slope, gentle slope		
Drainage:	Good		
Soil colour & type:	White sand		
Vegetation condition:	1		
Fire age & intensity:	Old, no damage		
Disturbances:	None		
Leaf litter:	Moderate	Wood litter:	Negligible
Humus/Litter (%):	11-30		



Species List

Species	Status	Stratum	% Cover	Height (cm)
<i>Anigozanthos humilis</i>		G2	<2%T	15
<i>Banksia attenuata</i>		M1	10-30%	180
<i>Callitris ?acuminata</i>		M2	<2%T	80
<i>Calothamnus quadrifidus</i>		M2	<2%T	80
<i>Cassytha</i> sp.		M3	<2%T	C
<i>Conospermum triplinervium</i>		M3	<2%T	15
<i>Conostylis ?teretiuscula</i>		G2	<2%N	15
<i>Conostylis</i> sp.		G2	<2%T	15
<i>Daviesia podophylla</i>		M2	<2%T	60
<i>Drosera ?macrantha</i>		G2	<2%T	10
<i>Drosera erythrorhiza</i> subsp. <i>erythrorhiza</i>		G2	<2%N	1
<i>Eremaea asterocarpa</i>		M2	2-10%	60
<i>Haemodorum</i> sp.		G2	<2%T	10

Species	Status	Stratum	% Cover	Height (cm)
<i>Hakea erinacea</i>		M3	<2%T	30
<i>Hakea ruscifolia</i>		M2	<2%T	100
<i>Hibbertia acerosa</i>		M3	<2%T	20
<i>Hibbertia hypericoides</i>		M2	2-10%	40
<i>Hypocalymma xanthopetalum</i>		M2	2-10%	60
<i>Isotropis ?cuneifolia</i>		G2	<2%N	10
<i>Jacksonia floribunda</i>		M2	<2%T	70
<i>Lepidobolus</i> sp.		G1	<2%T	30
<i>Lepidosperma</i> sp.		G1	<2%N	30
<i>Leptospermum spinescens</i>		M2	<2%T	80
<i>Melaleuca ?tinkeri</i>		M2	10-30%	100
<i>Melaleuca</i> sp.		M2	<2%T	100
<i>Mesomelaena pseudostygia</i>		G1	2-10%	60
<i>Mesomelaena tetragona</i>		G1	<2%T	70
<i>Neurachne alopecuroidea</i>		G1	<2%N	5
<i>Patersonia occidentalis</i>		G2	<2%T	40
<i>Petrophile macrostachya</i>		M3	<2%N	40
<i>Pimelea</i> sp.		M3	<2%T	20
<i>Schoenus ?brevisetis</i>		G1	<2%N	20
<i>Schoenus ?clandestinus</i>		G1	<2%N	5
<i>Scholtzia</i> sp.		M2	<2%T	60
<i>Stirlingia latifolia</i>		M2	2-10%	100
<i>Strangea cynanchicarpa</i>		M2	2-10%	80
<i>Stylidium</i> sp.		G2	<2%N	2
<i>Thysanotus ?patersonii</i>		G2	<2%T	40



Threatened and Priority Flora Report Form

Please complete as much of the form as possible.

For information on how to complete the form please refer to the Threatened & Priority Flora Report Form (TPRF) manual on the DPaW website at <http://www.dpaw.wa.gov.au/>

TAXON: <u>Lepidobolus quadratus</u>		TPFL Pop. No.: _____	
OBSERVATION DATE: <u>01/08/2016</u>		CONSERVATION STATUS: <u>P3</u> New population <input checked="" type="checkbox"/>	
OBSERVER/S: <u>Mathew Gannaway</u>		PHONE: <u>(08) 6222 8058</u>	
ROLE: <u>Consultant - Ecologist</u>		ORGANISATION: <u>GHD</u>	

DESCRIPTION OF LOCATION (Provide at least nearest town/named locality, and the distance and direction to that place):

Located west of Banovich Road and north of Jurien Road, approximately 20 km north east of Jurien town site.

Reserve No.: _____

DISTRICT: Midwest **LGA:** Shire of Dandaragan Land manager present:

DATUM: GDA94 / MGA94 <input checked="" type="checkbox"/> AGD84 / AMG84 <input type="checkbox"/> WGS84 <input type="checkbox"/> Unknown <input type="checkbox"/>	COORDINATES: (If UTM coords provided, Zone is also required)			METHOD USED:	
	DecDegrees <input type="checkbox"/>	DegMinSec <input type="checkbox"/>	UTMs <input checked="" type="checkbox"/>	GPS <input checked="" type="checkbox"/>	Differential GPS <input type="checkbox"/> Map <input type="checkbox"/>
	Lat / Northing: <u>331527</u>		No. satellites: _____		Map used: _____
	Long / Easting: <u>6659221</u>		Boundary polygon captured: <input type="checkbox"/>		Map scale: _____
	Zone: <u>50J</u>				

LAND TENURE:

Nature reserve <input type="checkbox"/>	Timber reserve <input type="checkbox"/>	Private property <input checked="" type="checkbox"/>	Rail reserve <input type="checkbox"/>	Shire road reserve <input type="checkbox"/>
National park <input type="checkbox"/>	State forest <input type="checkbox"/>	Pastoral lease <input type="checkbox"/>	MRWA road reserve <input type="checkbox"/>	Other Crown reserve <input type="checkbox"/>
Conservation park <input type="checkbox"/>	Water reserve <input type="checkbox"/>	UCL <input type="checkbox"/>	SLK/Pole _____ to _____	Specify other: _____

AREA ASSESSMENT: Edge survey Partial survey Full survey Area observed (m²): _____

EFFORT: Time spent surveying (minutes): _____ No. of minutes spent / 100 m²: _____

POP'N COUNT ACCURACY: Actual Extrapolation Estimate

Count method: (Refer to field manual for list) _____

WHAT COUNTED: Plants Clumps Clonal stems

TOTAL POP'N STRUCTURE:	Mature:	Juveniles:	Seedlings:	Totals:
Alive	3			3
Dead				

Area of pop (m²): _____

Note: Pls record count as numbers (not percentages) for database.

QUADRATS PRESENT: No. _____ Size _____ Data attached Total area of quadrats (m²): _____

Summary Quad. Totals: Alive

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REPRODUCTIVE STATE: Clonal Vegetative Flowerbud Flower
Immature fruit Fruit Dehisced fruit Percentage in flower: _____%

CONDITION OF PLANTS: Healthy Moderate Poor Senescent

COMMENT:

THREATS - type, agent and supporting information:

E.g. clearing, too frequent fire, weed, disease. Refer to field manual for list of threats & agents. **Specify agent** where relevant.

Rate current and potential threat impact: N=Nil, L=Low, M=Medium, H=High, E=Extreme

Estimate time to potential impact: S=Short (<12mths), M=Medium (<5yrs), L=Long (5yrs+)

	Current impact (N-E)	Potential Impact (L-E)	Potential Threat Onset (S-L)
J Weeds	N	M	L
J	---	---	---
J	---	---	---

Please return completed form to **Species And Communities Branch** DPaW,

Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.

Record entered by: _____ Sheet No.: _____ Record Accepted in Database



Threatened and Priority Flora Report Form

Version 1.2 August 2013

HABITAT INFORMATION: (Check more than one box for combinations or where necessary)

LANDFORM:	ROCK TYPE:	LOOSE ROCK:	SOIL TYPE:	SOIL COLOUR:	DRAINAGE:
Crest <input type="checkbox"/> Hill <input type="checkbox"/> Ridge <input type="checkbox"/> Outcrop <input type="checkbox"/> Slope <input checked="" type="checkbox"/> Flat <input type="checkbox"/> Open depression <input type="checkbox"/> Drainage line <input type="checkbox"/> Closed depression <input type="checkbox"/> Wetland <input type="checkbox"/>	Granite <input type="checkbox"/> Dolerite <input type="checkbox"/> Laterite <input checked="" type="checkbox"/> Ironstone <input type="checkbox"/> Limestone <input type="checkbox"/> Quartz <input type="checkbox"/> Specify other:	(on soil surface; e.g. gravel, quartz fields) 0-10% <input checked="" type="checkbox"/> 10-30% <input type="checkbox"/> 30-50% <input type="checkbox"/> 50-100% <input type="checkbox"/>	Sand <input type="checkbox"/> Sandy loam <input type="checkbox"/> Loam <input type="checkbox"/> Clay loam <input checked="" type="checkbox"/> Light clay <input type="checkbox"/> Peat <input type="checkbox"/> Specify other:	Red <input type="checkbox"/> Brown <input checked="" type="checkbox"/> Yellow <input type="checkbox"/> White <input type="checkbox"/> Grey <input type="checkbox"/> Black <input type="checkbox"/> Specify other:	Well drained <input checked="" type="checkbox"/> Seasonally inundated <input type="checkbox"/> Permanently inundated <input type="checkbox"/> Tidal <input type="checkbox"/> Specify other:

Specific Landform Element: (Refer to field manual for additional values)

CONDITION OF SOIL:

Dry Moist Waterlogged Inundated Cracked Saline Other:

VEGETATION CLASSIFICATION:*

E.g. 1. Banksia woodland (B. attenuata, B. ilicifolia);
 2. Open shrubland (Hibbertia sp., Acacia spp.)
 3. Isolated clumps of sedges (Mesomelaena tetragona)

1. Heathland (*Allocasuarina microstachya*, *A. humilis*, *Banksia armata*, *Hibbertia hypericoides*)
2. Sparse rushland (*Schoenus ?nanus*, *Schoenus subflavus*)
3. Isolated grasses (*Neurachne alopecuroidea*)
- 4.

ASSOCIATED SPECIES:

Other (non-dominant) spp

Hypocalymma xanthopetalum
Hakea incrassata
Xanthorrhoea drummondii
Melaleuca ?trichophylla

* Please record up to four of the most representative vegetation layers (with up to three dominant species in each layer). Structural Formations should follow 2009 *Australian Soil and Land Survey Field Handbook* guidelines – refer to field manual for further information and structural formation table.

CONDITION OF HABITAT: Pristine Excellent Very good Good Degraded Completely degraded

COMMENT:

FIRE HISTORY: Last Fire: Season/Month: _____ Year: _____ Fire Intensity: High Medium Low No signs of fire

FENCING: Not required Present Replace / repair Required Length req'd: _____

ROADSIDE MARKERS: Not required Present Replace / reposition Required Quantity req'd: _____

OTHER COMMENTS: (Please include recommended management actions and/or implemented actions - include date. Also include details of additional data available, and how to locate it.)

Please return completed form to **Species And Communities Branch** DPaW,
 Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.

Record entered by: _____ Sheet No.: _____ Record Accepted in Database



Threatened and Priority Flora Report Form

DRF PERMIT/ LICENCE No: SL011729

Note if only observing plants (i.e. no specimens or plant material is taken) then no permit/licence is required. For further information on permit and licencing requirements see the Threatened Flora and Wildlife Licensing pages on DPaW's website. Any actions carried out under licence/permit should be recorded above in the OTHER COMMENTS section.

SPECIMEN: Collectors No: MG03 WA Herb. Regional Herb. District Herb. Other:

ATTACHED: Map Mudmap Photo GIS data Field notes Other:

COPY SENT TO: Regional Office District Office Other:

Submitter of record: Mathew Gannaway

Role: Ecologist

Signature:



Date submitted: 12/09/2016

Please return completed form to **Species And Communities Branch** DPaW,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.



Threatened and Priority Flora Report Form

Please complete as much of the form as possible.

For information on how to complete the form please refer to the Threatened & Priority Flora Report Form (TPRF) manual on the DPaW website at <http://www.dpaw.wa.gov.au/>

TAXON: <u>Stylidium ?hymenocraspedum</u>		TPFL Pop. No.: _____
OBSERVATION DATE: <u>03/08/2016</u>	CONSERVATION STATUS: <u>P3</u>	New population <input checked="" type="checkbox"/>
OBSERVER/S: <u>Mathew Gannaway</u>		PHONE : <u>(08) 6222 8058</u>
ROLE: <u>Consultant - Ecologist</u>		ORGANISATION: <u>GHD</u>

DESCRIPTION OF LOCATION (Provide at least nearest town/named locality, and the distance and direction to that place):

Located west of Banovich Road and north of Jurien Road, approximately 20 km north east of Jurien town site.

Reserve No.: _____

DISTRICT: Midwest **LGA:** Shire of Dandaragan Land manager present:

DATUM:	COORDINATES: (If UTM coords provided, Zone is also required)	METHOD USED:
GDA94 / MGA94 <input checked="" type="checkbox"/>	DecDegrees <input type="checkbox"/> DegMinSec <input type="checkbox"/> UTM's <input checked="" type="checkbox"/>	GPS <input checked="" type="checkbox"/> Differential GPS <input type="checkbox"/> Map <input type="checkbox"/>
AGD84 / AMG84 <input type="checkbox"/>	Lat / Northing: <u>330847</u>	No. satellites: _____ Map used: _____
WGS84 <input type="checkbox"/>	Long / Easting: <u>6656140</u>	Boundary polygon captured: <input type="checkbox"/> Map scale: _____
Unknown <input type="checkbox"/>	Zone: <u>50J</u>	

LAND TENURE:

- | | | | | |
|--|---|--|--|--|
| Nature reserve <input type="checkbox"/> | Timber reserve <input type="checkbox"/> | Private property <input checked="" type="checkbox"/> | Rail reserve <input type="checkbox"/> | Shire road reserve <input type="checkbox"/> |
| National park <input type="checkbox"/> | State forest <input type="checkbox"/> | Pastoral lease <input type="checkbox"/> | MRWA road reserve <input type="checkbox"/> | Other Crown reserve <input type="checkbox"/> |
| Conservation park <input type="checkbox"/> | Water reserve <input type="checkbox"/> | UCL <input type="checkbox"/> | SLK/Pole _____ to _____ | Specify other: _____ |

AREA ASSESSMENT: Edge survey Partial survey Full survey Area observed (m²): _____

EFFORT: Time spent surveying (minutes): _____ No. of minutes spent / 100 m²: _____

POP'N COUNT ACCURACY: Actual Extrapolation Estimate

Count method: (Refer to field manual for list) _____

WHAT COUNTED: Plants Clumps Clonal stems

TOTAL POP'N STRUCTURE:	Mature:	Juveniles:	Seedlings:	Totals:	Area of pop (m ²): _____ Note: Pls record count as numbers (not percentages) for database.
Alive	4			4	
Dead					

QUADRATS PRESENT: No. _____ Size _____ Data attached Total area of quadrats (m²): _____

Summary Quad. Totals: Alive

--	--	--	--

REPRODUCTIVE STATE: Clonal Vegetative Flowerbud Flower
Immature fruit Fruit Dehisced fruit Percentage in flower: _____%

CONDITION OF PLANTS: Healthy Moderate Poor Senescent

COMMENT:

THREATS - type, agent and supporting information:

E.g. clearing, too frequent fire, weed, disease. Refer to field manual for list of threats & agents. **Specify agent** where relevant.

Rate current and potential threat impact: N=Nil, L=Low, M=Medium, H=High, E=Extreme

Estimate time to potential impact: S=Short (<12mths), M=Medium (<5yrs), L=Long (5yrs+)

THREATS - type, agent and supporting information:	Current impact (N-E)	Potential Impact (L-E)	Potential Threat Onset (S-L)
J Weeds	N	M	L
J	---	---	---
J	---	---	---

Please return completed form to **Species And Communities Branch** DPaW,

Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.

Record entered by: _____ Sheet No.: _____ Record Accepted in Database



Threatened and Priority Flora Report Form

Version 1.2 August 2013

HABITAT INFORMATION: (Check more than one box for combinations or where necessary)

LANDFORM:	ROCK TYPE:	LOOSE ROCK:	SOIL TYPE:	SOIL COLOUR:	DRAINAGE:
Crest <input type="checkbox"/> Hill <input type="checkbox"/> Ridge <input type="checkbox"/> Outcrop <input type="checkbox"/> Slope <input checked="" type="checkbox"/> Flat <input type="checkbox"/> Open depression <input type="checkbox"/> Drainage line <input type="checkbox"/> Closed depression <input type="checkbox"/> Wetland <input type="checkbox"/>	Granite <input type="checkbox"/> Dolerite <input type="checkbox"/> Laterite <input type="checkbox"/> Ironstone <input type="checkbox"/> Limestone <input type="checkbox"/> Quartz <input type="checkbox"/> Specify other:	(on soil surface; e.g. gravel, quartz fields) 0-10% <input type="checkbox"/> 10-30% <input type="checkbox"/> 30-50% <input type="checkbox"/> 50-100% <input type="checkbox"/>	Sand <input checked="" type="checkbox"/> Sandy loam <input type="checkbox"/> Loam <input type="checkbox"/> Clay loam <input type="checkbox"/> Light clay <input type="checkbox"/> Peat <input type="checkbox"/> Specify other:	Red <input type="checkbox"/> Brown <input type="checkbox"/> Yellow <input type="checkbox"/> White <input checked="" type="checkbox"/> Grey <input type="checkbox"/> Black <input type="checkbox"/> Specify other:	Well drained <input checked="" type="checkbox"/> Seasonally inundated <input type="checkbox"/> Permanently inundated <input type="checkbox"/> Tidal <input type="checkbox"/> Specify other:

Specific Landform Element: (Refer to field manual for additional values)

CONDITION OF SOIL:

Dry Moist Waterlogged Inundated Cracked Saline Other:

VEGETATION CLASSIFICATION:*

E.g. 1. Banksia woodland (B. attenuata, B. ilicifolia);
 2. Open shrubland (Hibbertia sp., Acacia spp.)
 3. Isolated clumps of sedges (Mesomelaena tetragona)

1. Woodland (Eucalyptus todtiana, Banksia attenuata, B. menziesii)
2. Heathland (Adenanthos cygnorum subsp. cygnorum, Eremaea spp., Hibbertia spp.)
3. Sparse herbland (Stylidium spp., Conostylis spp., Drosera spp.)
- 4.

ASSOCIATED SPECIES:

Other (non-dominant) spp

Banksia candolleana
 Jacksonia floribunda
 Blancoa canescens
 Johnsonia pubescens subsp. pubescens

* Please record up to four of the most representative vegetation layers (with up to three dominant species in each layer). Structural Formations should follow 2009 *Australian Soil and Land Survey Field Handbook* guidelines – refer to field manual for further information and structural formation table.

CONDITION OF HABITAT: Pristine Excellent Very good Good Degraded Completely degraded

COMMENT:

FIRE HISTORY: Last Fire: Season/Month: _____ Year: _____ Fire Intensity: High Medium Low No signs of fire

FENCING: Not required Present Replace / repair Required Length req'd: _____

ROADSIDE MARKERS: Not required Present Replace / reposition Required Quantity req'd: _____

OTHER COMMENTS: (Please include recommended management actions and/or implemented actions - include date. Also include details of additional data available, and how to locate it.)

Please return completed form to **Species And Communities Branch** DPaW,
 Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.

Record entered by: _____ Sheet No.: _____ Record Accepted in Database



Threatened and Priority Flora Report Form

DRF PERMIT/ LICENCE No: SL011729

Note if only observing plants (i.e. no specimens or plant material is taken) then no permit/licence is required. For further information on permit and licencing requirements see the Threatened Flora and Wildlife Licensing pages on DPaW's website. Any actions carried out under licence/permit should be recorded above in the OTHER COMMENTS section.

SPECIMEN: Collectors No: WA Herb. Regional Herb. District Herb. Other:

ATTACHED: Map Mudmap Photo GIS data Field notes Other:

COPY SENT TO: Regional Office District Office Other:

Submitter of record: Mathew Gannaway

Role: Ecologist

Signature:



Date submitted: 12/09/2016

Please return completed form to **Species And Communities Branch** DPaW,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.



Threatened and Priority Flora Report Form

Please complete as much of the form as possible.

For information on how to complete the form please refer to the Threatened & Priority Flora Report Form (TPRF) manual on the DPaw website at <http://www.dpaw.wa.gov.au/>

TAXON: <u>Stylidium ?tortincarpum</u>		TPFL Pop. No.: _____	
OBSERVATION DATE: <u>03/08/2016</u>		CONSERVATION STATUS: <u>P3</u> New population <input checked="" type="checkbox"/>	
OBSERVER/S: <u>Mathew Gannaway</u>		PHONE: <u>(08) 6222 8058</u>	
ROLE: <u>Consultant - Ecologist</u>		ORGANISATION: <u>GHD</u>	

DESCRIPTION OF LOCATION (Provide at least nearest town/named locality, and the distance and direction to that place):

Located west of Banovich Road and north of Jurien Road, approximately 20 km north east of Jurien town site.

Reserve No.: _____

DISTRICT: Midwest **LGA:** Shire of Dandaragan Land manager present:

DATUM: GDA94 / MGA94 <input checked="" type="checkbox"/> AGD84 / AMG84 <input type="checkbox"/> WGS84 <input type="checkbox"/> Unknown <input type="checkbox"/>	COORDINATES: (If UTM coords provided, Zone is also required)			METHOD USED:	
	DecDegrees <input type="checkbox"/>	DegMinSec <input type="checkbox"/>	UTMs <input checked="" type="checkbox"/>	GPS <input checked="" type="checkbox"/>	Differential GPS <input type="checkbox"/> Map <input type="checkbox"/>
	Lat / Northing: <u>331363</u>		No. satellites: _____		Map used: _____
	Long / Easting: <u>6659059</u>		Boundary polygon captured: <input type="checkbox"/>		Map scale: _____
	Zone: <u>50J</u>				

LAND TENURE:

- | | | | | |
|--|---|--|--|--|
| Nature reserve <input type="checkbox"/> | Timber reserve <input type="checkbox"/> | Private property <input checked="" type="checkbox"/> | Rail reserve <input type="checkbox"/> | Shire road reserve <input type="checkbox"/> |
| National park <input type="checkbox"/> | State forest <input type="checkbox"/> | Pastoral lease <input type="checkbox"/> | MRWA road reserve <input type="checkbox"/> | Other Crown reserve <input type="checkbox"/> |
| Conservation park <input type="checkbox"/> | Water reserve <input type="checkbox"/> | UCL <input type="checkbox"/> | SLK/Pole _____ to _____ | Specify other: _____ |

AREA ASSESSMENT: Edge survey Partial survey Full survey Area observed (m²): _____

EFFORT: Time spent surveying (minutes): _____ No. of minutes spent / 100 m²: _____

POP'N COUNT ACCURACY: Actual Extrapolation Estimate

Count method: (Refer to field manual for list) _____

WHAT COUNTED: Plants Clumps Clonal stems

TOTAL POP'N STRUCTURE:	Mature:	Juveniles:	Seedlings:	Totals:
Alive	2			2
Dead				

Area of pop (m²): _____

Note: Pls record count as numbers (not percentages) for database.

QUADRATS PRESENT: No. _____ Size _____ Data attached Total area of quadrats (m²): _____

Summary Quad. Totals: Alive

--	--	--	--

REPRODUCTIVE STATE: Clonal Vegetative Flowerbud Flower
Immature fruit Fruit Dehisced fruit Percentage in flower: _____%

CONDITION OF PLANTS: Healthy Moderate Poor Senescent

COMMENT:

THREATS - type, agent and supporting information:

E.g. clearing, too frequent fire, weed, disease. Refer to field manual for list of threats & agents. **Specify agent** where relevant.

Rate current and potential threat impact: N=Nil, L=Low, M=Medium, H=High, E=Extreme

Estimate time to potential impact: S=Short (<12mths), M=Medium (<5yrs), L=Long (5yrs+)

THREATS - type, agent and supporting information:	Current impact (N-E)	Potential Impact (L-E)	Potential Threat Onset (S-L)
J Weeds	N	M	L
J	_____	_____	_____
J	_____	_____	_____

Please return completed form to **Species And Communities Branch** DPaw,

Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.

Record entered by: _____ Sheet No.: _____ Record Accepted in Database



Threatened and Priority Flora Report Form

Version 1.2 August 2013

HABITAT INFORMATION: (Check more than one box for combinations or where necessary)

LANDFORM:	ROCK TYPE:	LOOSE ROCK:	SOIL TYPE:	SOIL COLOUR:	DRAINAGE:
Crest <input type="checkbox"/> Hill <input type="checkbox"/> Ridge <input type="checkbox"/> Outcrop <input type="checkbox"/> Slope <input type="checkbox"/> Flat <input type="checkbox"/> Open depression <input type="checkbox"/> Drainage line <input checked="" type="checkbox"/> Closed depression <input type="checkbox"/> Wetland <input type="checkbox"/>	Granite <input type="checkbox"/> Dolerite <input type="checkbox"/> Laterite <input type="checkbox"/> Ironstone <input type="checkbox"/> Limestone <input type="checkbox"/> Quartz <input type="checkbox"/> Specify other:	(on soil surface; e.g. gravel, quartz fields) 0-10% <input type="checkbox"/> 10-30% <input type="checkbox"/> 30-50% <input type="checkbox"/> 50-100% <input type="checkbox"/>	Sand <input type="checkbox"/> Sandy loam <input type="checkbox"/> Loam <input type="checkbox"/> Clay loam <input checked="" type="checkbox"/> Light clay <input type="checkbox"/> Peat <input type="checkbox"/> Specify other:	Red <input type="checkbox"/> Brown <input checked="" type="checkbox"/> Yellow <input type="checkbox"/> White <input type="checkbox"/> Grey <input type="checkbox"/> Black <input type="checkbox"/> Specify other:	Well drained <input type="checkbox"/> Seasonally inundated <input checked="" type="checkbox"/> Permanently inundated <input type="checkbox"/> Tidal <input type="checkbox"/> Specify other:

Specific Landform Element: (Refer to field manual for additional values)

CONDITION OF SOIL:

Dry Moist Waterlogged Inundated Cracked Saline Other:

VEGETATION CLASSIFICATION:*

E.g. 1. Banksia woodland (B. attenuata, B. ilicifolia);
 2. Open shrubland (Hibbertia sp., Acacia spp.)
 3. Isolated clumps of sedges (Mesomelaena tetragona)

1. Woodland (Melaleuca raphiophylla, Eucalyptus rudis, Corymbia calophylla)
2. Open shrubland (Pimelea argentea, Melaleuca viminea, Calothamnus quadrifidus)
3. Open heathland (Hypocalymma angustifolium, Melaleuca platycalyx, Acacia spp.)
- 4.

ASSOCIATED SPECIES:

Other (non-dominant) spp

Trymalium odoratissimum
 *Romulea rosea
 *Hypochaeris glabra

* Please record up to four of the most representative vegetation layers (with up to three dominant species in each layer). Structural Formations should follow 2009 *Australian Soil and Land Survey Field Handbook* guidelines – refer to field manual for further information and structural formation table.

CONDITION OF HABITAT: Pristine Excellent Very good Good Degraded Completely degraded

COMMENT:

FIRE HISTORY: Last Fire: Season/Month: _____ Year: _____ Fire Intensity: High Medium Low No signs of fire

FENCING: Not required Present Replace / repair Required Length req'd: _____

ROADSIDE MARKERS: Not required Present Replace / reposition Required Quantity req'd: _____

OTHER COMMENTS: (Please include recommended management actions and/or implemented actions - include date. Also include details of additional data available, and how to locate it.)

Please return completed form to **Species And Communities Branch** DPaW,
 Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.

Record entered by: _____ Sheet No.: _____ Record Accepted in Database



Threatened and Priority Flora Report Form

DRF PERMIT/ LICENCE No: SL011729

Note if only observing plants (i.e. no specimens or plant material is taken) then no permit/licence is required. For further information on permit and licencing requirements see the Threatened Flora and Wildlife Licensing pages on DPaW's website. Any actions carried out under licence/permit should be recorded above in the OTHER COMMENTS section.

SPECIMEN: Collectors No: WA Herb. Regional Herb. District Herb. Other:

ATTACHED: Map Mudmap Photo GIS data Field notes Other:

COPY SENT TO: Regional Office District Office Other:

Submitter of record: Mathew Gannaway

Role: Ecologist

Signature:



Date submitted: 12/09/2016

Please return completed form to **Species And Communities Branch** DPaW,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.



Threatened and Priority Flora Report Form

Please complete as much of the form as possible.

For information on how to complete the form please refer to the Threatened & Priority Flora Report Form (TPRF) manual on the DPaW website at <http://www.dpaw.wa.gov.au/>

TAXON: <u>Lepidobolus quadratus</u>		TPFL Pop. No.: _____	
OBSERVATION DATE: <u>01/08/2016</u>		CONSERVATION STATUS: <u>P3</u> New population <input checked="" type="checkbox"/>	
OBSERVER/S: <u>Mathew Gannaway</u>		PHONE: <u>(08) 6222 8058</u>	
ROLE: <u>Consultant - Ecologist</u>		ORGANISATION: <u>GHD</u>	

DESCRIPTION OF LOCATION (Provide at least nearest town/named locality, and the distance and direction to that place):

Located west of Banovich Road and north of Jurien Road, approximately 20 km north east of Jurien town site.

Reserve No.: _____

DISTRICT: Midwest **LGA:** Shire of Dandaragan Land manager present:

DATUM: GDA94 / MGA94 <input checked="" type="checkbox"/> AGD84 / AMG84 <input type="checkbox"/> WGS84 <input type="checkbox"/> Unknown <input type="checkbox"/>	COORDINATES: (If UTM coords provided, Zone is also required)			METHOD USED:		
	DecDegrees <input type="checkbox"/>	DegMinSec <input type="checkbox"/>	UTMs <input checked="" type="checkbox"/>	GPS <input checked="" type="checkbox"/>	Differential GPS <input type="checkbox"/>	Map <input type="checkbox"/>
	Lat / Northing: <u>329935</u>			No. satellites: _____		Map used: _____
	Long / Easting: <u>6658244</u>			Boundary polygon captured: <input type="checkbox"/>		Map scale: _____
	Zone: <u>50J</u>					

LAND TENURE:

Nature reserve <input type="checkbox"/>	Timber reserve <input type="checkbox"/>	Private property <input checked="" type="checkbox"/>	Rail reserve <input type="checkbox"/>	Shire road reserve <input type="checkbox"/>
National park <input type="checkbox"/>	State forest <input type="checkbox"/>	Pastoral lease <input type="checkbox"/>	MRWA road reserve <input type="checkbox"/>	Other Crown reserve <input type="checkbox"/>
Conservation park <input type="checkbox"/>	Water reserve <input type="checkbox"/>	UCL <input type="checkbox"/>	SLK/Pole _____ to _____	Specify other: _____

AREA ASSESSMENT: Edge survey Partial survey Full survey Area observed (m²): _____

EFFORT: Time spent surveying (minutes): _____ No. of minutes spent / 100 m²: _____

POP'N COUNT ACCURACY: Actual Extrapolation Estimate

Count method: (Refer to field manual for list) _____

WHAT COUNTED: Plants Clumps Clonal stems

TOTAL POP'N STRUCTURE:	Mature:	Juveniles:	Seedlings:	Totals:
Alive	6			6
Dead				

Area of pop (m²): _____

Note: Pls record count as numbers (not percentages) for database.

QUADRATS PRESENT: No. _____ Size _____ Data attached Total area of quadrats (m²): _____

Summary Quad. Totals: Alive

--	--	--	--

REPRODUCTIVE STATE: Clonal Vegetative Flowerbud Flower
Immature fruit Fruit Dehisced fruit Percentage in flower: _____%

CONDITION OF PLANTS: Healthy Moderate Poor Senescent

COMMENT:

THREATS - type, agent and supporting information:

E.g. clearing, too frequent fire, weed, disease. Refer to field manual for list of threats & agents. **Specify agent** where relevant.

Rate current and potential threat impact: N=Nil, L=Low, M=Medium, H=High, E=Extreme

Estimate time to potential impact: S=Short (<12mths), M=Medium (<5yrs), L=Long (5yrs+)

	Current impact (N-E)	Potential Impact (L-E)	Potential Threat Onset (S-L)
J Weeds	N	M	L
J	---	---	---
J	---	---	---

Please return completed form to **Species And Communities Branch** DPaW,

Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.

Record entered by: _____ Sheet No.: _____ Record Accepted in Database



Threatened and Priority Flora Report Form

HABITAT INFORMATION: (Check more than one box for combinations or where necessary)

LANDFORM:	ROCK TYPE:	LOOSE ROCK:	SOIL TYPE:	SOIL COLOUR:	DRAINAGE:
Crest <input type="checkbox"/> Hill <input type="checkbox"/> Ridge <input type="checkbox"/> Outcrop <input type="checkbox"/> Slope <input checked="" type="checkbox"/> Flat <input type="checkbox"/> Open depression <input type="checkbox"/> Drainage line <input type="checkbox"/> Closed depression <input type="checkbox"/> Wetland <input type="checkbox"/>	Granite <input type="checkbox"/> Dolerite <input type="checkbox"/> Laterite <input checked="" type="checkbox"/> Ironstone <input type="checkbox"/> Limestone <input type="checkbox"/> Quartz <input type="checkbox"/> Specify other:	(on soil surface; e.g. gravel, quartz fields) 0-10% <input type="checkbox"/> 10-30% <input checked="" type="checkbox"/> 30-50% <input type="checkbox"/> 50-100% <input type="checkbox"/>	Sand <input checked="" type="checkbox"/> Sandy loam <input type="checkbox"/> Loam <input type="checkbox"/> Clay loam <input checked="" type="checkbox"/> Light clay <input type="checkbox"/> Peat <input type="checkbox"/> Specify other:	Red <input type="checkbox"/> Brown <input type="checkbox"/> Yellow <input type="checkbox"/> White <input type="checkbox"/> Grey <input checked="" type="checkbox"/> Black <input type="checkbox"/> Specify other:	Well drained <input checked="" type="checkbox"/> Seasonally inundated <input type="checkbox"/> Permanently inundated <input type="checkbox"/> Tidal <input type="checkbox"/> Specify other:

Specific Landform Element: (Refer to field manual for additional values)

CONDITION OF SOIL:

Dry Moist Waterlogged Inundated Cracked Saline Other:

VEGETATION CLASSIFICATION:*

E.g. 1. Banksia woodland (B. attenuata, B. ilicifolia);
 2. Open shrubland (Hibbertia sp., Acacia spp.)
 3. Isolated clumps of sedges (Mesomelaena tetragona)

1. Heathland (Petrophile chrysantha, Banksia armata, Calothamnus sanguineus, Daviesia nudiflora)
2. Sparse rushland (Schoenus ?nanus)
3. Isolated sedge (Lepidosperma squamatum)
4. Isolated herbs (Burchardia sp., Tetratheca paucifolia, Anigozanthos humilis)

ASSOCIATED SPECIES:

Other (non-dominant) spp

Hakea anadenia
 Hakea erinacea
 Hibbertia hypericoides

* Please record up to four of the most representative vegetation layers (with up to three dominant species in each layer). Structural Formations should follow 2009 *Australian Soil and Land Survey Field Handbook* guidelines – refer to field manual for further information and structural formation table.

CONDITION OF HABITAT: Pristine Excellent Very good Good Degraded Completely degraded

COMMENT:

FIRE HISTORY: Last Fire: Season/Month: _____ Year: _____ Fire Intensity: High Medium Low No signs of fire

FENCING: Not required Present Replace / repair Required Length req'd: _____

ROADSIDE MARKERS: Not required Present Replace / reposition Required Quantity req'd: _____

OTHER COMMENTS: (Please include recommended management actions and/or implemented actions - include date. Also include details of additional data available, and how to locate it.)

Please return completed form to **Species And Communities Branch** DPaW,
 Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.

Record entered by: _____ Sheet No.: _____ Record Accepted in Database



Threatened and Priority Flora Report Form

DRF PERMIT/ LICENCE No: SL011729

Note if only observing plants (i.e. no specimens or plant material is taken) then no permit/licence is required. For further information on permit and licencing requirements see the Threatened Flora and Wildlife Licensing pages on DPaW's website. Any actions carried out under licence/permit should be recorded above in the OTHER COMMENTS section.

SPECIMEN: Collectors No: MG03 WA Herb. Regional Herb. District Herb. Other:

ATTACHED: Map Mudmap Photo GIS data Field notes Other:

COPY SENT TO: Regional Office District Office Other:

Submitter of record: Mathew Gannaway

Role: Ecologist

Signature:



Date submitted: 12/09/2016

Please return completed form to **Species And Communities Branch** DPaW,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.



Threatened and Priority Flora Report Form

Please complete as much of the form as possible.

For information on how to complete the form please refer to the Threatened & Priority Flora Report Form (TPRF) manual on the DPaw website at <http://www.dpaw.wa.gov.au/>

TAXON: <u>Acacia retrorsa</u>		TPFL Pop. No.: _____	
OBSERVATION DATE: <u>02/08/2016</u>		CONSERVATION STATUS: <u>P2</u> New population <input checked="" type="checkbox"/>	
OBSERVER/S: <u>Mathew Gannaway</u>		PHONE: <u>(08) 6222 8058</u>	
ROLE: <u>Consultant - Ecologist</u>		ORGANISATION: <u>GHD</u>	

DESCRIPTION OF LOCATION (Provide at least nearest town/named locality, and the distance and direction to that place):

Located west of Banovich Road and north of Jurien Road, approximately 20 km north east of Jurien town site.

Reserve No.: _____

DISTRICT: Midwest **LGA:** Shire of Dandaragan Land manager present:

DATUM: GDA94 / MGA94 <input checked="" type="checkbox"/> AGD84 / AMG84 <input type="checkbox"/> WGS84 <input type="checkbox"/> Unknown <input type="checkbox"/>	COORDINATES: (If UTM coords provided, Zone is also required)			METHOD USED:	
	DecDegrees <input type="checkbox"/>	DegMinSec <input type="checkbox"/>	UTMs <input checked="" type="checkbox"/>	GPS <input checked="" type="checkbox"/>	Differential GPS <input type="checkbox"/> Map <input type="checkbox"/>
	Lat / Northing: <u>328792</u>		No. satellites: _____		Map used: _____
	Long / Easting: <u>6659297</u>		Boundary polygon captured: <input type="checkbox"/>		Map scale: _____
	Zone: <u>50J</u>				

LAND TENURE:

- | | | | | |
|--|---|--|--|--|
| Nature reserve <input type="checkbox"/> | Timber reserve <input type="checkbox"/> | Private property <input checked="" type="checkbox"/> | Rail reserve <input type="checkbox"/> | Shire road reserve <input type="checkbox"/> |
| National park <input type="checkbox"/> | State forest <input type="checkbox"/> | Pastoral lease <input type="checkbox"/> | MRWA road reserve <input type="checkbox"/> | Other Crown reserve <input type="checkbox"/> |
| Conservation park <input type="checkbox"/> | Water reserve <input type="checkbox"/> | UCL <input type="checkbox"/> | SLK/Pole _____ to _____ | Specify other: _____ |

AREA ASSESSMENT: Edge survey Partial survey Full survey Area observed (m²): _____

EFFORT: Time spent surveying (minutes): _____ No. of minutes spent / 100 m²: _____

POP'N COUNT ACCURACY: Actual Extrapolation Estimate

Count method: (Refer to field manual for list) _____

WHAT COUNTED: Plants Clumps Clonal stems

TOTAL POP'N STRUCTURE:	Mature:	Juveniles:	Seedlings:	Totals:
Alive	1			1
Dead				

Area of pop (m²): _____

Note: Pls record count as numbers (not percentages) for database.

QUADRATS PRESENT: No. _____ Size _____ Data attached Total area of quadrats (m²): _____

Summary Quad. Totals: Alive

--	--	--	--

REPRODUCTIVE STATE: Clonal Vegetative Flowerbud Flower
Immature fruit Fruit Dehisced fruit Percentage in flower: _____%

CONDITION OF PLANTS: Healthy Moderate Poor Senescent

COMMENT:

THREATS - type, agent and supporting information:

E.g. clearing, too frequent fire, weed, disease. Refer to field manual for list of threats & agents. **Specify agent** where relevant.

Rate current and potential threat impact: N=Nil, L=Low, M=Medium, H=High, E=Extreme

Estimate time to potential impact: S=Short (<12mths), M=Medium (<5yrs), L=Long (5yrs+)

	Current impact (N-E)	Potential Impact (L-E)	Potential Threat Onset (S-L)
J Weeds	N	M	L
J	_____	_____	_____
J	_____	_____	_____

Please return completed form to **Species And Communities Branch** DPaw,

Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.

Record entered by: _____ Sheet No.: _____ Record Accepted in Database



Threatened and Priority Flora Report Form

Version 1.2 August 2013

HABITAT INFORMATION: (Check more than one box for combinations or where necessary)

LANDFORM:	ROCK TYPE:	LOOSE ROCK:	SOIL TYPE:	SOIL COLOUR:	DRAINAGE:
Crest <input type="checkbox"/> Hill <input type="checkbox"/> Ridge <input type="checkbox"/> Outcrop <input type="checkbox"/> Slope <input checked="" type="checkbox"/> Flat <input type="checkbox"/> Open depression <input type="checkbox"/> Drainage line <input type="checkbox"/> Closed depression <input type="checkbox"/> Wetland <input type="checkbox"/>	Granite <input type="checkbox"/> Dolerite <input type="checkbox"/> Laterite <input checked="" type="checkbox"/> Ironstone <input type="checkbox"/> Limestone <input type="checkbox"/> Quartz <input type="checkbox"/> Specify other:	(on soil surface; e.g. gravel, quartz fields) 0-10% <input checked="" type="checkbox"/> 10-30% <input type="checkbox"/> 30-50% <input type="checkbox"/> 50-100% <input type="checkbox"/>	Sand <input type="checkbox"/> Sandy loam <input checked="" type="checkbox"/> Loam <input type="checkbox"/> Clay loam <input type="checkbox"/> Light clay <input type="checkbox"/> Peat <input type="checkbox"/> Specify other:	Red <input type="checkbox"/> Brown <input type="checkbox"/> Yellow <input type="checkbox"/> White <input type="checkbox"/> Grey <input type="checkbox"/> Black <input type="checkbox"/> Orange Specify other:	Well drained <input checked="" type="checkbox"/> Seasonally inundated <input type="checkbox"/> Permanently inundated <input type="checkbox"/> Tidal <input type="checkbox"/> Specify other:

Specific Landform Element: (Refer to field manual for additional values)

CONDITION OF SOIL:

Dry Moist Waterlogged Inundated Cracked Saline Other:

VEGETATION CLASSIFICATION:*

E.g. 1. Banksia woodland (B. attenuata, B. ilicifolia);
 2. Open shrubland (Hibbertia sp., Acacia spp.)
 3. Isolated clumps of sedges (Mesomelaena tetragona)

1. Heathland (*Allocasuarina humilis*, *Cryptandra pungens*, *Hakea anadenia*, *Hypocalymma xanthopetalum*)
2. Isolated clumps of mallee (*Eucalyptus drummondii*, *Eucalyptus wandoo*)
3. Sparse rushland (*Lepidosperma* sp., *Schoenus* sp._
4. Isolated herbs (*Conostylis* spp., *Drosera* spp., *Stylidium* spp.)

ASSOCIATED SPECIES:

Other (non-dominant) spp

Hibbertia hypericoides
Conostephium preissii
Neurachne alopecuroidea
Xanthorrhoea drummondii

* Please record up to four of the most representative vegetation layers (with up to three dominant species in each layer). Structural Formations should follow 2009 *Australian Soil and Land Survey Field Handbook* guidelines – refer to field manual for further information and structural formation table.

CONDITION OF HABITAT: Pristine Excellent Very good Good Degraded Completely degraded

COMMENT:

FIRE HISTORY: Last Fire: Season/Month: _____ Year: _____ Fire Intensity: High Medium Low No signs of fire

FENCING: Not required Present Replace / repair Required Length req'd: _____

ROADSIDE MARKERS: Not required Present Replace / reposition Required Quantity req'd: _____

OTHER COMMENTS: (Please include recommended management actions and/or implemented actions - include date. Also include details of additional data available, and how to locate it.)

Please return completed form to **Species And Communities Branch** DPaW,
 Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.

Record entered by: _____ Sheet No.: _____ Record Accepted in Database



Threatened and Priority Flora Report Form

DRF PERMIT/ LICENCE No: SL011729

Note if only observing plants (i.e. no specimens or plant material is taken) then no permit/licence is required. For further information on permit and licencing requirements see the Threatened Flora and Wildlife Licensing pages on DPaW's website. Any actions carried out under licence/permit should be recorded above in the OTHER COMMENTS section.

SPECIMEN: Collectors No: MG37 WA Herb. Regional Herb. District Herb. Other:

ATTACHED: Map Mudmap Photo GIS data Field notes Other:

COPY SENT TO: Regional Office District Office Other:

Submitter of record: Mathew Gannaway

Role: Ecologist

Signature:



Date submitted: 12/09/2016

Please return completed form to **Species And Communities Branch** DPaW,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.



Threatened and Priority Flora Report Form

Please complete as much of the form as possible.

For information on how to complete the form please refer to the Threatened & Priority Flora Report Form (TPRF) manual on the DPaw website at <http://www.dpaw.wa.gov.au/>

TAXON: <u>Acacia retrorsa</u>		TPFL Pop. No.: _____	
OBSERVATION DATE: <u>02/08/2016</u>		CONSERVATION STATUS: <u>P2</u> New population <input checked="" type="checkbox"/>	
OBSERVER/S: <u>Mathew Gannaway</u>		PHONE: <u>(08) 6222 8058</u>	
ROLE: <u>Consultant - Ecologist</u>		ORGANISATION: <u>GHD</u>	

DESCRIPTION OF LOCATION (Provide at least nearest town/named locality, and the distance and direction to that place):

Located west of Banovich Road and north of Jurien Road, approximately 20 km north east of Jurien town site.

Reserve No.: _____

DISTRICT: Midwest **LGA:** Shire of Dandaragan Land manager present:

DATUM:		COORDINATES: (If UTM coords provided, Zone is also required)		METHOD USED:	
GDA94 / MGA94 <input checked="" type="checkbox"/>	DecDegrees <input type="checkbox"/>	DegMinSec <input type="checkbox"/>	UTMs <input checked="" type="checkbox"/>	GPS <input checked="" type="checkbox"/>	Differential GPS <input type="checkbox"/> Map <input type="checkbox"/>
AGD84 / AMG84 <input type="checkbox"/>	Lat / Northing: <u>328113</u>		No. satellites: _____		Map used: _____
WGS84 <input type="checkbox"/>	Long / Easting: <u>6659659</u>		Boundary polygon captured: <input type="checkbox"/>		Map scale: _____
Unknown <input type="checkbox"/>	Zone: <u>50J</u>				

LAND TENURE:

- | | | | | |
|--|---|--|--|--|
| Nature reserve <input type="checkbox"/> | Timber reserve <input type="checkbox"/> | Private property <input checked="" type="checkbox"/> | Rail reserve <input type="checkbox"/> | Shire road reserve <input type="checkbox"/> |
| National park <input type="checkbox"/> | State forest <input type="checkbox"/> | Pastoral lease <input type="checkbox"/> | MRWA road reserve <input type="checkbox"/> | Other Crown reserve <input type="checkbox"/> |
| Conservation park <input type="checkbox"/> | Water reserve <input type="checkbox"/> | UCL <input type="checkbox"/> | SLK/Pole _____ to _____ | Specify other: _____ |

AREA ASSESSMENT: Edge survey Partial survey Full survey Area observed (m²): _____

EFFORT: Time spent surveying (minutes): _____ No. of minutes spent / 100 m²: _____

POP'N COUNT ACCURACY: Actual Extrapolation Estimate

Count method: (Refer to field manual for list) _____

WHAT COUNTED: Plants Clumps Clonal stems

TOTAL POP'N STRUCTURE:	Mature:	Juveniles:	Seedlings:	Totals:	Area of pop (m ²): _____ Note: Pls record count as numbers (not percentages) for database.
Alive	1			1	
Dead					

QUADRATS PRESENT: No. _____ Size _____ Data attached Total area of quadrats (m²): _____

Summary Quad. Totals: Alive

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REPRODUCTIVE STATE: Clonal Vegetative Flowerbud Flower
 Immature fruit Fruit Dehisced fruit Percentage in flower: _____%

CONDITION OF PLANTS: Healthy Moderate Poor Senescent

COMMENT:

THREATS - type, agent and supporting information:

E.g. clearing, too frequent fire, weed, disease. Refer to field manual for list of threats & agents. **Specify agent** where relevant.

Rate current and potential threat impact: N=Nil, L=Low, M=Medium, H=High, E=Extreme

Estimate time to potential impact: S=Short (<12mths), M=Medium (<5yrs), L=Long (5yrs+)

THREATS - type, agent and supporting information:	Current impact (N-E)	Potential Impact (L-E)	Potential Threat Onset (S-L)
J Weeds	L	M	M
J	---	---	---
J	---	---	---

Please return completed form to **Species And Communities Branch** DPaw,

Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.

Record entered by: _____ Sheet No.: _____ Record Accepted in Database



Threatened and Priority Flora Report Form

HABITAT INFORMATION: (Check more than one box for combinations or where necessary)

LANDFORM:	ROCK TYPE:	LOOSE ROCK:	SOIL TYPE:	SOIL COLOUR:	DRAINAGE:
Crest <input type="checkbox"/> Hill <input type="checkbox"/> Ridge <input type="checkbox"/> Outcrop <input type="checkbox"/> Slope <input type="checkbox"/> Flat <input type="checkbox"/> Open depression <input type="checkbox"/> Drainage line <input checked="" type="checkbox"/> Closed depression <input type="checkbox"/> Wetland <input type="checkbox"/>	Granite <input type="checkbox"/> Dolerite <input type="checkbox"/> Laterite <input type="checkbox"/> Ironstone <input type="checkbox"/> Limestone <input type="checkbox"/> Quartz <input type="checkbox"/> Specify other:	(on soil surface; e.g. gravel, quartz fields) 0-10% <input type="checkbox"/> 10-30% <input type="checkbox"/> 30-50% <input type="checkbox"/> 50-100% <input type="checkbox"/>	Sand <input type="checkbox"/> Sandy loam <input type="checkbox"/> Loam <input type="checkbox"/> Clay loam <input checked="" type="checkbox"/> Light clay <input type="checkbox"/> Peat <input type="checkbox"/> Specify other:	Red <input type="checkbox"/> Brown <input checked="" type="checkbox"/> Yellow <input type="checkbox"/> White <input type="checkbox"/> Grey <input type="checkbox"/> Black <input type="checkbox"/> Specify other:	Well drained <input type="checkbox"/> Seasonally inundated <input checked="" type="checkbox"/> Permanently inundated <input type="checkbox"/> Tidal <input type="checkbox"/> Specify other:

Specific Landform Element: (Refer to field manual for additional values)

CONDITION OF SOIL:

Dry Moist Waterlogged Inundated Cracked Saline Other:

VEGETATION CLASSIFICATION:*

E.g. 1. Banksia woodland (B. attenuata, B. ilicifolia);
 2. Open shrubland (Hibbertia sp., Acacia spp.)
 3. Isolated clumps of sedges (Mesomelaena tetragona)

1. Woodland (Melaleuca raphiophylla, Eucalyptus rudis)
2. Open shrubland (Pimelea argentea, Melaleuca viminea, Calothamnus quadrifidus)
3. Open heathland (Hypocalymma angustifolium, Melaleuca platycalyx, Acacia spp.)
4. Open herbland (*Lysimachia arvensis, *Romulea rosea)

ASSOCIATED SPECIES:

Other (non-dominant) spp

Trymalium odoratissimum

* Please record up to four of the most representative vegetation layers (with up to three dominant species in each layer). Structural Formations should follow 2009 *Australian Soil and Land Survey Field Handbook* guidelines – refer to field manual for further information and structural formation table.

CONDITION OF HABITAT: Pristine Excellent Very good Good Degraded Completely degraded

COMMENT:

FIRE HISTORY: Last Fire: Season/Month: _____ Year: _____ Fire Intensity: High Medium Low No signs of fire

FENCING: Not required Present Replace / repair Required Length req'd: _____

ROADSIDE MARKERS: Not required Present Replace / reposition Required Quantity req'd: _____

OTHER COMMENTS: (Please include recommended management actions and/or implemented actions - include date. Also include details of additional data available, and how to locate it.)

Please return completed form to **Species And Communities Branch** DPaW,
 Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.

Record entered by: _____ Sheet No.: _____ Record Accepted in Database



Threatened and Priority Flora Report Form

DRF PERMIT/ LICENCE No: SL011729

Note if only observing plants (i.e. no specimens or plant material is taken) then no permit/licence is required. For further information on permit and licencing requirements see the Threatened Flora and Wildlife Licensing pages on DPaW's website. Any actions carried out under licence/permit should be recorded above in the OTHER COMMENTS section.

SPECIMEN: Collectors No: MG37 WA Herb. Regional Herb. District Herb. Other:

ATTACHED: Map Mudmap Photo GIS data Field notes Other:

COPY SENT TO: Regional Office District Office Other:

Submitter of record: Mathew Gannaway

Role: Ecologist

Signature:



Date submitted: 12/09/2016

Please return completed form to **Species And Communities Branch** DPaW,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.



Threatened and Priority Flora Report Form

Please complete as much of the form as possible.

For information on how to complete the form please refer to the Threatened & Priority Flora Report Form (TPRF) manual on the DPaW website at <http://www.dpaw.wa.gov.au/>

TAXON: <u>Grevillea delta</u>		TPFL Pop. No.: _____	
OBSERVATION DATE: <u>02/08/2016</u>		CONSERVATION STATUS: <u>P2</u> New population <input checked="" type="checkbox"/>	
OBSERVER/S: <u>Mathew Gannaway</u>		PHONE <u>(08) 6222 8058</u>	
ROLE: <u>Consultant - Ecologist</u>		ORGANISATION: <u>GHD</u>	

DESCRIPTION OF LOCATION (Provide at least nearest town/named locality, and the distance and direction to that place):

Located west of Banovich Road and north of Jurien Road, approximately 20 km north east of Jurien town site.

Reserve No.: _____

DISTRICT: Midwest **LGA:** Shire of Dandaragan Land manager present:

DATUM: GDA94 / MGA94 <input checked="" type="checkbox"/> AGD84 / AMG84 <input type="checkbox"/> WGS84 <input type="checkbox"/> Unknown <input type="checkbox"/>	COORDINATES: (If UTM coords provided, Zone is also required)			METHOD USED:	
	DecDegrees <input type="checkbox"/>	DegMinSec <input type="checkbox"/>	UTMs <input checked="" type="checkbox"/>	GPS <input checked="" type="checkbox"/>	Differential GPS <input type="checkbox"/> Map <input type="checkbox"/>
	Lat / Northing: <u>328371</u>		No. satellites: _____		Map used: _____
	Long / Easting: <u>6659895</u>		Boundary polygon captured: <input type="checkbox"/>		Map scale: _____
	Zone: <u>50J</u>				

LAND TENURE:

- | | | | | |
|--|---|--|--|--|
| Nature reserve <input type="checkbox"/> | Timber reserve <input type="checkbox"/> | Private property <input checked="" type="checkbox"/> | Rail reserve <input type="checkbox"/> | Shire road reserve <input type="checkbox"/> |
| National park <input type="checkbox"/> | State forest <input type="checkbox"/> | Pastoral lease <input type="checkbox"/> | MRWA road reserve <input type="checkbox"/> | Other Crown reserve <input type="checkbox"/> |
| Conservation park <input type="checkbox"/> | Water reserve <input type="checkbox"/> | UCL <input type="checkbox"/> | SLK/Pole _____ to _____ | Specify other: _____ |

AREA ASSESSMENT: Edge survey Partial survey Full survey Area observed (m²): _____

EFFORT: Time spent surveying (minutes): _____ No. of minutes spent / 100 m²: _____

POP'N COUNT ACCURACY: Actual Extrapolation Estimate

Count method: (Refer to field manual for list) _____

WHAT COUNTED: Plants Clumps Clonal stems

TOTAL POP'N STRUCTURE:	Mature:	Juveniles:	Seedlings:	Totals:
Alive	1			1
Dead				

Area of pop (m²): _____

Note: Pls record count as numbers (not percentages) for database.

QUADRATS PRESENT: No. _____ Size _____ Data attached Total area of quadrats (m²): _____

Summary Quad. Totals: Alive

--	--	--	--

REPRODUCTIVE STATE: Clonal Vegetative Flowerbud Flower
Immature fruit Fruit Dehisced fruit Percentage in flower: _____%

CONDITION OF PLANTS: Healthy Moderate Poor Senescent

COMMENT:

THREATS - type, agent and supporting information:

E.g. clearing, too frequent fire, weed, disease. Refer to field manual for list of threats & agents. **Specify agent** where relevant.

Rate current and potential threat impact: N=Nil, L=Low, M=Medium, H=High, E=Extreme

Estimate time to potential impact: S=Short (<12mths), M=Medium (<5yrs), L=Long (5yrs+)

	Current impact (N-E)	Potential Impact (L-E)	Potential Threat Onset (S-L)
J Weeds	N	M	L
J	---	---	---
J	---	---	---

Please return completed form to **Species And Communities Branch DPaW,**

Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer,** Species and Communities Branch.

Record entered by: _____ Sheet No.: _____ Record Accepted in Database



Threatened and Priority Flora Report Form

Version 1.2 August 2013

HABITAT INFORMATION: (Check more than one box for combinations or where necessary)

LANDFORM:	ROCK TYPE:	LOOSE ROCK:	SOIL TYPE:	SOIL COLOUR:	DRAINAGE:
Crest <input type="checkbox"/> Hill <input type="checkbox"/> Ridge <input type="checkbox"/> Outcrop <input type="checkbox"/> Slope <input checked="" type="checkbox"/> Flat <input type="checkbox"/> Open depression <input type="checkbox"/> Drainage line <input type="checkbox"/> Closed depression <input type="checkbox"/> Wetland <input type="checkbox"/>	Granite <input type="checkbox"/> Dolerite <input type="checkbox"/> Laterite <input type="checkbox"/> Ironstone <input type="checkbox"/> Limestone <input type="checkbox"/> Quartz <input type="checkbox"/> Specify other:	(on soil surface; e.g. gravel, quartz fields) 0-10% <input type="checkbox"/> 10-30% <input type="checkbox"/> 30-50% <input type="checkbox"/> 50-100% <input type="checkbox"/>	Sand <input type="checkbox"/> Sandy loam <input type="checkbox"/> Loam <input type="checkbox"/> Clay loam <input checked="" type="checkbox"/> Light clay <input type="checkbox"/> Peat <input type="checkbox"/> Specify other:	Red <input type="checkbox"/> Brown <input checked="" type="checkbox"/> Yellow <input type="checkbox"/> White <input type="checkbox"/> Grey <input type="checkbox"/> Black <input type="checkbox"/> Specify other:	Well drained <input checked="" type="checkbox"/> Seasonally inundated <input type="checkbox"/> Permanently inundated <input type="checkbox"/> Tidal <input type="checkbox"/> Specify other:

Specific Landform Element: (Refer to field manual for additional values)

CONDITION OF SOIL:

Dry Moist Waterlogged Inundated Cracked Saline Other:

VEGETATION CLASSIFICATION:*

E.g. 1. Banksia woodland (B. attenuata, B. ilicifolia);
 2. Open shrubland (Hibbertia sp., Acacia spp.)
 3. Isolated clumps of sedges (Mesomelaena tetragona)

1. Woodland (Eucalyptus wandoo subsp. pulverea, Eucalyptus rudis)
2. Open shrubland (Pimelea argentea, Melaleuca viminea, Calothamnus quadrifidus)
3. Open heathland (Hypocalymma angustifolium, Melaleuca platycalyx, Acacia spp.)
- 4.

ASSOCIATED SPECIES:

Other (non-dominant) spp

Trymalium odoratissimum
 Xanthorrhoea drummondii

* Please record up to four of the most representative vegetation layers (with up to three dominant species in each layer). Structural Formations should follow 2009 *Australian Soil and Land Survey Field Handbook* guidelines – refer to field manual for further information and structural formation table.

CONDITION OF HABITAT: Pristine Excellent Very good Good Degraded Completely degraded

COMMENT:

FIRE HISTORY: Last Fire: Season/Month: _____ Year: _____ Fire Intensity: High Medium Low No signs of fire

FENCING: Not required Present Replace / repair Required Length req'd: _____

ROADSIDE MARKERS: Not required Present Replace / reposition Required Quantity req'd: _____

OTHER COMMENTS: (Please include recommended management actions and/or implemented actions - include date. Also include details of additional data available, and how to locate it.)

Please return completed form to **Species And Communities Branch** DPaW,
 Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.

Record entered by: _____ Sheet No.: _____ Record Accepted in Database



Threatened and Priority Flora Report Form

DRF PERMIT/ LICENCE No: SL011729

Note if only observing plants (i.e. no specimens or plant material is taken) then no permit/licence is required. For further information on permit and licencing requirements see the Threatened Flora and Wildlife Licensing pages on DPaW's website. Any actions carried out under licence/permit should be recorded above in the OTHER COMMENTS section.

SPECIMEN: Collectors No: MG40 WA Herb. Regional Herb. District Herb. Other:

ATTACHED: Map Mudmap Photo GIS data Field notes Other:

COPY SENT TO: Regional Office District Office Other:

Submitter of record: Mathew Gannaway

Role: Ecologist

Signature:



Date submitted: 12/09/2016

Please return completed form to **Species And Communities Branch** DPaW,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.



Threatened and Priority Flora Report Form

Please complete as much of the form as possible.

For information on how to complete the form please refer to the Threatened & Priority Flora Report Form (TPRF) manual on the DPaW website at <http://www.dpaw.wa.gov.au/>

TAXON: <u>Hakea neurophylla</u>		TPFL Pop. No.: _____	
OBSERVATION DATE: <u>02/08/2016</u>		CONSERVATION STATUS: <u>P4</u> <input checked="" type="checkbox"/> New population	
OBSERVER/S: <u>Mathew Gannaway</u>		PHONE: <u>(08) 6222 8058</u>	
ROLE: <u>Consultant - Ecologist</u>		ORGANISATION: <u>GHD</u>	

DESCRIPTION OF LOCATION (Provide at least nearest town/named locality, and the distance and direction to that place):

Located west of Banovich Road and north of Jurien Road, approximately 20 km north east of Jurien town site.

Reserve No.: _____

DISTRICT: Midwest **LGA:** Shire of Dandaragan **Land manager present:**

DATUM: GDA94 / MGA94 <input checked="" type="checkbox"/> AGD84 / AMG84 <input type="checkbox"/> WGS84 <input type="checkbox"/> Unknown <input type="checkbox"/>	COORDINATES: (If UTM coords provided, Zone is also required)			METHOD USED:	
	DecDegrees <input type="checkbox"/>	DegMinSec <input type="checkbox"/>	UTMs <input checked="" type="checkbox"/>	GPS <input checked="" type="checkbox"/>	Differential GPS <input type="checkbox"/> Map <input type="checkbox"/>
	Lat / Northing: <u>329224</u>		No. satellites: _____		Map used: _____
	Long / Easting: <u>6660537</u>		Boundary polygon captured: <input type="checkbox"/>		Map scale: _____
	Zone: <u>50J</u>				

LAND TENURE:

Nature reserve Timber reserve Private property Rail reserve Shire road reserve
 National park State forest Pastoral lease MRWA road reserve Other Crown reserve
 Conservation park Water reserve UCL SLK/Pole _____ to _____ Specify other: _____

AREA ASSESSMENT: Edge survey Partial survey Full survey Area observed (m²): _____

EFFORT: Time spent surveying (minutes): _____ No. of minutes spent / 100 m²: _____

POP'N COUNT ACCURACY: Actual Extrapolation Estimate

Count method: (Refer to field manual for list) _____

WHAT COUNTED: Plants Clumps Clonal stems

TOTAL POP'N STRUCTURE:	Mature:	Juveniles:	Seedlings:	Totals:
Alive	5			5
Dead				

Area of pop (m²): _____

Note: Pls record count as numbers (not percentages) for database.

QUADRATS PRESENT: No. _____ Size _____ Data attached Total area of quadrats (m²): _____

Summary Quad. Totals: Alive

--	--	--	--

REPRODUCTIVE STATE: Clonal Vegetative Flowerbud Flower
 Immature fruit Fruit Dehisced fruit Percentage in flower: _____%

CONDITION OF PLANTS: Healthy Moderate Poor Senescent

COMMENT:

THREATS - type, agent and supporting information:

E.g. clearing, too frequent fire, weed, disease. Refer to field manual for list of threats & agents. **Specify agent** where relevant.

Rate current and potential threat impact: N=Nil, L=Low, M=Medium, H=High, E=Extreme

Estimate time to potential impact: S=Short (<12mths), M=Medium (<5yrs), L=Long (5yrs+)

	Current impact (N-E)	Potential Impact (L-E)	Potential Threat Onset (S-L)
J Weeds	N	M	L
J	---	---	---
J	---	---	---

Please return completed form to **Species And Communities Branch** DPaW,

Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.

Record entered by: _____ Sheet No.: _____ Record Accepted in Database



Threatened and Priority Flora Report Form

Version 1.2 August 2013

HABITAT INFORMATION: (Check more than one box for combinations or where necessary)

LANDFORM:	ROCK TYPE:	LOOSE ROCK:	SOIL TYPE:	SOIL COLOUR:	DRAINAGE:
Crest <input type="checkbox"/> Hill <input type="checkbox"/> Ridge <input type="checkbox"/> Outcrop <input type="checkbox"/> Slope <input checked="" type="checkbox"/> Flat <input type="checkbox"/> Open depression <input type="checkbox"/> Drainage line <input type="checkbox"/> Closed depression <input type="checkbox"/> Wetland <input type="checkbox"/>	Granite <input type="checkbox"/> Dolerite <input type="checkbox"/> Laterite <input checked="" type="checkbox"/> Ironstone <input type="checkbox"/> Limestone <input type="checkbox"/> Quartz <input type="checkbox"/> Specify other:	(on soil surface; e.g. gravel, quartz fields) 0-10% <input checked="" type="checkbox"/> 10-30% <input type="checkbox"/> 30-50% <input type="checkbox"/> 50-100% <input type="checkbox"/>	Sand <input type="checkbox"/> Sandy loam <input checked="" type="checkbox"/> Loam <input type="checkbox"/> Clay loam <input type="checkbox"/> Light clay <input type="checkbox"/> Peat <input type="checkbox"/> Specify other:	Red <input type="checkbox"/> Brown <input type="checkbox"/> Yellow <input type="checkbox"/> White <input type="checkbox"/> Grey <input checked="" type="checkbox"/> Black <input type="checkbox"/> Specify other:	Well drained <input checked="" type="checkbox"/> Seasonally inundated <input type="checkbox"/> Permanently inundated <input type="checkbox"/> Tidal <input type="checkbox"/> Specify other:

Specific Landform Element: (Refer to field manual for additional values)

CONDITION OF SOIL:

Dry Moist Waterlogged Inundated Cracked Saline Other:

VEGETATION CLASSIFICATION:*

E.g. 1. Banksia woodland (B. attenuata, B. ilicifolia);
 2. Open shrubland (Hibbertia sp., Acacia spp.)
 3. Isolated clumps of sedges (Mesomelaena tetragona)

- Woodland (Eucalyptus todtiana, Banksia attenuata, B. menziesii)
- Heathland (Adenanthos cygnorum subsp. cygnorum, Eremaea spp., Hibbertia spp.)
- Sparse herbland (Blancoa canescens, Conostylis spp., Drosera spp.)
-

ASSOCIATED SPECIES:

Other (non-dominant) spp

Banksia candolleana
 Jacksonia floribunda
 Johnsonia pubescens subsp. pubescens

* Please record up to four of the most representative vegetation layers (with up to three dominant species in each layer). Structural Formations should follow 2009 *Australian Soil and Land Survey Field Handbook* guidelines – refer to field manual for further information and structural formation table.

CONDITION OF HABITAT: Pristine Excellent Very good Good Degraded Completely degraded

COMMENT:

FIRE HISTORY: Last Fire: Season/Month: _____ Year: _____ Fire Intensity: High Medium Low No signs of fire

FENCING: Not required Present Replace / repair Required Length req'd: _____

ROADSIDE MARKERS: Not required Present Replace / reposition Required Quantity req'd: _____

OTHER COMMENTS: (Please include recommended management actions and/or implemented actions - include date. Also include details of additional data available, and how to locate it.)

Please return completed form to **Species And Communities Branch** DPaW,
 Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.

Record entered by: _____ Sheet No.: _____ Record Accepted in Database



Threatened and Priority Flora Report Form

DRF PERMIT/ LICENCE No: SL011729

Note if only observing plants (i.e. no specimens or plant material is taken) then no permit/licence is required. For further information on permit and licencing requirements see the Threatened Flora and Wildlife Licensing pages on DPaW's website. Any actions carried out under licence/permit should be recorded above in the OTHER COMMENTS section.

SPECIMEN: Collectors No: MG42 WA Herb. Regional Herb. District Herb. Other:

ATTACHED: Map Mudmap Photo GIS data Field notes Other:

COPY SENT TO: Regional Office District Office Other:

Submitter of record: Mathew Gannaway

Role: Ecologist

Signature:



Date submitted: 12/09/2016

Please return completed form to **Species And Communities Branch** DPaW,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.



Threatened and Priority Flora Report Form

Please complete as much of the form as possible.

For information on how to complete the form please refer to the Threatened & Priority Flora Report Form (TPRF) manual on the DPaW website at <http://www.dpaw.wa.gov.au/>

TAXON: <u>Hensmania stoniella</u>		TPFL Pop. No.: _____	
OBSERVATION DATE: <u>02/08/2016</u>		CONSERVATION STATUS: <u>P3</u> New population <input checked="" type="checkbox"/>	
OBSERVER/S: <u>Mathew Gannaway</u>		PHONE: <u>(08) 6222 8058</u>	
ROLE: <u>Consultant - Ecologist</u>		ORGANISATION: <u>GHD</u>	

DESCRIPTION OF LOCATION (Provide at least nearest town/named locality, and the distance and direction to that place):

Located west of Banovich Road and north of Jurien Road, approximately 20 km north east of Jurien town site.

Reserve No.: _____

DISTRICT: Midwest **LGA:** Shire of Dandaragan Land manager present:

DATUM:		COORDINATES: (If UTM coords provided, Zone is also required)		METHOD USED:	
GDA94 / MGA94 <input checked="" type="checkbox"/>	DecDegrees <input type="checkbox"/>	DegMinSec <input type="checkbox"/>	UTMs <input checked="" type="checkbox"/>	GPS <input checked="" type="checkbox"/>	Differential GPS <input type="checkbox"/> Map <input type="checkbox"/>
AGD84 / AMG84 <input type="checkbox"/>	Lat / Northing: <u>330847</u>		No. satellites: _____		Map used: _____
WGS84 <input type="checkbox"/>	Long / Easting: <u>6656140</u>		Boundary polygon captured: <input type="checkbox"/>		Map scale: _____
Unknown <input type="checkbox"/>	Zone: <u>50J</u>				

LAND TENURE:

- | | | | | |
|--|---|--|--|--|
| Nature reserve <input type="checkbox"/> | Timber reserve <input type="checkbox"/> | Private property <input checked="" type="checkbox"/> | Rail reserve <input type="checkbox"/> | Shire road reserve <input type="checkbox"/> |
| National park <input type="checkbox"/> | State forest <input type="checkbox"/> | Pastoral lease <input type="checkbox"/> | MRWA road reserve <input type="checkbox"/> | Other Crown reserve <input type="checkbox"/> |
| Conservation park <input type="checkbox"/> | Water reserve <input type="checkbox"/> | UCL <input type="checkbox"/> | SLK/Pole _____ to _____ | Specify other: _____ |

AREA ASSESSMENT: Edge survey Partial survey Full survey Area observed (m²): _____

EFFORT: Time spent surveying (minutes): _____ No. of minutes spent / 100 m²: _____

POP'N COUNT ACCURACY: Actual Extrapolation Estimate

Count method: (Refer to field manual for list) _____

WHAT COUNTED: Plants Clumps Clonal stems

TOTAL POP'N STRUCTURE:	Mature:	Juveniles:	Seedlings:	Totals:	Area of pop (m ²): _____ Note: Pls record count as numbers (not percentages) for database.
Alive	4			4	
Dead					

QUADRATS PRESENT: No. _____ Size _____ Data attached Total area of quadrats (m²): _____

Summary Quad. Totals: Alive

--	--	--	--

REPRODUCTIVE STATE: Clonal Vegetative Flowerbud Flower
Immature fruit Fruit Dehisced fruit Percentage in flower: _____%

CONDITION OF PLANTS: Healthy Moderate Poor Senescent

COMMENT:

THREATS - type, agent and supporting information: <small>E.g. clearing, too frequent fire, weed, disease. Refer to field manual for list of threats & agents. Specify agent where relevant. Rate current and potential threat impact: N=Nil, L=Low, M=Medium, H=High, E=Extreme Estimate time to potential impact: S=Short (<12mths), M=Medium (<5yrs), L=Long (5yrs+)</small>	Current impact (N-E)	Potential Impact (L-E)	Potential Threat Onset (S-L)
J Weeds	N	M	L
J	_____	_____	_____
J	_____	_____	_____

Please return completed form to **Species And Communities Branch DPaW,**

Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer,** Species and Communities Branch.

Record entered by: _____ Sheet No.: _____ Record Accepted in Database



Threatened and Priority Flora Report Form

Version 1.2 August 2013

HABITAT INFORMATION: (Check more than one box for combinations or where necessary)

LANDFORM:	ROCK TYPE:	LOOSE ROCK:	SOIL TYPE:	SOIL COLOUR:	DRAINAGE:
Crest <input type="checkbox"/> Hill <input type="checkbox"/> Ridge <input type="checkbox"/> Outcrop <input type="checkbox"/> Slope <input checked="" type="checkbox"/> Flat <input type="checkbox"/> Open depression <input type="checkbox"/> Drainage line <input type="checkbox"/> Closed depression <input type="checkbox"/> Wetland <input type="checkbox"/>	Granite <input type="checkbox"/> Dolerite <input type="checkbox"/> Laterite <input type="checkbox"/> Ironstone <input type="checkbox"/> Limestone <input type="checkbox"/> Quartz <input type="checkbox"/> Specify other:	(on soil surface; e.g. gravel, quartz fields) 0-10% <input type="checkbox"/> 10-30% <input type="checkbox"/> 30-50% <input type="checkbox"/> 50-100% <input type="checkbox"/>	Sand <input checked="" type="checkbox"/> Sandy loam <input type="checkbox"/> Loam <input type="checkbox"/> Clay loam <input type="checkbox"/> Light clay <input type="checkbox"/> Peat <input type="checkbox"/> Specify other:	Red <input type="checkbox"/> Brown <input type="checkbox"/> Yellow <input type="checkbox"/> White <input checked="" type="checkbox"/> Grey <input type="checkbox"/> Black <input type="checkbox"/> Specify other:	Well drained <input checked="" type="checkbox"/> Seasonally inundated <input type="checkbox"/> Permanently inundated <input type="checkbox"/> Tidal <input type="checkbox"/> Specify other:

Specific Landform Element: (Refer to field manual for additional values)

CONDITION OF SOIL:

Dry Moist Waterlogged Inundated Cracked Saline Other:

VEGETATION CLASSIFICATION:*

E.g. 1. Banksia woodland (B. attenuata, B. ilicifolia);
 2. Open shrubland (Hibbertia sp., Acacia spp.)
 3. Isolated clumps of sedges (Mesomelaena tetragona)

1. Woodland (Eucalyptus todtiana, Banksia attenuata, B. menziesii)
2. Heathland (Adenanthos cygnorum subsp. cygnorum, Eremaea spp., Hibbertia spp.)
3. Sparse hermland (Blancoa canescens, Conostylis spp., Drosera spp.)
- 4.

ASSOCIATED SPECIES:

Other (non-dominant) spp

Banksia candolleana
 Jacksonia floribunda
 Johnsonia pubescens subsp. pubescens

* Please record up to four of the most representative vegetation layers (with up to three dominant species in each layer). Structural Formations should follow 2009 *Australian Soil and Land Survey Field Handbook* guidelines – refer to field manual for further information and structural formation table.

CONDITION OF HABITAT: Pristine Excellent Very good Good Degraded Completely degraded

COMMENT:

FIRE HISTORY: Last Fire: Season/Month: _____ Year: _____ Fire Intensity: High Medium Low No signs of fire

FENCING: Not required Present Replace / repair Required Length req'd: _____

ROADSIDE MARKERS: Not required Present Replace / reposition Required Quantity req'd: _____

OTHER COMMENTS: (Please include recommended management actions and/or implemented actions - include date. Also include details of additional data available, and how to locate it.)

Please return completed form to **Species And Communities Branch** DPaW,
 Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.

Record entered by: _____ Sheet No.: _____ Record Accepted in Database



Threatened and Priority Flora Report Form

DRF PERMIT/ LICENCE No: SL011729

Note if only observing plants (i.e. no specimens or plant material is taken) then no permit/licence is required. For further information on permit and licencing requirements see the Threatened Flora and Wildlife Licensing pages on DPaW's website. Any actions carried out under licence/permit should be recorded above in the OTHER COMMENTS section.

SPECIMEN: Collectors No: MG54 WA Herb. Regional Herb. District Herb. Other:

ATTACHED: Map Mudmap Photo GIS data Field notes Other:

COPY SENT TO: Regional Office District Office Other:

Submitter of record: Mathew Gannaway

Role: Ecologist

Signature:



Date submitted: 12/09/2016

Please return completed form to **Species And Communities Branch** DPaW,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.



Threatened and Priority Flora Report Form

Please complete as much of the form as possible.

For information on how to complete the form please refer to the Threatened & Priority Flora Report Form (TPRF) manual on the DPaW website at <http://www.dpaw.wa.gov.au/>

TAXON: <u>Thelymitra variegata</u>		TPFL Pop. No.: _____	
OBSERVATION DATE: <u>02/08/2016</u>		CONSERVATION STATUS: <u>P2</u> New population <input checked="" type="checkbox"/>	
OBSERVER/S: <u>Mathew Gannaway</u>		PHONE: <u>(08) 6222 8058</u>	
ROLE: <u>Consultant - Ecologist</u>		ORGANISATION: <u>GHD</u>	

DESCRIPTION OF LOCATION (Provide at least nearest town/named locality, and the distance and direction to that place):

Located west of Banovich Road and north of Jurien Road, approximately 20 km north east of Jurien town site.

Reserve No.: _____

DISTRICT: Midwest **LGA:** Shire of Dandaragan Land manager present:

DATUM: GDA94 / MGA94 <input checked="" type="checkbox"/> AGD84 / AMG84 <input type="checkbox"/> WGS84 <input type="checkbox"/> Unknown <input type="checkbox"/>	COORDINATES: (If UTM coords provided, Zone is also required)			METHOD USED:	
	DecDegrees <input type="checkbox"/>	DegMinSec <input type="checkbox"/>	UTMs <input checked="" type="checkbox"/>	GPS <input checked="" type="checkbox"/>	Differential GPS <input type="checkbox"/> Map <input type="checkbox"/>
	Lat / Northing: <u>329843</u>		No. satellites: _____		Map used: _____
	Long / Easting: <u>6659663</u>		Boundary polygon captured: <input type="checkbox"/>		Map scale: _____
	Zone: <u>50J</u>				

LAND TENURE:

Nature reserve Timber reserve Private property Rail reserve Shire road reserve
 National park State forest Pastoral lease MRWA road reserve Other Crown reserve
 Conservation park Water reserve UCL SLK/Pole _____ to _____ Specify other: _____

AREA ASSESSMENT: Edge survey Partial survey Full survey Area observed (m²): _____

EFFORT: Time spent surveying (minutes): _____ No. of minutes spent / 100 m²: _____

POP'N COUNT ACCURACY: Actual Extrapolation Estimate

Count method: (Refer to field manual for list) _____

WHAT COUNTED: Plants Clumps Clonal stems

TOTAL POP'N STRUCTURE:	Mature:	Juveniles:	Seedlings:	Totals:
Alive	1			1
Dead				

Area of pop (m²): _____

Note: Pls record count as numbers (not percentages) for database.

QUADRATS PRESENT: No. _____ Size _____ Data attached Total area of quadrats (m²): _____

Summary Quad. Totals: Alive

--	--	--	--

REPRODUCTIVE STATE: Clonal Vegetative Flowerbud Flower
 Immature fruit Fruit Dehisced fruit Percentage in flower: _____%

CONDITION OF PLANTS: Healthy Moderate Poor Senescent

COMMENT:

THREATS - type, agent and supporting information:

E.g. clearing, too frequent fire, weed, disease. Refer to field manual for list of threats & agents. **Specify agent** where relevant.

Rate current and potential threat impact: N=Nil, L=Low, M=Medium, H=High, E=Extreme

Estimate time to potential impact: S=Short (<12mths), M=Medium (<5yrs), L=Long (5yrs+)

	Current impact (N-E)	Potential Impact (L-E)	Potential Threat Onset (S-L)
J Weeds	N	M	L
J	_____	_____	_____
J	_____	_____	_____

Please return completed form to **Species And Communities Branch** DPaW,

Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.

Record entered by: _____ Sheet No.: _____ Record Accepted in Database



Threatened and Priority Flora Report Form

Version 1.2 August 2013

HABITAT INFORMATION: (Check more than one box for combinations or where necessary)

LANDFORM:	ROCK TYPE:	LOOSE ROCK:	SOIL TYPE:	SOIL COLOUR:	DRAINAGE:
Crest <input type="checkbox"/> Hill <input type="checkbox"/> Ridge <input type="checkbox"/> Outcrop <input type="checkbox"/> Slope <input checked="" type="checkbox"/> Flat <input type="checkbox"/> Open depression <input type="checkbox"/> Drainage line <input type="checkbox"/> Closed depression <input type="checkbox"/> Wetland <input type="checkbox"/>	Granite <input type="checkbox"/> Dolerite <input type="checkbox"/> Laterite <input checked="" type="checkbox"/> Ironstone <input type="checkbox"/> Limestone <input type="checkbox"/> Quartz <input type="checkbox"/> Specify other:	(on soil surface; e.g. gravel, quartz fields) 0-10% <input type="checkbox"/> 10-30% <input checked="" type="checkbox"/> 30-50% <input type="checkbox"/> 50-100% <input type="checkbox"/>	Sand <input checked="" type="checkbox"/> Sandy loam <input type="checkbox"/> Loam <input type="checkbox"/> Clay loam <input type="checkbox"/> Light clay <input type="checkbox"/> Peat <input type="checkbox"/> Specify other:	Red <input type="checkbox"/> Brown <input type="checkbox"/> Yellow <input type="checkbox"/> White <input type="checkbox"/> Grey <input checked="" type="checkbox"/> Black <input type="checkbox"/> Specify other:	Well drained <input checked="" type="checkbox"/> Seasonally inundated <input type="checkbox"/> Permanently inundated <input type="checkbox"/> Tidal <input type="checkbox"/> Specify other:

Specific Landform Element: (Refer to field manual for additional values)

CONDITION OF SOIL:

Dry Moist Waterlogged Inundated Cracked Saline Other:

VEGETATION CLASSIFICATION:*

E.g. 1. Banksia woodland (B. attenuata, B. ilicifolia);
 2. Open shrubland (Hibbertia sp., Acacia spp.)
 3. Isolated clumps of sedges (Mesomelaena tetragona)

1. Heathland (Xanthorrhoea spp., Kingia australis, Banksia spp., Calothamnus spp.)
2. Isolated rushes (Caustis dioica, Schoenus spp.)
3. Sparse hermland (Stylidium spp., Conostylis spp., Drosera spp.)
- 4.

ASSOCIATED SPECIES:

Other (non-dominant) spp

Cryptandra spp.
 Hakea spp.
 Hibbertia spp.

* Please record up to four of the most representative vegetation layers (with up to three dominant species in each layer). Structural Formations should follow 2009 *Australian Soil and Land Survey Field Handbook* guidelines – refer to field manual for further information and structural formation table.

CONDITION OF HABITAT: Pristine Excellent Very good Good Degraded Completely degraded

COMMENT:

FIRE HISTORY: Last Fire: Season/Month: _____ Year: _____ Fire Intensity: High Medium Low No signs of fire

FENCING: Not required Present Replace / repair Required Length req'd: _____

ROADSIDE MARKERS: Not required Present Replace / reposition Required Quantity req'd: _____

OTHER COMMENTS: (Please include recommended management actions and/or implemented actions - include date. Also include details of additional data available, and how to locate it.)

Please return completed form to **Species And Communities Branch** DPaW,
 Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.

Record entered by: _____ Sheet No.: _____ Record Accepted in Database



Threatened and Priority Flora Report Form

DRF PERMIT/ LICENCE No: SL011729

Note if only observing plants (i.e. no specimens or plant material is taken) then no permit/licence is required. For further information on permit and licencing requirements see the Threatened Flora and Wildlife Licensing pages on DPaW's website. Any actions carried out under licence/permit should be recorded above in the OTHER COMMENTS section.

SPECIMEN: Collectors No: WA Herb. Regional Herb. District Herb. Other:

ATTACHED: Map Mudmap Photo GIS data Field notes Other:

COPY SENT TO: Regional Office District Office Other:

Submitter of record: Mathew Gannaway **Role:** Ecologist

Signature:  **Date submitted:** 12/09/2016

Please return completed form to **Species And Communities Branch** DPaW,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.



Threatened and Priority Flora Report Form

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For information on how to complete the form please refer to the Threatened & Priority Flora Report Form (TPRF) manual on the DPaW website at <http://www.dpaw.wa.gov.au/>

TAXON: <u>Hakea megalosperma</u>		TPFL Pop. No.: _____
OBSERVATION DATE: <u>03/08/2016</u>	CONSERVATION STATUS: <u>T</u>	New population <input checked="" type="checkbox"/>
OBSERVER/S: <u>Mathew Gannaway</u>	PHONE _____	<u>(08) 6222 8058</u>
ROLE: <u>Consultant - Ecologist</u>	ORGANISATION: <u>GHD</u>	

DESCRIPTION OF LOCATION (Provide at least nearest town/named locality, and the distance and direction to that place):

Located west of Banovich Road and north of Jurien Road, approximately 20 km north east of Jurien town site.

Reserve No.: _____

DISTRICT: Midwest **LGA:** Shire of Dandaragan Land manager present:

DATUM:	COORDINATES: (If UTM coords provided, Zone is also required)	METHOD USED:
GDA94 / MGA94 <input checked="" type="checkbox"/>	DecDegrees <input type="checkbox"/> DegMinSec <input type="checkbox"/> UTM's <input checked="" type="checkbox"/>	GPS <input checked="" type="checkbox"/> Differential GPS <input type="checkbox"/> Map <input type="checkbox"/>
AGD84 / AMG84 <input type="checkbox"/>	Lat / Northing: <u>329707</u>	No. satellites: _____ Map used: _____
WGS84 <input type="checkbox"/>	Long / Easting: <u>6660683</u>	Boundary polygon captured: <input type="checkbox"/> Map scale: _____
Unknown <input type="checkbox"/>	Zone: <u>50J</u>	

LAND TENURE:

- | | | | | |
|--|---|--|--|--|
| Nature reserve <input type="checkbox"/> | Timber reserve <input type="checkbox"/> | Private property <input checked="" type="checkbox"/> | Rail reserve <input type="checkbox"/> | Shire road reserve <input type="checkbox"/> |
| National park <input type="checkbox"/> | State forest <input type="checkbox"/> | Pastoral lease <input type="checkbox"/> | MRWA road reserve <input type="checkbox"/> | Other Crown reserve <input type="checkbox"/> |
| Conservation park <input type="checkbox"/> | Water reserve <input type="checkbox"/> | UCL <input type="checkbox"/> | SLK/Pole _____ to _____ | Specify other: _____ |

AREA ASSESSMENT: Edge survey Partial survey Full survey Area observed (m²): _____

EFFORT: Time spent surveying (minutes): _____ No. of minutes spent / 100 m²: _____

POP'N COUNT ACCURACY: Actual Extrapolation Estimate

Count method: (Refer to field manual for list) _____

WHAT COUNTED: Plants Clumps Clonal stems

TOTAL POP'N STRUCTURE:	Mature:	Juveniles:	Seedlings:	Totals:
Alive	12	5		17
Dead				

Area of pop (m²): _____

Note: Pls record count as numbers (not percentages) for database.

QUADRATS PRESENT: No. _____ Size _____ Data attached Total area of quadrats (m²): _____

Summary Quad. Totals: Alive

--	--	--	--

REPRODUCTIVE STATE: Clonal Vegetative Flowerbud Flower
 Immature fruit Fruit Dehisced fruit Percentage in flower: _____%

CONDITION OF PLANTS: Healthy Moderate Poor Senescent

COMMENT:

THREATS - type, agent and supporting information:

E.g. clearing, too frequent fire, weed, disease. Refer to field manual for list of threats & agents. **Specify agent** where relevant.

Rate current and potential threat impact: N=Nil, L=Low, M=Medium, H=High, E=Extreme

Estimate time to potential impact: S=Short (<12mths), M=Medium (<5yrs), L=Long (5yrs+)

	Current impact (N-E)	Potential Impact (L-E)	Potential Threat Onset (S-L)
J Weeds	N	M	L
J	---	---	---
J	---	---	---

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Version 1.2 August 2013

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Specific Landform Element: (Refer to field manual for additional values)

CONDITION OF SOIL:

Dry Moist Waterlogged Inundated Cracked Saline Other:

VEGETATION CLASSIFICATION:*

E.g. 1. Banksia woodland (B. attenuata, B. ilicifolia);
 2. Open shrubland (Hibbertia sp., Acacia spp.)
 3. Isolated clumps of sedges (Mesomelaena tetragona)

1. Heathland (Conothamnus trinervis, Calothmanus sanguineus, Hibbertia hypericoides)
2. Isolated rushes (Caustis dioica, Schoenus spp.)
3. Sparse hermland (Stylidium spp., Conostylis spp., Drosera spp., Dampiera sp.)
- 4.

ASSOCIATED SPECIES:

Other (non-dominant) spp

Hakea conchifolia
 Melaleuca spp.
 Xanthorrhoea drummondii
 Lambertia multiflora

* Please record up to four of the most representative vegetation layers (with up to three dominant species in each layer). Structural Formations should follow 2009 *Australian Soil and Land Survey Field Handbook* guidelines – refer to field manual for further information and structural formation table.

CONDITION OF HABITAT: Pristine Excellent Very good Good Degraded Completely degraded

COMMENT:

FIRE HISTORY: Last Fire: Season/Month: _____ Year: _____ Fire Intensity: High Medium Low No signs of fire

FENCING: Not required Present Replace / repair Required Length req'd: _____

ROADSIDE MARKERS: Not required Present Replace / reposition Required Quantity req'd: _____

OTHER COMMENTS: (Please include recommended management actions and/or implemented actions - include date. Also include details of additional data available, and how to locate it.)

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Threatened and Priority Flora Report Form

DRF PERMIT/ LICENCE No: SL011729

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SPECIMEN: Collectors No: WA Herb. Regional Herb. District Herb. Other:

ATTACHED: Map Mudmap Photo GIS data Field notes Other:

COPY SENT TO: Regional Office District Office Other:

Submitter of record: Mathew Gannaway

Role: Ecologist

Signature:



Date submitted: 12/09/2016

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RECORDS: Please forward to **Flora Administrative Officer**, Species and Communities Branch.

Appendix E – Fauna Data

Fauna species list

Fauna Likelihood of Occurrence assessment guidelines

Fauna Likelihood of Occurrence assessment

Fauna recorded during GHD survey – August 2016

Family	Scientific name	Common name	Status	August Survey
Birds				
Acanthizidae	<i>Acanthiza apicalis subsp whitlocki</i>	Inland Thornbill		4
Acanthizidae	<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill		8
Acanthizidae	<i>Calamanthus campestris</i>	Rufous Fieldwren		3
Acanthizidae	<i>Gerygone fusca</i>	Western Gerygone		10
Acanthizidae	<i>Smicronis brevirostris</i>	Weebill		14
Acanthizidae	<i>Sericornis frontalis</i>	White-browed Scrubwren		6
Accipitridae	<i>Aquila audax</i>	Wedge tailed Eagle		2
Accipitridae	<i>Accipiter fasciatus</i>	Brown Goshawk		1
Accipitridae	<i>Haliastur sphenurus</i>	Whistling Kite		1
Anatidae	<i>Anas gracilis</i>	Grey Teal		2
Anatidae	<i>Anas superciliosa</i>	Black Duck		2
Anatidae	<i>Chenonetta jubata</i>	Australian Wood Duck		20
Anatidae	<i>Todorna tadornoides</i>	Australian Shellduck		camera
Ardeidae	<i>Ardea pacifica</i>	White-necked Heron		1
Ardeidae	<i>Egretta novaehollandiae</i>	White-faced Heron		1
Artamidae	<i>Artamus cinereus</i>	Black-faced Woodswallow		4
Artamidae	<i>Cracticus nigrogularis</i>	Pied Butcherbird		1
Artamidae	<i>Gymnorhina tibicen</i>	Australian Magpie		1, camera
Artamidae	<i>Strepera versicolor</i>	Grey Currawong		1
Cacatuidae	<i>Cacatua pastinator</i>	Western Long-billed Corella	GIBP	many
Cacatuidae	<i>Calyptorhynchus latirostris</i>	Carnaby's Black Cockatoo	En En, GIBP	many
Cacatuidae	<i>Eolophus roseicapilla</i>	Galah		many
Campephagidae	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike		4
Campephagidae	<i>Lalage tricolor</i>	White-winged Triller		2
Casuariidae	<i>Dromaius novaehollandiae</i>	Emu		8, camera
Climacteridae	<i>Climacteris rufa</i>	Rufous Treecreeper	GIBP	1
Columbidae	<i>Ocyphaps lophotes</i>	Crested Pigeon		2
Columbidae	<i>Phaps chalcoptera</i>	Common Bronzewing		2
Corvidae	<i>Corvus coronoides</i>	Australian Raven		6, camera
Cuculidae	<i>Cacomantis flabelliformis</i>	Fan-tailed Cuckoo		10
Cuculidae	<i>Cacomantis pallidus</i>	Pallid Cuckoo		1
Cuculidae	<i>Chrysococcyx basalis</i>	Horsfield's Bronze Cuckoo		4, camera
Cuculidae	<i>Chrysococcyx lucidus</i>	Shining Bronze Cuckoo		1
Falconidae	<i>Falco berigora</i>	Brown Falcon		2
Falconidae	<i>Falco cenchroides</i>	Nankeen Kestrel		1
Falconidae	<i>Falco longipennis</i>	Australian Hobby		2
Halcyonidae	<i>Dacelo novaeguineae</i>	Laughing Kookaburra	int	6
Hirundinidae	<i>Hirundo neoxena</i>	Welcome Swallow		8
Hirundinidae	<i>Petrochelidon nigricans</i>	Tree Martin		9
Maluridae	<i>Malurus elegans</i>	Red-winged Fairywren		2
Maluridae	<i>Malurus pulcherrimus</i>	Blue-breasted Fairy-wren	GIBP	4
Maluridae	<i>Malurus splendens</i>	Splendid Fairywren		6, camera
Meliphagidae	<i>Acanthagenys rufogularis</i>	Spiny-cheeked Honeyeater		1
Meliphagidae	<i>Acanthorhynchus superciliosus</i>	Western Spinebill	GIBP	1
Meliphagidae	<i>Anthochaera carunculata</i>	Red Wattlebird		2

Meliphagidae	<i>Anthochaera lunulata</i>	Western Wattlebird		2
Meliphagidae	<i>Epthianura albifrons</i>	White-fronted Chat		8
Meliphagidae	<i>Gliciphila melanops</i>	Tawny-crowned Honeyeater		6
Meliphagidae	<i>Lichmera indistincta</i>	Brown Honeyeater		8
Meliphagidae	<i>Melithreptus brevirostris</i>	Brown-headed Honeyeater		2
Meliphagidae	<i>Phylidonyris niger</i>	White-cheeked Honeyeater		many
Monarchidae	<i>Grallina cyanoleuca</i>	Magpie Lark		1
Motacillidae	<i>Anthus australis</i>	Australasian Pipit		2
Neosittidae	<i>Daphoenositta chrysoptera</i>	Varied Sittella		4
Otididae	<i>Ardeotis australis</i>	Australian Bustard		prints
Pachycephalidae	<i>Colluricincla harmonica</i>	Grey Shrike Thrush		4
Pachycephalidae	<i>Oreocica gutturalis subsp pallescens</i>	Crested Bellbird		1
Pachycephalidae	<i>Pachycephala rufiventris</i>	Rufous Whistler		4
Pardalotidae	<i>Pardalotus striatus</i>	Striated Pardalote		many
Petroicidae	<i>Petroica boodang</i>	Scarlet Robin		4
Petroicidae	<i>Petroica goodenovii</i>	Red-capped Robin		4
Petroicidae	<i>Macroeca fascinans</i>	Jacky Winter		1
Podargidae	<i>Podargus strigoides</i>	Tawny Frogmouth		3
Psittacidae	<i>Barnardius zonarius semitorquatus</i>	Australian Ringneck		many
Psittacidae	<i>Glossopsitta porphyrocephala</i>	Purple-crowned Lorikeet		2
Rallidae	<i>Porphyrio porphyrio</i>	Purple Swamphen		1
Rhipiduridae	<i>Rhipidura albiscapa</i>	Grey Fantail		10
Rhipiduridae	<i>Rhipidura leucophrys</i>	Willy Wagtail		1
Strigidae	<i>Ninox novaeseelandiae subsp ocellata</i>	Southern Boobook		many
Threskiornithidae	<i>Threskiornis spinicollis</i>	Straw-necked Ibis		5
Timaliidae	<i>Zosterops lateralis subsp chloronotus</i>	Silvereye		4
Tytonidae	<i>Tyto javanica</i>	Barn Owl		1
Reptiles				
Carphodactylidae	<i>Underwoodisaurus milii</i>	Barking Gecko		2
Diplodactylidae	<i>Crenadactylus ocellatus ocellatus</i>	Clawless Gecko		3
Diplodactylidae	<i>Strophurus spinigerus</i>	Solt Spiny-tailed Gecko		1
Elapidae	<i>Demansia psammophis reticulata</i>	Yellow-faced Whipsnake		1
Elapidae	<i>Parasuta gouldii</i>	Gould's Snake		1
Scincidae	<i>Ctenotus fallens</i>	West Coast Ctenotus		1
Scincidae	<i>Lerista distinguenda sp nov.</i>	South-western Four-toed Slider		1
Scincidae	<i>Menetia greyii</i>	Common Dwarf Skink		1
Scincidae	<i>Morethia obscura</i>	Shrubland Snake-eyed Skink		1
Scincidae	<i>Tiliqua rugosa</i>	Bobtail		3, camera
Varanidae	<i>Varanus gouldii</i>	Goulds Monitor		1
Varanidae	<i>Varanus tristis</i>	Black-headed Monitor		camera
Amphibians				
Hylidae	<i>Litoria adelaidensis</i>	Slender Tree Frog		10
Limnodynastidae	<i>Limnodynastes dorsalis</i>	Pobblebonk		6
Limnodynastidae	<i>Helioporus eyrei</i>	Moaning Frog		3
Limnodynastidae	<i>Neobatrachus pelobatoides</i>	Humming Frog		2
Myobatrachidae	<i>Crinia pseudinsignifera</i>	False Western Froglet		many

Mammals				
Canidae	<i>Vulpes vulpes</i>	Fox	int	prints, camera
Dasyuridae	<i>Sminthopsis crassicaudata/granulipes</i>	Fat-tailed or White-tailed Dunnart (Likely)		camera
Dasyuridae	<i>Sminthopsis griseoventer</i>	Grey-bellied Dunnart (Likely)		camera
Emballonuridae	<i>Austromomus australis</i>	White-striped Freetail Bat		calls
Felidae	<i>Felis catus</i>	Cat	int	prints, camera
Canidae	<i>Canis lupis</i>	Dog	int	prints
Suidae	<i>Sus scrofa</i>	Pigs	int	digs, camera
Leporidae	<i>Oryctolagus cuniculus</i>	Rabbit	int	many
Macropodidae	<i>Macropus fuliginosus</i>	Western Grey Kangaroo		many
Macropodidae	<i>Macropus irma</i>	Western Brush Wallaby	P4	camera
Muridae	<i>Mus musculus</i>	House Mouse	int	camera
Muridae	<i>Pseudomys albocinereus</i>	Ash Grey Mouse (Likely)		camera
Muridae	<i>Rattus fuscipes</i>	Western Bush Rat (Likely)		camera
Tachyglossidae	<i>Tachyglossus aculeatus</i>	Echidna		1, digs, camera
Vespertilionidae	<i>Chalinolobus gouldii</i>	Gould's Wattled Bat		calls
Vespertilionidae	<i>Chalinolobus morio</i>	Chocolate Wattled Bat		calls
Vespertilionidae	<i>Vespadelus regulus</i>	Southern Forest Bat		calls
Vespertilionidae	<i>Nyctophilus sp.</i>	Long-eared Bats		calls

Legend:

many or number = recorded during current survey or numbers recorded (observed or heard)

Shed skin, scats, tracks, prints or digs = Evidence of observation

calls = bat detector (anabat or SM2) record

GIBP = Global Important Bird Population species

Camera= Recorded via remote camera

intro= introduced species

Conservation codes – Appendix B

Parameters of fauna Likelihood of Occurrence assessment

Assessment outcome	Description
Present	Species recorded during the field survey or from recent, reliable records from within the survey area.
Likely	Species are likely to occur in the survey area where there is suitable habitat within the survey area and there are recent records of occurrence of the species in close proximity to the survey area OR Species known distribution overlaps with the survey area and there is suitable habitat within the survey area.
Unlikely	Species assessed as unlikely include: those species previously recorded within the study area however: <ul style="list-style-type: none"> • There is limited (i.e. the type, quality and quantity of the habitat is generally poor or restricted) habitat in the survey area. The suitable habitat within the survey area is isolated from other areas of suitable habitat and the species has no capacity to migrate into the survey area. OR • Those species that have a known distribution overlapping with the survey area however: there is limited (i.e. the type, quality and quantity of the habitat is generally poor or restricted) habitat in the survey area the suitable habitat within the survey area is isolated from other areas of suitable habitat and the species has no capacity to migrate into the survey area.
Highly unlikely	Species that are considered highly unlikely to occur in the survey area include those species: <ul style="list-style-type: none"> • That have no suitable habitat within the survey area • That have become locally extinct, or are not known to have ever been present in the region of the survey area.

Status (see Appendix B for full explanation)

EPBC Act – Species listed as one or more of the following MM = migratory marine species, MW = migratory wetland species, MiT = migratory terrestrial species, Vu = Vulnerable, En = Endangered

WC Act - Species listed as CR = critically endangered, En = endangered, Vu = Vulnerable, CD = conservation dependent, IA = international migratory agreement migratory birds, OS = other specially protected fauna

DPaW – Species listed as Priority (P) 1, 2, 3 or 4

Source information - desktop searches

PMST = DotEE PMST to identify fauna listed under the EPBC Act potentially occurring within the study area accessed July 2016

NM = DPaW NatureMap (2007-2016) records of threatened fauna, database search within the study area (accessed July 2016),

DPaW = WA Government, Department of Parks and Wildlife Threatened and Priority fauna rankings (current as of 20 November 2015) - *Wildlife Conservation Act 1950* for the DPaW Swan region <http://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/threatened-animals>

Definitions

study area = a 20 km buffer around the survey area

locality = the area within an approximate 50 km radius of the survey area

Fauna Likelihood of Occurrence assessment

Common name (species name)	Status (WC Act/DPAW, EPBC Act)		Search			Description & habitat requirements	Habitat with survey areas / Records (NatureMap)	Likelihood of Occurrence
	WC Act	EPBC Act	NM	EPBC PMST	DPaW			
Birds								
Carnaby's Black Cockatoo (<i>Calyptorhynchus latirostris</i>)	EN	EN	X	X		Carnaby's Black Cockatoo mainly occurs in uncleared or remnant native eucalypt woodlands and in shrubland or kwongan heathland dominated by Hakea, Banksia and Grevillea species. The species also occurs in forests containing Marri (<i>Corymbia calophylla</i>), Jarrah (<i>Eucalyptus marginata</i>) or Karri (<i>E. diversicolor</i>). Breeding usually occurs in the Wheatbelt region of WA in large Wandoo (<i>E. wandoo</i>), with flocks moving to the higher rainfall coastal areas to forage after the breeding season. Feeds on the seeds of a variety of native plants, including <i>Allocasuarina</i> , <i>Banksia</i> , <i>Eucalyptus</i> , <i>Grevillea</i> and <i>Hakea</i> , and some introduced plants (DSEWPaC 2012).	Both feeding and Breeding habitat is present for this species with both events recorded. Numerous birds were also recorded moving throughout the survey area and roosting recorded.	Present, feeding breeding and roosting was recorded.

Common name (species name)	Status (WC Act/DPAW, EPBC Act)		Search			Description & habitat requirements	Habitat with survey areas / Records (NatureMap)	Likelihood of Occurrence
	WC Act	EPBC Act	NM	EPBC PMST	DPaW			
Western Ground Parrot (<i>Pezoporus flaviventris</i>)	CR	CR	X			There is only one population remaining of the western sub-species of the Ground Parrot, in coastal heath east of Esperance in southeast of Western Australia. There are only two remaining areas of refuge, Cape Arid and Fitzgerald River National Parks, with about 110 individuals still thought to live in the wild. Historically the species also inhabited the mid west coastal heath around Congara and Jurien Bay, however has not been recorded in these areas for some time. The Western Ground Parrot inhabits low, dry or swampy, near-coastal heathlands on sandplains and uplands in areas that receive 400-500 mm of rainfall annually (Gilfillan et al 2007, McNee 1999, 2000). The vegetation in such heathlands consists of moderately dense, low shrubs (usually not more than 0.5-1.0 m tall) and often with an open understorey of low sedges, including Mesomelaena species, that are usually less than 0.5 m tall. The vegetation usually includes scattered clumps of emergent, stunted (DEWHA 2010) low-mallee and sometimes taller shrubs, or occasionally with some scattered tussock-grasses (Gilfillan et al 2007, McNee 1999). The Western Ground Parrot is usually recorded in areas of vegetation that have remained unburnt for five or more years.	Low heathland is present for this species to forage and breed. Numerous records are present in the Mid west from Bow River, Moora Mullewa and Carnamah with the most recent record from 2015. It should be noted that most of these records have a low certainty rating however the most recent (2015) is highly certain.	Likely, this species could not be assessed as unlikely due to the amount of habitat available in the area and lack of survey effort. This species requires additional survey effort to confirm.

Common name (species name)	Status (WC Act/DPAW, EPBC Act)		Search			Description & habitat requirements	Habitat with survey areas / Records (NatureMap)	Likelihood of Occurrence
	WC Act	EPBC Act	NM	EPBC PMST	DPaW			
Malleefowl (<i>Leipoa ocellata</i>)	VU	VU	X	X		The Malleefowl generally occurs in semi-arid areas of Western Australia, from Carnarvon to south east of the Eyre Bird Observatory (south-east WA). It occupies shrublands and low woodlands that are dominated by mallee vegetation, as well as native pine <i>Callitris</i> woodlands, Acacia shrublands, Broombush (<i>Melaleuca uncinata</i>) vegetation or coastal heathlands. The nest is a large mound of sand or soil and organic matter (Jones and Goth 2008; Morcombe 2004).	Some habitat is present for the species in the Wandoo and Marri Woodlands, however there are no records in the Mount Lesueur region and either occur in the coastal Acacia shrublands or further inland in the Mallee. This is probably due to the extremely dense nature of the heaths in this region.	Unlikely
Peregrine Falcon, (<i>Falco peregrinus</i>)	OS	-	X			The Peregrine Falcon is seen occasionally anywhere in the south-west of WA. It is found everywhere from woodlands to open grasslands and coastal cliffs - though less frequently in desert regions. The species is known to have a very large home range and nests primarily on ledges of cliffs, shallow tree hollows, and ledges of building in cities (Morcombe 2004).	Habitat is present for this species throughout the survey area for both hunting (all of the survey area) and some breeding (Wandoo and Marri). Records are present for this species surrounding the survey are with the closest only approximately 10 km east.	Likely

Common name (species name)	Status (WC Act/DPAW, EPBC Act)		Search			Description & habitat requirements	Habitat with survey areas / Records (NatureMap)	Likelihood of Occurrence
	WC Act	EPBC Act	NM	EPBC PMST	DPaW			
Sharp-tailed Sandpiper (<i>Calidris acuminata</i>)	IA	IA	X			In WA, scattered records occur along the Nullarbor Plain and the southern areas of the Great Victoria Desert. They are widespread from Cape Arid to Carnarvon, around coastal and subcoastal plains of Pilbara Region to south-west and east Kimberley Division. Inland records indicate the species is widespread and scattered from Newman, east to Lake Cohen, south to Boulder and west to Meekatharra (Higgins & Davies 1996). The Sharp-tailed Sandpiper prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation including lagoons, swamps, lakes and pools near the coast, and dams, waterholes, soaks, bore drains and bore swamps, salt pans and hypersaline salt lakes inland. They use flooded paddocks, sedgeland and other ephemeral wetlands, but leave when they dry. They tend to occupy coastal mudflats mainly after ephemeral. Sometimes they occur on rocky shores and rarely on exposed reefs (Higgins & Davies 1996). They have also been recorded roosting in mangroves (Minton & Whitelaw 2000).	No wetlands or areas suitable for this species to utilise are present within the survey area. Minor drainage lines are present on site but would unlikely be a resource for this species. Records in the region are mostly coastal or associated with larger inland wetlands and water courses.	Unlikely
Grey Plover (<i>Pluvialis squatarola</i>)	IA	IA	X			In non-breeding grounds in Australia, Grey Plovers occur almost entirely in coastal areas, where they usually inhabit sheltered embayments, estuaries and lagoons with mudflats and sandflats, and occasionally on rocky coasts with wave-cut platforms or reef-flats, or on reefs within muddy lagoons. They also occur around terrestrial wetlands such as near-coastal lakes and swamps, or salt-lakes. The species is also very occasionally recorded further inland, where they occur around wetlands or salt-lakes (Marchant & Higgins 1993).	No wetlands or areas suitable for this species to utilise are present within the survey area. Minor drainage lines are present on site but would unlikely be a resource for this species. Records in the region are mostly coastal on beaches.	Unlikely

Common name (species name)	Status (WC Act/DPAW, EPBC Act)		Search			Description & habitat requirements	Habitat with survey areas / Records (NatureMap)	Likelihood of Occurrence
	WC Act	EPBC Act	NM	EPBC PMST	DPaW			
Grey Wagtail (<i>Motacilla cinerea</i>)	IA	IA		X		A migratory species that regularly visits northern Australia particularly the area from Broome to Darwin (Morcombe 2004). The species prefers coastal habitat near to water where it prefers to forage. However the species has been recorded further inland feeding on plains (Morcombe 2004).	The cleared areas of the survey area maybe utilised by the species however very few records of the species are present outside of the Kimberley and northern regions and would rarely visit the area.	Unlikely
Common Greenshank (<i>Tringa nebularia</i>)	IA	IA		X		The Common Greenshank does not breed in Australia; however, the species occurs in all types of wetland and has the widest distribution of any shorebird in Australia (DSEWPaC 2013).	No wetlands or areas suitable for this species to utilise are present within the survey area. Minor drainage lines are present on site but would unlikely be a resource for this species. Records in the region are mostly coastal on beaches or on inland wetlands and water bodies. The three dams in the survey area maybe used opportunistically.	Unlikely

Common name (species name)	Status (WC Act/DPAW, EPBC Act)		Search			Description & habitat requirements	Habitat with survey areas / Records (NatureMap)	Likelihood of Occurrence
	WC Act	EPBC Act	NM	EPBC PMST	DPaW			
Wood Sandpiper (<i>Tringa glareola</i>)	IA	IA	X			The Wood Sandpiper is a seasonal visitor to Australia and has its largest numbers recorded in north-west Australia (Roebuck Bay near to Broome). Off the Tringa group (like the Common Greenshank) the Wood Sandpiper utilises a broad range of habitat types throughout Western Australia. Typical habitat includes well-vegetated, shallow, freshwater wetlands, such as swamps, billabongs, lakes, pools and waterholes. This species does not breed in Australia (DSEWPaC 2013).	No wetlands or areas suitable for this species to utilise are present within the survey area. Minor drainage lines are present on site but would unlikely be a resource for this species. Records in the region are mostly coastal on beaches or on inland wetlands and water bodies. The three dams in the survey area maybe used opportunistically.	Unlikely
Sanderling (<i>Calidris alba</i>)	IA	IA	X			The Sanderling is a seasonal visitor the Australia. In Western Australia, the Sanderling occurs on most of the coast from Eyre to Derby, and also around Wyndham. They are more often recorded on the south and southwest coasts, north to around southern Shark Bay, with more sparsely scattered records further. The species is recorded mostly on open sandy beaches exposed to open sea-swell, and also on exposed sandbars and spits, and shingle banks, where they forage in the wave-wash zone and amongst rotting seaweed (DSEWPaC 2013).	No wetlands or areas suitable for this species to utilise are present within the survey area. Minor drainage lines are present on site but would unlikely be a resource for this species. Records in the region are mostly coastal on beaches.	Unlikely
Reptiles								

Common name (species name)	Status (WC Act/DPAW, EPBC Act)		Search			Description & habitat requirements	Habitat with survey areas / Records (NatureMap)	Likelihood of Occurrence
	WC Act	EPBC Act	NM	EPBC PMST	DPaW			
Gilled Slender Blue-tongue Skink, (<i>Cyclodomorphus branchialis</i>)	VU	-	X			The Gilled Slender Blue-tongue Skink is endemic to the Midwest of Western Australia. It occupies an area between Murchison River and Irwin River in the coastal region, and extends inland to Yalgoo. This taxon inhabits semi-arid scrubs on heavy soil (Storr <i>et. al.</i> 1999). Little is known about the habitat preferences of this taxon (Shea and Miller 1995), but specimens have been known to burrow under gravelly soils and leaf litter during daylight hours.	Some habitat is present for this species in heathlands on lateritic soils however one dubious record is known from the region. The population is typically known from the region between Irwin and Murchison Rivers.	Unlikely
Western Spiny-tailed Skink (<i>Egernia stokesii</i> subsp. <i>badia</i>)	VU	EN	X	X		Most of the Western Spiny-tailed Skink brown form sites occur in York Gum (<i>Eucalyptus loxophleba</i>) woodland with some sites are in Gimlet (<i>E. salubris</i>) and Salmon Gum (<i>E. salmonophloia</i>) woodland. Populations persist in woodland patches as small as 1 ha and completely surrounded by wheat fields. Sites with the greatest number of individuals had numerous fallen logs and a low intensity of grazing by domestic stock. Hollow logs are required for refuge sites in woodland habitat. Preferred refuges consist of piles of several overlapping hollow logs providing a combination of basking and shelter sites. Populations on farms in the Perenjori shire occupy abandoned farmhouses, sheds and woodpiles.	Some habitat is present for the species in the Wandoo and Marri Woodlands, however there are no records in the Mount Lesueur region. All the records in <i>NatureMap</i> are present further inland in open woodlands.	Unlikely

Common name (species name)	Status (WC Act/DPAW, EPBC Act)		Search			Description & habitat requirements	Habitat with survey areas / Records (NatureMap)	Likelihood of Occurrence
	WC Act	EPBC Act	NM	EPBC PMST	DPaW			
Woma Python (<i>Aspidites ramsayi</i> SW pop.)	P1				X	The Woma inhabits woodlands, heaths and shrublands, often with spinifex. It occurs in the sub-humid and arid areas across Australia's interior with a separate sub-population occurring in the Wheatbelt and Goldfields of Western Australia. The Woma shelters mainly in abandoned monitor and mammal burrows and in soil cracks (Wilson and Swan 2010).	Some habitat is present for this species in heathlands on sandy soils and records are present in the region with one approximately 40 km south east. The species is highly cryptic and rarely observed and the survey area is within the known distribution of the south western population.	Likely
Black-striped Snake (<i>Neelaps calonotos</i>)	P3				X	This Black-striped Snake is restricted to the sandy coastal strip near Perth, between Mandurah and Lancelin. It occurs on dunes and sand-plains vegetated with heaths and eucalypt/banksia woodlands. This species is seriously threatened by increasing development within its restricted distribution (Wilson and Swan 2013).	Some habitat is present for this species in heathlands on sandy soils and records are present in the region with two records approximately 20 km north and 23 km east of the survey area. The species is highly cryptic and rarely observed and the survey area is within the known range of the species.	Likely
Mammals								

Common name (species name)	Status (WC Act/DPAW, EPBC Act)		Search			Description & habitat requirements	Habitat with survey areas / Records (NatureMap)	Likelihood of Occurrence
	WC Act	EPBC Act	NM	EPBC PMST	DPaW			
Dibbler (<i>Parantechinus apicalis</i>)	En	En			X	Historically Dibblers have been recorded over an extensive area from Jurien Bay to Cape Arid National Park and numerous islands of the coast (two populations are present on Boullanger and Whitlock Islands of the coast of Jurien) and it is likely that they can occupy a diverse range of habitats (Friend 2004). However, the species seem to prefer vegetation with a dense canopy greater than 1 m high which has been unburnt for at least 10 years or more (Baczocha & Start 1997). Typically, captures have been on sandy substrates although occasional records are on laterite soils.	Some habitat is present for this species in dense heathlands on sandy and lateritic soils, however few records are available on the mainland (two populations are present on Boullanger and Whitlock Islands of the coast of Jurien) for this species with one record approximately 120 km south east of the survey area in 1999.	Unlikely
Chuditch, Western Quoll (<i>Dasyurus geoffroii</i>)	Vu	V		X		The Chuditch inhabits eucalypt forest (especially Jarrah, <i>Eucalyptus marginata</i>), dry woodland and mallee shrublands. In Jarrah forest, Chuditch populations occur in both moist, densely vegetated, steeply sloping forest and drier, open, gently sloping forest. Most diurnal resting sites in sclerophyll forest consist of hollow logs or earth burrows (Van Dyke and Strahan 2008). The species can travel large distances, has a large home range and is sparsely populated through a large portion of its range.	Habitat is present for this species throughout the survey area with the woodlands providing refugia for denning and breeding and heathlands and shrubland for foraging. Numerous records for the species are present to the south of the survey area with the closest being 75 and 81 km away.	Likely, this species could not be assessed as unlikely due to the amount of habitat available in the area and lack of survey effort. This species requires additional survey effort to confirm.

Common name (species name)	Status (WC Act/DPAW, EPBC Act)		Search			Description & habitat requirements	Habitat with survey areas / Records (NatureMap)	Likelihood of Occurrence
	WC Act	EPBC Act	NM	EPBC PMST	DPaW			
South-western Brush-tailed Phascogale (<i>Phascogale tapoatafa</i>)	Vu				X	Dry sclerophyll forests and open woodlands with a generally sparse ground-storey, which contain suitable nesting resources such as tree hollows, rotted stumps and tree cavities (Van Dyck and Strahan 2008).	Habitat is present for this species throughout the survey area with the woodlands providing refugia for denning and breeding and heathlands and shrubland for foraging, however no records for the species are documented north of Perth.	Unlikely
Ghost Bat, (<i>Macroderma gigas</i>)	Vu	Vu	X			The Ghost Bat occurs in a wide range of habitats, and requires an undisturbed cave, deep fissure or disused mine shaft in which to roost. It is patchily distributed across Australia, and is sensitive to disturbance, with populations now contracting north and present only in the Pilbara and Kimberley (Van Dyck and Strahan 2008).	Habitat is present for the species in the woodlands particularly those trees with large hollows however the species has not been recorded in the region for over 200 years.	Highly Unlikely

Common name (species name)	Status (WC Act/DPAW, EPBC Act)		Search			Description & habitat requirements	Habitat with survey areas / Records (NatureMap)	Likelihood of Occurrence
	WC Act	EPBC Act	NM	EPBC PMST	DPaW			
Southern Brown Bandicoot, (<i>Isoodon obesulus</i>)	P5	-	X			The Quenda prefers dense scrubby, often swampy, vegetation with dense cover up to one metre high. However, it also occurs in woodlands, and may use less ideal habitat where this habitat occurs adjacent to the thicker, more desirable vegetation. The species often feeds in adjacent forest and woodland that is burnt on a regular basis and in areas of pasture and cropland lying close to dense cover (Van Dyck and Strahan 2008).	Some habitat is present for this species in dense heathlands on sandy and lateritic soils, however few records are present for this species in the region, with the survey area being at the most north limit of their distribution. One record is approximately 20 km south west of the survey area.	Likely, this species could not be assessed as unlikely due to the amount of habitat available in the area and lack of survey effort. This species requires additional survey effort to confirm.
Tammar Wallaby (<i>Macropus eugenii derbianus</i>)	P4				X	The Tammar Wallaby inhabits dense, low vegetation for daytime shelter and open grassy areas for feeding. Inhabits coastal scrub, heath, dry sclerophyll (leafy) forest and thickets in mallee and woodland The tammar wallaby is currently known to inhabit three islands in the Houtman Abrolhos group, Garden Island near Perth, Middle and North Twin Peak Islands in the Archipelago of the Recherche, and at least nine sites on the mainland including, Dryandra, Boyagin, Tutanning Batalling (reintroduced) Perup, private property near Pingelly, Jaloran Road timber reserve near Wagin, Hopetown, Stirling Range National Park, and Fitzgerald River National Park (Van Dyck and Strahan 2008).	Habitat is present for this species in the dense heathlands and shrublands however the species is not known to occur in the region, except on some islands within the Abrolhos of Geraldton.	Unlikely

Common name (species name)	Status (WC Act/DPAW, EPBC Act)		Search			Description & habitat requirements	Habitat with survey areas / Records (NatureMap)	Likelihood of Occurrence
	WC Act	EPBC Act	NM	EPBC PMST	DPaW			
Western Brush Wallaby (<i>Macropus Irma</i>)	P4	-	X			The Western Brush Wallaby is a grazer found primarily in open forest or woodland, particularly favouring open, seasonally wet flats with low grasses and open scrubby thickets. It is also found in some areas of mallee and heathland, and is uncommon in karri forest. This species was once very common in the south-west of WA but has undergone a reduction in range and a significant decline in abundance in its current habitat. (Van Dyke and Strahan 2008).	Habitat is present for this species in the dense heathlands and shrublands and woodlands. The species is known to occur in the region, with multiple records surrounding the survey area. A sighting of a wallaby was undertaken during the survey and the species was verified via remote camera	Present

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Ultrasonic detection surveys

Ultrasonic files containing potential bat calls were recorded during the field surveys using Anabat Express detectors (Titley Scientific) and SM2BAT+ SongMeter recorders (Wildlife Acoustics Inc. USA). Bat calls were recorded between sunset and sunrise across consecutive nights at each site.

Call analysis

Craig Grabham from GHD completed the analysis of all data collected during the survey using ultrasonic bat detectors.

Data from SM2 units was downloaded and viewed using Kaleidoscope Viewer (version 3.1.6, Wildlife Acoustics Inc. 2016) as full-spectrum audio files. WAC files were also converted to Anabat sequence files (zero-crossing format) suitable for analysis in AnalookW version 4.1s (Corben 2015).

WAC files were viewed and bat calls were identified using Kaleidoscope Viewer by visually comparing the Kaleidoscope Viewer spectrogram and call characteristics (e.g. characteristic frequency and call shape) with reference calls and/or species call descriptions from available reference material. The spectrogram displayed each call sequence (see below for call definition) with information on the number and timing of calls.

Anabat sequence files were viewed and bat calls were identified using AnalookW by visually comparing the Analook time-frequency graph and call characteristics (e.g. characteristic frequency and call shape) with reference calls and/or species call descriptions from available reference material.

The call identification was also assisted by consulting distribution information for possible species (ALA and DPAW NatureMap records). No reference calls were collected during the survey.

A call (pass) was defined as a sequence of three or more consecutive pulses of similar frequency and shape. Calls with less than three defined consecutive pulses of similar frequency and shape were not unambiguously identified to a species but were used as part of the activity count for the survey area.

Due to variability in the quality of calls, the lack of published information regarding non-search phase calls and the difficulty in distinguishing some species the identification of each call was assigned a confidence rating (see Mills *et al.* 1996 & Duffy *et al.* 2000) as summarised in the table below. Due to the absence of reference calls from the study area and the poor quality of some the recordings and known overlap in call characteristics between some species, a conservative approach was taken when analysing calls.

Species nomenclature follows Armstrong (2011), then van Dyck *et al.* (2013).

Confidence ratings applied to calls

Identification	Description
D - Definite	Species identification not in doubt. Call sequence contains three or more consecutive pulses of similar frequency and shape. Call characteristics match those in referenced material or species reference calls.
PR - Probable	Call most likely to represent a particular species, but there exists a low probability of confusion with species of similar call type or call lacks sufficient detail (e.g. number of pulses).
SG - Species Group	X = Call made by one of two or more species. Call characteristics overlap making it too difficult to distinguish between species

Summary of results and survey effort

Microchiropteran bat detector surveys were completed for 26 nights at three locations during August 2016 within the survey area.

Five species were positively (Definite) identified of the 12 species that are known to occur from this part of the region (Armstrong 2011; NatureMap 2016). As many as three other species may also have been recorded using bat detectors, but poor data quality and/or interspecific call similarities precluded reliable identification of additional species.

The tables below provide site location details and a summary of the results for each site for each night.

Summary of bat call analysis May 2016

Species / Group	Anabat Express	SM2 unit 1	SM2 unit 2
<i>Austronomus australis</i>	D	-	D
<i>Chalinolobus gouldii</i>	D	D	D
<i>Chalinolobus morio</i>	D	D	D
<i>Vespadelus regulus</i>	D	D	D
<i>Nyctophilus sp.</i>	D	D	D
<i>Ozimops kitcheneri</i>	-	PR	D

Notes:

Total number of species recorded for each night/site is based on definite (D) identification only. Total number of D species for each night includes one *Nyctophilus* species where recorded.

See Table 1 for confidence rating e.g. D or Pr, - = not recorded. X = species group present.

CE, E, VU – species listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, P1- 4 (priority species) species under the *Wildlife Conservation Act 1950*

Qualifications

Craig Grabham has completed microchiropteran bat surveys and assessments in WA, New South Wales (NSW), Queensland (QLD), Victoria, Tasmania and the Northern Territory (NT) employing a variety of methods including harp trapping, light tagging, habitat surveys (e.g. cave assessments), roost surveillance (using infrared and thermal video cameras), and echolocation survey (Wildlife Acoustic's SongMeter and Eco Meter devices and Titley Electronic Anabat devices) and analysis (Wildlife Acoustic's SongScope and Chris Corben's Analook). He has completed bat surveys for infrastructure, residential, and mining projects. Craig has also completed bat inventory surveys for National Parks, Nature Reserves, catchment management areas and private land conservation projects. His honours project investigated the use of remnant and revegetated habitats by microchiropteran bats across a fragmented rural landscape in the Eastern Billabong Catchment (south-west slopes) in NSW.

Craig has completed the following training courses with regard to ultrasonic call recording and analysis:

- Anabat system training course – Titley Scientific (December 2012)
- Wildlife Acoustic's Song Meter and SongScope training – Faunatech/Austbat (July 2015).

To date Craig has completed echolocation analysis and reporting for more than 102 projects from WA, NSW, NT, QLD and Victoria since joining GHD in 2006 from calls collected during field surveys from Anabat detectors and/or Song Meter units and identified using Analook or SongScope software.

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Appendix F – Offsets Calculator

Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*
2 October 2012

This guide relies on Macros being enabled in your browser.

Matter of National Environmental Significance	
Name	Carnaby's Cockatoo
EPBC Act status	Endangered
Annual probability of extinction Based on IUCN category definitions	1.2%

Key to Cell Colours
User input required
Drop-down list
Calculated output
Not applicable to attribute

Impact calculator							
Impact calculator	Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact	Units	Information source	
	<i>Ecological communities</i>						
	Area of community	No		Area			
				Quality			
				Total quantum of impact	0.00		
	<i>Threatened species habitat</i>						
	Area of habitat	Yes		Area	88.7	Hectares	
				Quality	8	Scale 0-10	
				Total quantum of impact	70.96	Adjusted hectares	
	<i>Threatened species</i>						
Number of features e.g. Nest hollows, habitat trees	No						
Condition of habitat Change in habitat condition, but no change in extent	No						
Birth rate e.g. Change in nest success	No						
Mortality rate e.g. Change in number of road kills per year	No						
Number of individuals e.g. Individual plants/animals	No						

Offset calculator																					
Offset calculator	Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)	Start area and quality	Future area and quality without offset	Future area and quality with offset	Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost (\$ total)	Information source				
	<i>Ecological Communities</i>																				
	Area of community	No					Risk-related time horizon (max. 20 years)	Start area (hectares)	Risk of loss (%) without offset		Risk of loss (%) with offset										
							Future area without offset (adjusted hectares)	0.0	Future area with offset (adjusted hectares)	0.0											
							Time until ecological benefit		Start quality (scale of 0-10)		Future quality without offset (scale of 0-10)		Future quality with offset (scale of 0-10)								
	<i>Threatened species habitat</i>																				
	Area of habitat	Yes	70.96	Adjusted hectares	Lot 1, 1395 Banovich Road, Hill River (1993 ha)	Time over which loss is averted (max. 20 years)	20	Start area (hectares)	564	Risk of loss (%) without offset	15%	Risk of loss (%) with offset	2%		73.32	80%	58.66	46.21	75.63	106.57%	Yes
							Future area without offset (adjusted hectares)	479.4	Future area with offset (adjusted hectares)	552.7											
							Time until ecological benefit	10	Start quality (scale of 0-10)	9	Future quality without offset (scale of 0-10)	8	Future quality with offset (scale of 0-10)	9	1.00	80%	0.80	0.71			
	<i>Threatened species</i>																				
Number of features e.g. Nest hollows, habitat trees	No																				
Condition of habitat Change in habitat condition, but no change in extent	No																				
Birth rate e.g. Change in nest success	No																				
Mortality rate e.g. Change in number of road kills per year	No																				
Number of individuals e.g. Individual plants/animals	No																				

Summary								
Summary	Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost (\$)		
						Direct offset (\$)	Other compensatory measures (\$)	Total (\$)
	Birth rate	0				\$0.00		\$0.00
	Mortality rate	0				\$0.00		\$0.00
	Number of individuals	0				\$0.00		\$0.00
	Number of features	0				\$0.00		\$0.00
	Condition of habitat	0				\$0.00		\$0.00
	Area of habitat	70.96	75.63	106.57%	Yes	\$0.00	N/A	\$0.00
Area of community	0				\$0.00		\$0.00	
					\$0.00	\$0.00	\$0.00	

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Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	M Gannaway G Gaikhorst	J Foster C Grabham		D Farrar		12/09/2016

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Appendix B. Carnaby's Black Cockatoo Investigations

Memo

To: Carmelo Gumina, Lisa Boulden

From: Karen Crews

Date: 7 June 2017

Subject: Great Northern Highway Muchea to Wubin Upgrade Stage 2: Carnaby's Black Cockatoo investigations Muchea North and Ippolo Road



Dear Carmelo,

This memo presents the outcomes of the following site inspections conducted for the Muchea North work package:

- identification suitable habitat trees for the erection of artificial nest boxes for Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) Muchea North and Ippolo Road offset site (lot M2091 Ippolo Road)
- searches for evidence of foraging by Carnaby's Black Cockatoo at Lot M2091 Ippolo Rd to determine usage at the site.

BACKGROUND

Muchea North is part of the Great Northern Highway (GNH) Muchea to Wubin Upgrade Stage 2 Project (the Project) and entails proposed upgrade works to the GNH between Old Gingin Road and Chittering Roadhouse, approximately 63 km north of Perth. The Department of Environment and Energy (DoEE) has deemed Muchea North a controlled action under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (EPBC ref: 2016/7656), with a contributing factor being proposed impacts to Carnaby's Black Cockatoo habitat. The species is listed as a matter of national environmental significance (NES) under the EPBC Act, with the conservation status of Endangered. It is also listed as Endangered under the *WA Wildlife Conservation Act 1950*.

Detailed black cockatoo habitat assessments conducted for Muchea North within the Muchea North EPBC Act Approval Boundary are documented in Phoenix (2015¹) and Phoenix (2017²).

Main Roads WA has committed to installing artificial nesting boxes for Carnaby's Black Cockatoo as part of the environmental offset for Muchea North. The Arup Jacobs JV (ASJV) requested Phoenix Environmental Sciences to provide advice in relation to where to place the new artificial nesting boxes. Up to 50 trees were required to be selected to allow for potential access or permission constraints to certain areas. Jacobs requested trees within the road reserve to be considered as a priority for selection followed by Lot M2091 Ippolo Rd.

The searches for evidence of foraging by Carnaby's Black Cockatoo at Lot M2091 Ippolo Rd were required to enable a comparison of the foraging value of the offset area to that of the Muchea North impact area.

¹ Phoenix. 2015. Flora and fauna assessment for Muchea North and Chittering study area. Phoenix Environmental Sciences Pty Ltd, Balcatta, WA. Unpublished report prepared for Muchea to Wubin Integrated Project Team (Main Roads WA, Jacobs and Arup).

² Phoenix. 2017. *Flora and fauna assessment for Muchea North and Chittering study area – Report Addendum*. Phoenix Environmental Sciences Pty Ltd, Balcatta, WA. Unpublished report prepared for Muchea to Wubin Integrated Project Team (Main Roads WA, Jacobs and Arup).

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Subject: Great Northern Highway Muchea to Wubin Upgrade Stage 2: Additional black cockatoo assessment for Muchea North

SCOPE

The scope of work was as follows:

1. Identify criteria for selection of suitable trees for artificial nest box erection.
2. Undertake a site visit to Muchea North and Lot M2091 Ippolo Rd to identify, record the location of and photograph, up to 50 suitable trees
3. Conduct searches for evidence foraging by Carnaby's Black Cockatoo at Lot M2091 Ippolo Rd.
4. Prepare a brief memo report summarising the results.

NEST BOX TREE SELECTION

Criteria for selection of trees

The following criteria were identified as relevant to the selection of suitable trees for the Muchea North project:

- Potential nest box trees should be located in the road reserve if possible, in accordance with Jacob's requirements, but outside the Muchea North disturbance footprint.
- Potential nest box trees should ideally be located in close proximity to the hollows that are being impacted – these were assumed to be the impact hollows that have been recorded with evidence of use (HT06261 HT06278, HT08752, HT08753, HT08754, HT14749).
- Lot M2091 Ippolo Rd was considered less suitable due to distance from the impact hollows; however, may need to be included as part of the mix of sites due to large number of nest boxes to be installed.
- Potential nest box trees should be mature and well shaded.
- Potential nest box trees should be accessible with a cherry picker to allow installation of the nest boxes.

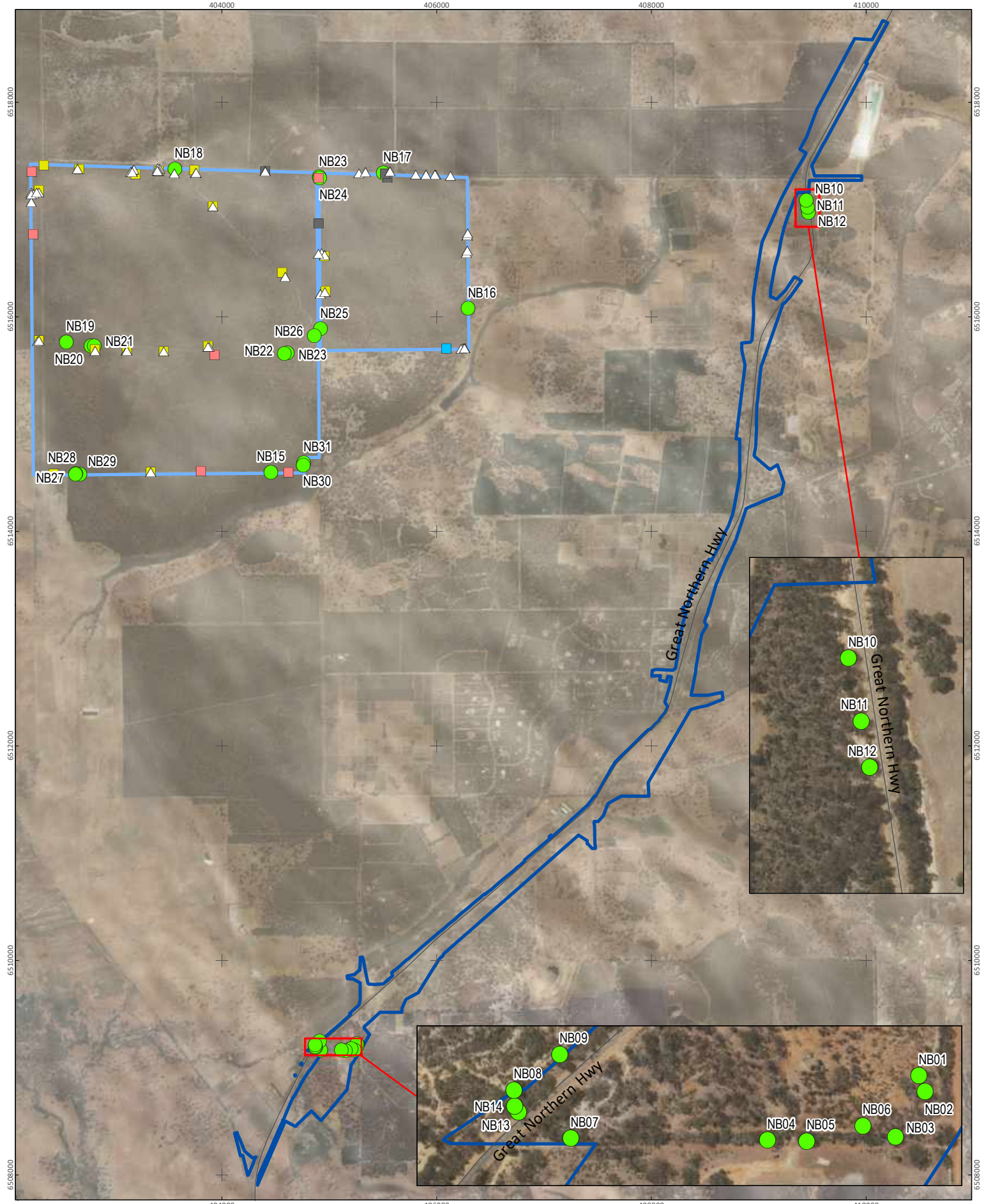
Site assessment

Site visits were undertaken to Muchea North on 9-10 May 2017, and to Ippolo Road on 24 May, by Tony Kirkby and Karen Crews. At Muchea North, trees were inspected in the vicinity of each impact hollow and potential nest box trees selected in accordance with the above criteria, as far as possible. At Ippolo Road, suitable trees were selected along existing access tracks only.

Four of the impact hollows (HT06261, HT06278, HT08752, HT14749) are located in the Main Roads gravel reserve site. The remaining two impact hollows (HT08753, HT08754) are north of this location and isolated from each other.

Thirty potential nest box trees have been recorded to date (Figure 1; Table 1), excluding one tree (NB07) which is being discounted as it will be impacted by the project. Photographs of each tree are provided in Attachment 1. The trees were demarcated with site number using white paint on (side facing away from the road) and location recorded by GPS. A photograph was taken of each tree. DGPS locations of each tree were subsequently recorded by John Hammon (Jacobs) and are shown in Table 1.

Please note that the selected trees are not considered ideal. Reasoning is provided below for each impact hollow and recommendations made for further investigation.



Jacobs
Great Northern Highway,
Muchea to Wubin Upgrades Project

Project No	1130
Date	07-Jun-17
Drawn by	KW
Map author	KC

0 0.25 0.5 1 1.5
Kilometres

1:45,000 (at A4) GDA 1994 MGA Zone 50

- Muchea North EPBC Act approval boundary
- Ippolo Road offset site (Lot M2091)
- Potential nest box trees
- △ Carnaby's Black Cockatoo (CBC) foraging evidence
- CBC habitat site - low evidence
- CBC habitat site - low value
- CBC habitat site - no evidence
- CBC habitat site - water point

Figure 1
Potential nest box trees and foraging habitat

PHOENIX
ENVIRONMENTAL SCIENCES

All information within this map is current as of 07-Jun-17. This product is subject to COPYRIGHT and is property of Phoenix Environmental Sciences (Phoenix). While Phoenix has taken care to ensure the accuracy of this product, Phoenix make no representations or warranties about its accuracy, completeness or suitability for any particular purpose.

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Table 1 Potential nest box trees

Tree No	Easting	Northing	Habitat tree being impacted
NB01	405259.52	6509220.99	HT06261, HT06278, HT08752, HT14749
NB02	405265.58	6509205.58	HT06261, HT06278, HT08752, HT14749
NB03	405236.93	6509161.83	HT06261, HT06278, HT08752, HT14749
NB04	405113.14	6509158.76	HT06261, HT06278, HT08752, HT14749
NB05	405151.2	6509157.5	HT06261, HT06278, HT08752, HT14749
NB06	405205.4	6509172.54	HT06261, HT06278, HT08752, HT14749
NB08	404867.41	6509206.98	HT06261, HT06278, HT08752, HT14749
NB09	404911.67	6509241.8	HT06261, HT06278, HT08752, HT14749
NB10	409444.53	6517083.44	HT08753
NB11	409457.81	6517018.3	HT08753
NB12	409466.34	6516970.26	HT08753
NB13	404871.6	6509186.28	HT06261, HT06278, HT08752, HT14749
NB14	404868.02	6509191.67	HT06261, HT06278, HT08752, HT14749
NB15	404458.86	6514549.49	<i>Lot M2091 Ioppolo Rd</i>
NB16	406294.36	6516075.95	<i>Lot M2091 Ioppolo Rd</i>
NB17	405504.9	6517341.37	<i>Lot M2091 Ioppolo Rd</i>
NB18	403562.7	6517374.57	<i>Lot M2091 Ioppolo Rd</i>
NB19	402550.76	6515763.36	<i>Lot M2091 Ioppolo Rd</i>
NB20	402780.99	6515726.72	<i>Lot M2091 Ioppolo Rd</i>
NB21	402810.45	6515724.78	<i>Lot M2091 Ioppolo Rd</i>
NB22	404581.71	6515654.69	<i>Lot M2091 Ioppolo Rd</i>
NB23	404906.72	6517303.79	<i>Lot M2091 Ioppolo Rd</i>
NB23	404608.24	6515660.48	<i>Lot M2091 Ioppolo Rd</i>
NB24	404910.62	6517292.74	<i>Lot M2091 Ioppolo Rd</i>
NB25	404918.72	6515885.02	<i>Lot M2091 Ioppolo Rd</i>
NB26	404861.36	6515820.2	<i>Lot M2091 Ioppolo Rd</i>
NB27	402635	6514534	<i>Lot M2091 Ioppolo Rd</i>
NB28	402640	6514537	<i>Lot M2091 Ioppolo Rd</i>
NB29	402678	6514534	<i>Lot M2091 Ioppolo Rd</i>
NB30	404759	6514617	<i>Lot M2091 Ioppolo Rd</i>
NB31	404763	6514638	<i>Lot M2091 Ioppolo Rd</i>

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HT08753

Three potential nest box trees were demarcated (NB10, NB11, NB 12) but these are located in a cluster ~600 m north of the impact hollow. Within the road reserve, the location of the three trees was considered the only safe area in the vicinity of HT08753 where a cherry picker could be deployed.

An alternative area has been identified that is considered more appropriate and contains several large, suitable trees (hatched in Figure 2) but it is within private tenure. Access would need to be arranged to this area before we can demarcate these trees. It is recommended that Jacobs consider suitability from an access perspective before further site visits are undertaken.

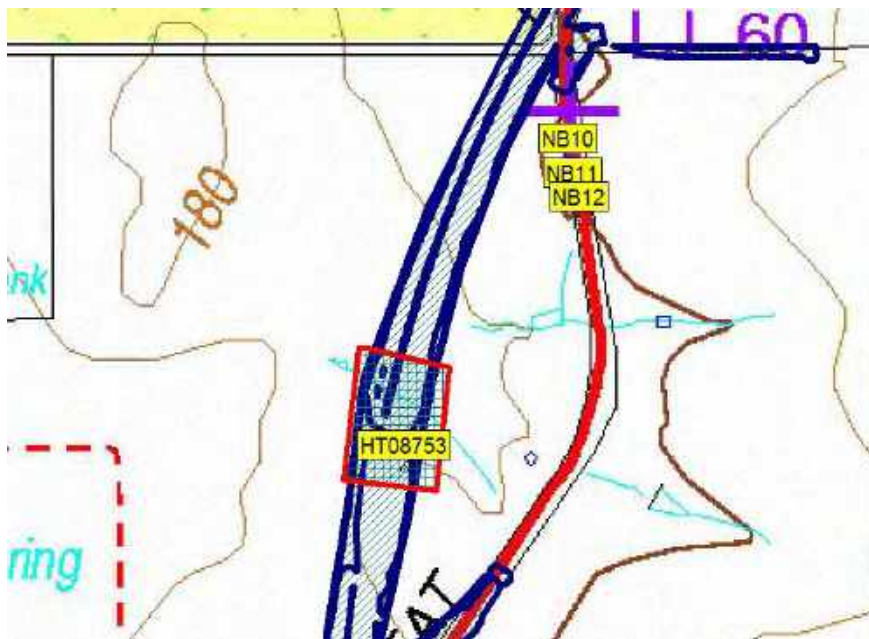


Figure 2 Potential nest box trees and other suitable area (hatched in red border) near HT08753

HT08754

No potential nest box trees were marked near this impact hollow. The only suitably sized trees identified within the road reserve in the vicinity of HT08754 were considered difficult to access with a cherry picker. The area in the vicinity of HT08754 outside the road reserve contains some suitable, large trees (hatched in Figure 3) but it is within private tenure. The best option would be to select trees from within the area hatched in Figure 3.

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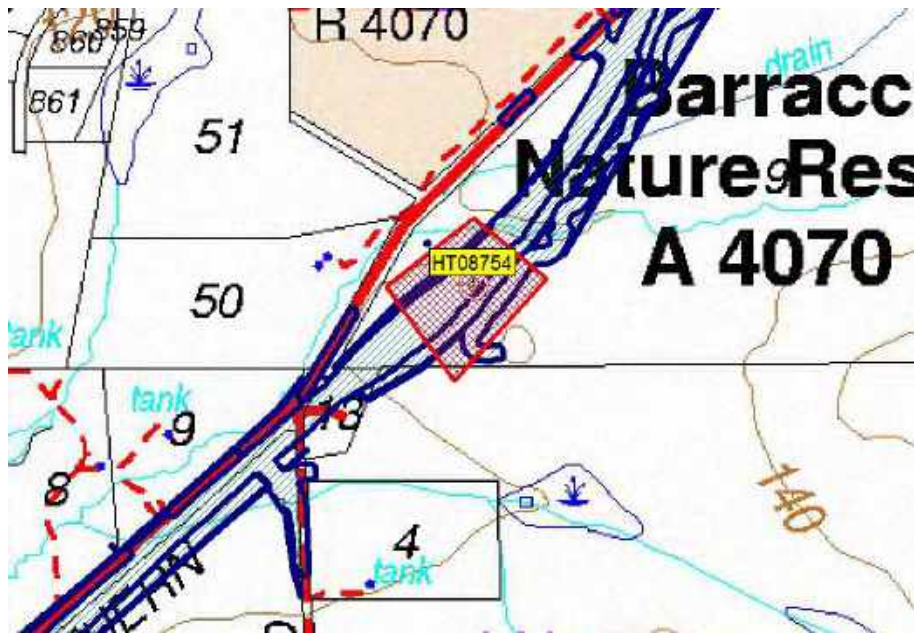


Figure 3 Suitable area (hatched in red) near HT08754

Gravel reserve - HT06261, HT06278, HT08752, HT14749

Eleven potential next box trees were marked in this area; however, Jacobs have since advised that one tree, NB07, will not be suitable as that tree will be impacted by the project. Therefore ten potential nest box trees are currently marked in this area. Some wandoo marked trees are located towards the back and top of the property to the east of the proposed re-alignment. Several Jarrah trees located in the road verge on the western side of GNH have also been marked.

Access to the trees near the GNH is not ideal; however, this may not be an issue if the nest boxes are installed after the current alignment is decommissioned. Many large trees are present nearby on adjacent private properties (see hatched area in Figure 4). It is considered that several of these would be more suitable than some of those selected. Further selection of potential trees in these locations is recommended, subject to consideration of access issues.

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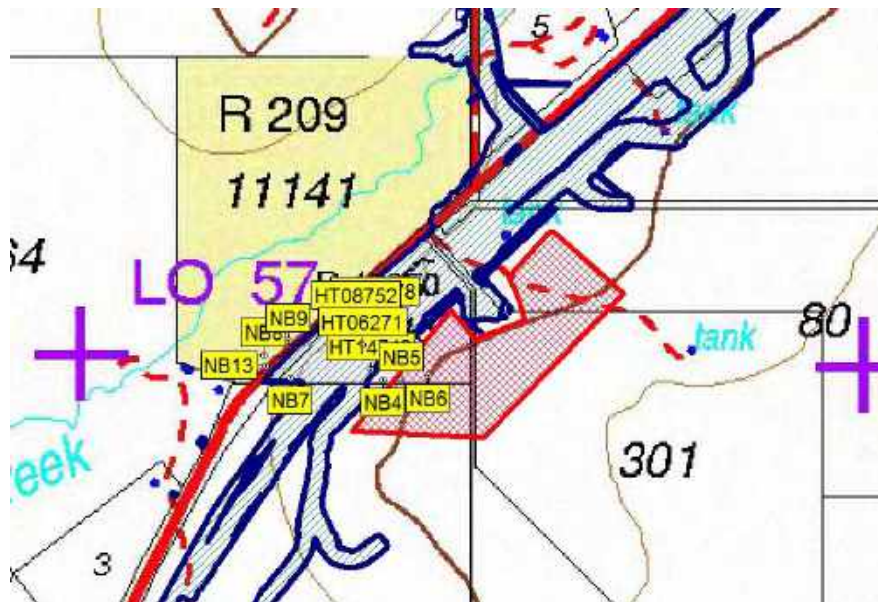


Figure 4 Potential nest box trees and other suitable area (hatched in red) near HT06261, HT06278, HT08752 and HT14749

Lot M2091 Ippolo Rd

Eighteen potential nest box trees have been marked to date in the Lot M2091 Ippolo Rd (Figure 1). All trees are located in close proximity to existing tracks. All marked trees were either Jarrah or Marri

Please note that not all trees marked are considered ideal locations for erection of artificial nest boxes. Further to this, some additional trees are present adjacent to tracks that may be more suitable but were not marked due to time constraints.

Use of Lot M2091 Ippolo Rd for the installation of artificial nest boxes should be considered after all options closer to the impact areas are fully investigated (as discussed above). If Lot M2091 Ippolo Rd is required for the implementation of this mitigation and offset action, further site selection and refinement of priority trees should be undertaken.

CARNABY'S BLACK COCKATOO FORAGING EVIDENCE AT IOPPOLO ROAD

Searches for evidence of foraging by Carnaby's Black Cockatoo at Lot M2091 Ippolo Rd were undertaken on 24 May. Due to the large size of the offset site and limited time available, searches were confined largely to areas along and close to existing access tracks within the site. All accessible tracks were driven and periodic stops made to conduct searches for foraging records. Additional notations were also made regarding level of foraging activity observed and general quality of feeding habitat for Carnaby's Black Cockatoo. Between 5 and 10 minutes was spent at each site.

Evidence of foraging by Carnaby's Black Cockatoo was recorded throughout the site, at several search locations (Figure 1). Most records were evidence of *Banksia attenuata* and *B. menziesii* chewings and grubbing. Both species occur in high abundance in several parts of the site. Apart from two locations, the records in areas identified as containing foraging habitat (in particular banksia woodlands) were noted to be

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in low abundance. In some locations where suitable habitat was identified, no foraging evidence was recorded. The two locations of high foraging evidence were located directly along tracks, one on the southern boundary close to a dam and one on the northern boundary.

Little evidence of marri chewings or foraging on other species other than banksias was observed. One record each of marri and *Xanthorrhoea preissii* chewings were noted. While marri nuts were inspected at several locations along track, little search effort was employed for other foraging species due to time constraints. Therefore this result for other feeding species is likely to be at least partly due to low emphasis placed on searches for other foraging species.

It was evident however that the banksia woodlands provided the highest value foraging habitat for Carnaby's Black Cockatoo within the site. It was also evident that quality of banksia woodland, as foraging habitat value, was variable, with some areas considered low value due to low banksia density and/or poor condition vegetation/high number of dead trees, while other areas were considered good quality foraging habitat. A detailed assessment of foraging habitat quality was not possible within the time available.

Based on the records collected (i.e. along and close to access tracks), the site appears to be subject to a low level of usage as foraging habitat by Carnaby's Black Cockatoo. Additional searches more intensively and systematically through the site may identify higher usage in areas that we not covered in the current survey.

CONCLUSION

In summary, we have selected to date 30 potential next box trees in Muchea North and Ippolo Road. Additional suitable trees exist within adjacent private properties close to the location of impact sites and these should be investigated as a first priority if it is feasible to select trees within these properties. Following this, further refinement of suitable trees in Ippolo Road is required.

Final selection of potential nest box trees may need to consider timing of the installation of artificial nest boxes relative to the construction program for Muchea North in terms of logistical access to trees. The Department of Environment and Energy may also require installation of the artificial nest boxes prior to removal of the impact hollows and before the next breeding season, which may also limit selection of final trees.

Based on the survey of Lot M2091 Ippolo Rd, Carnaby's Black Cockatoo appears to be utilising the site for foraging in very low densities; however, further surveys may identify more intensive utilisation in areas that were not searched.

Yours Sincerely,

Karen Crews

General Manager

karen.crews@phoenixenv.com.au

08 9345 1608

1/511 Wanneroo Rd Balcatta WA 6021

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Attachment 1 Potential next box tree photographs



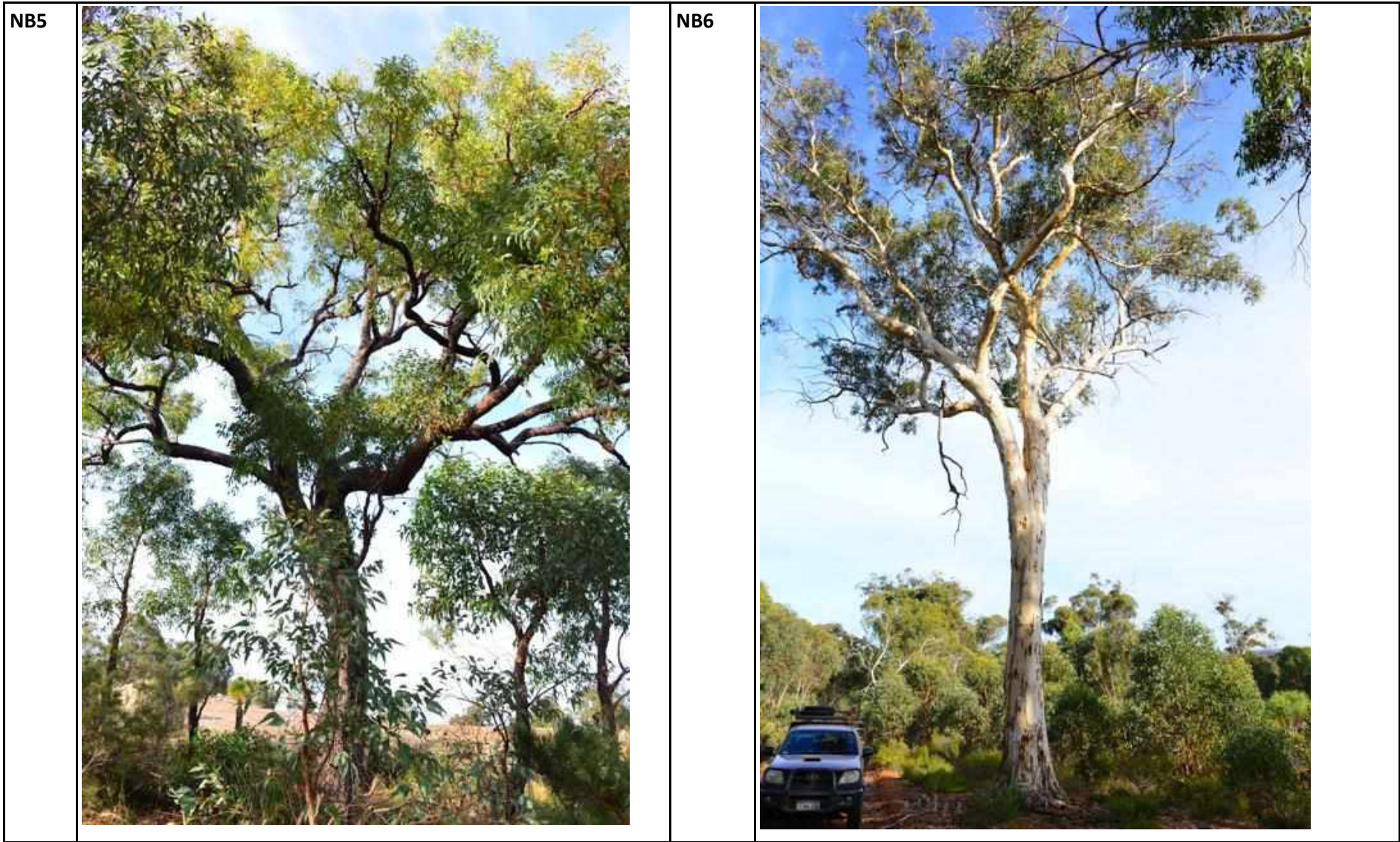
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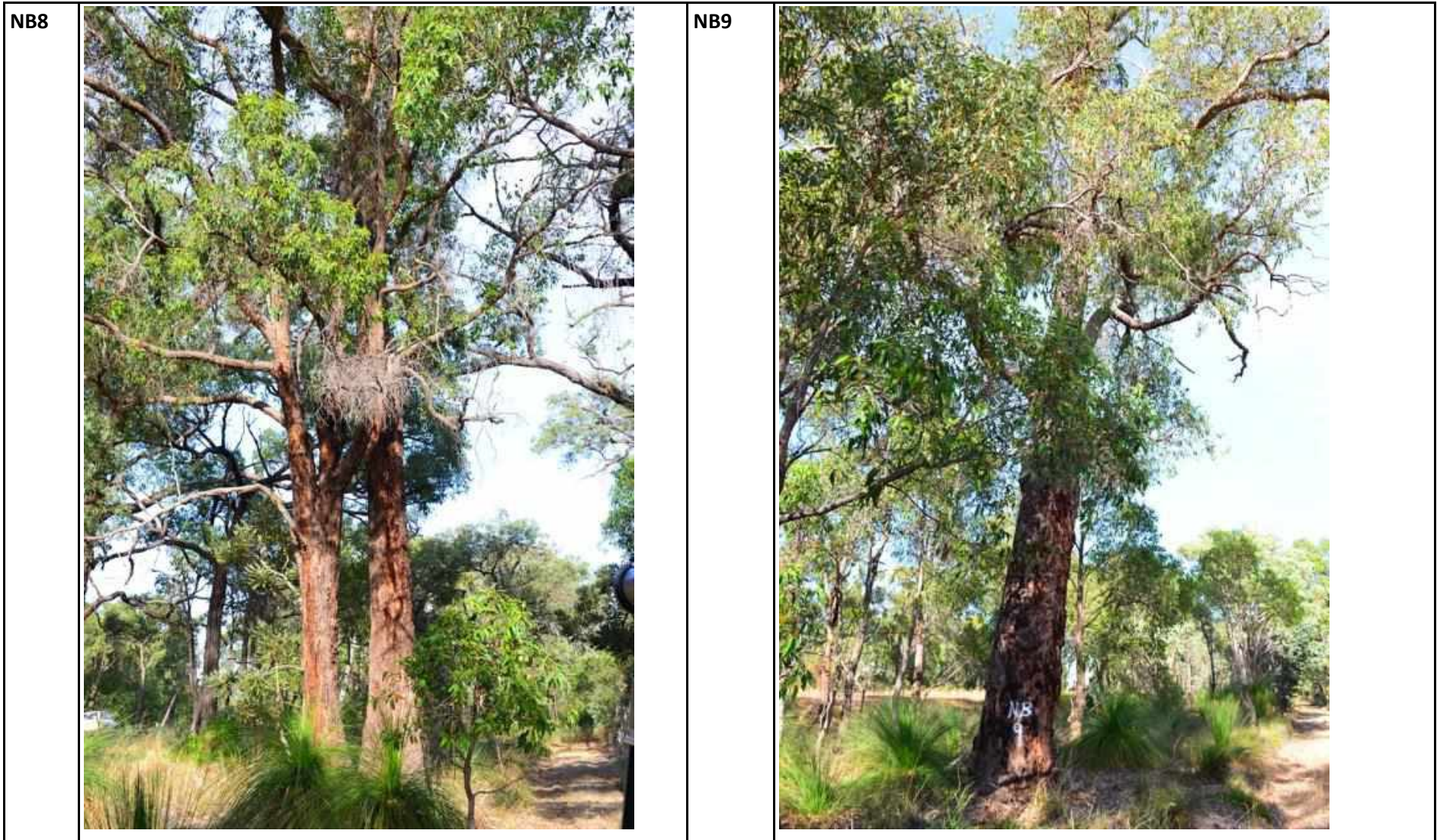
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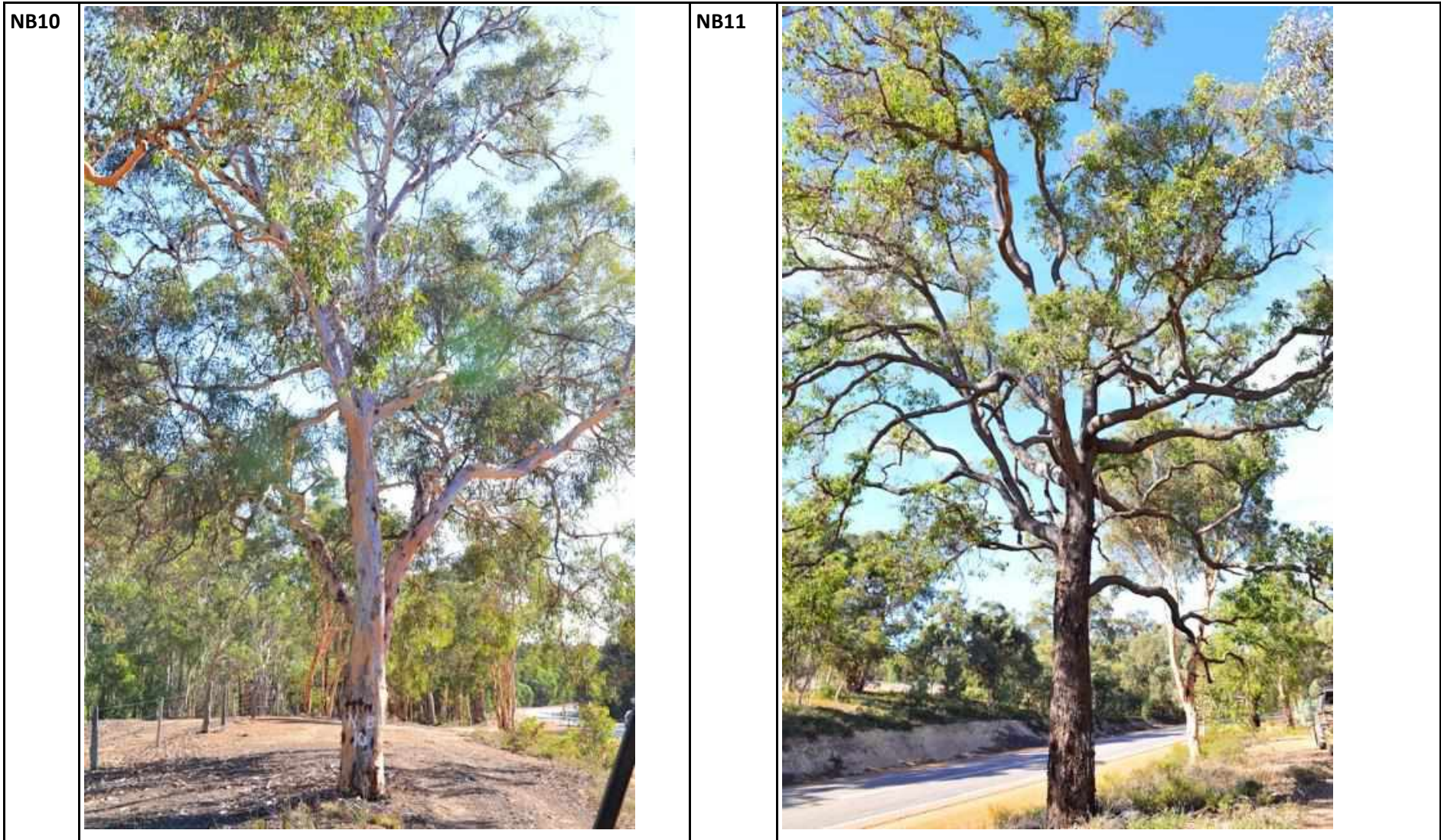
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NB14		NB15	
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NB16		NB17	No photo
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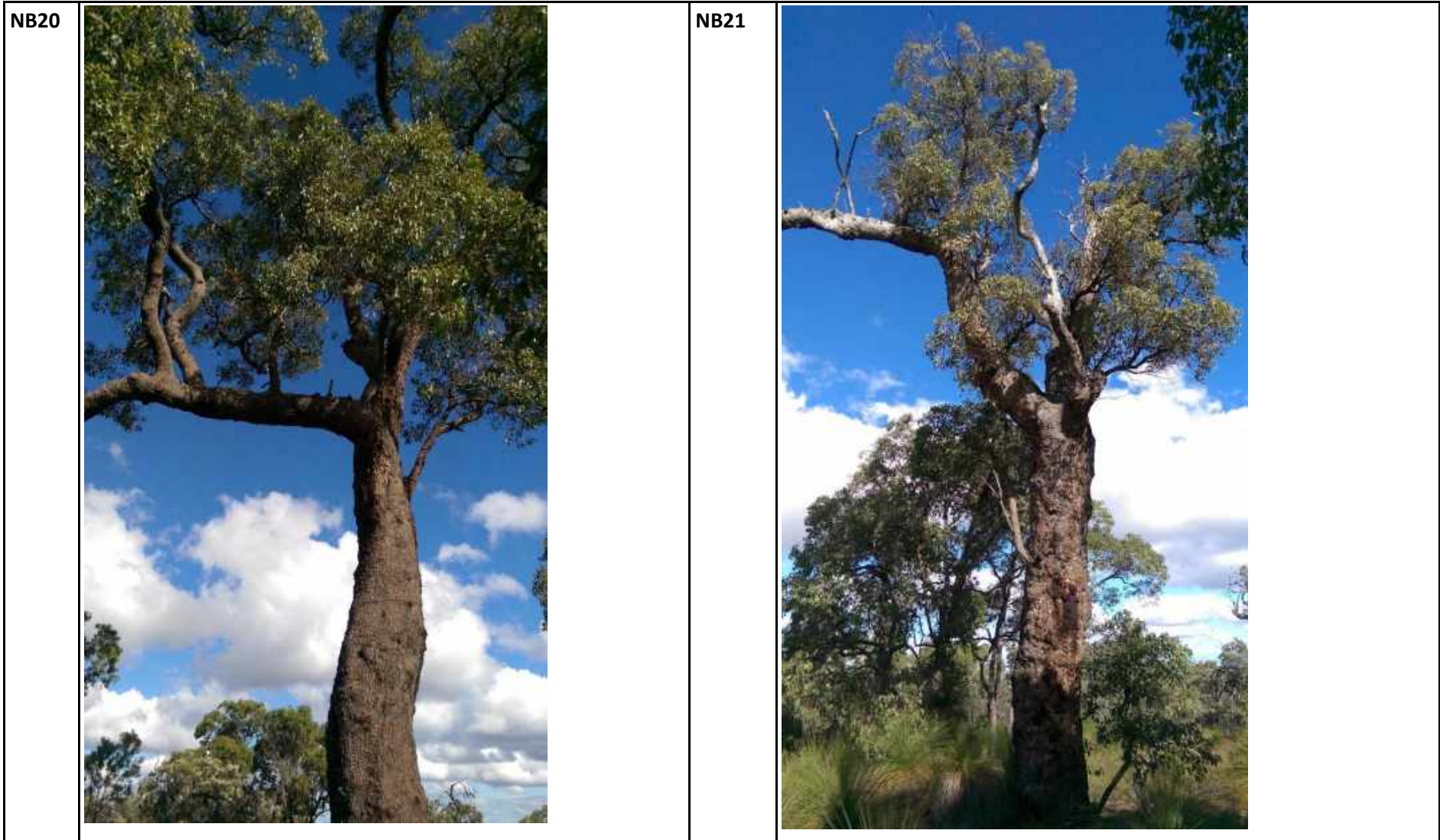
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NB18	No photo	NB19	
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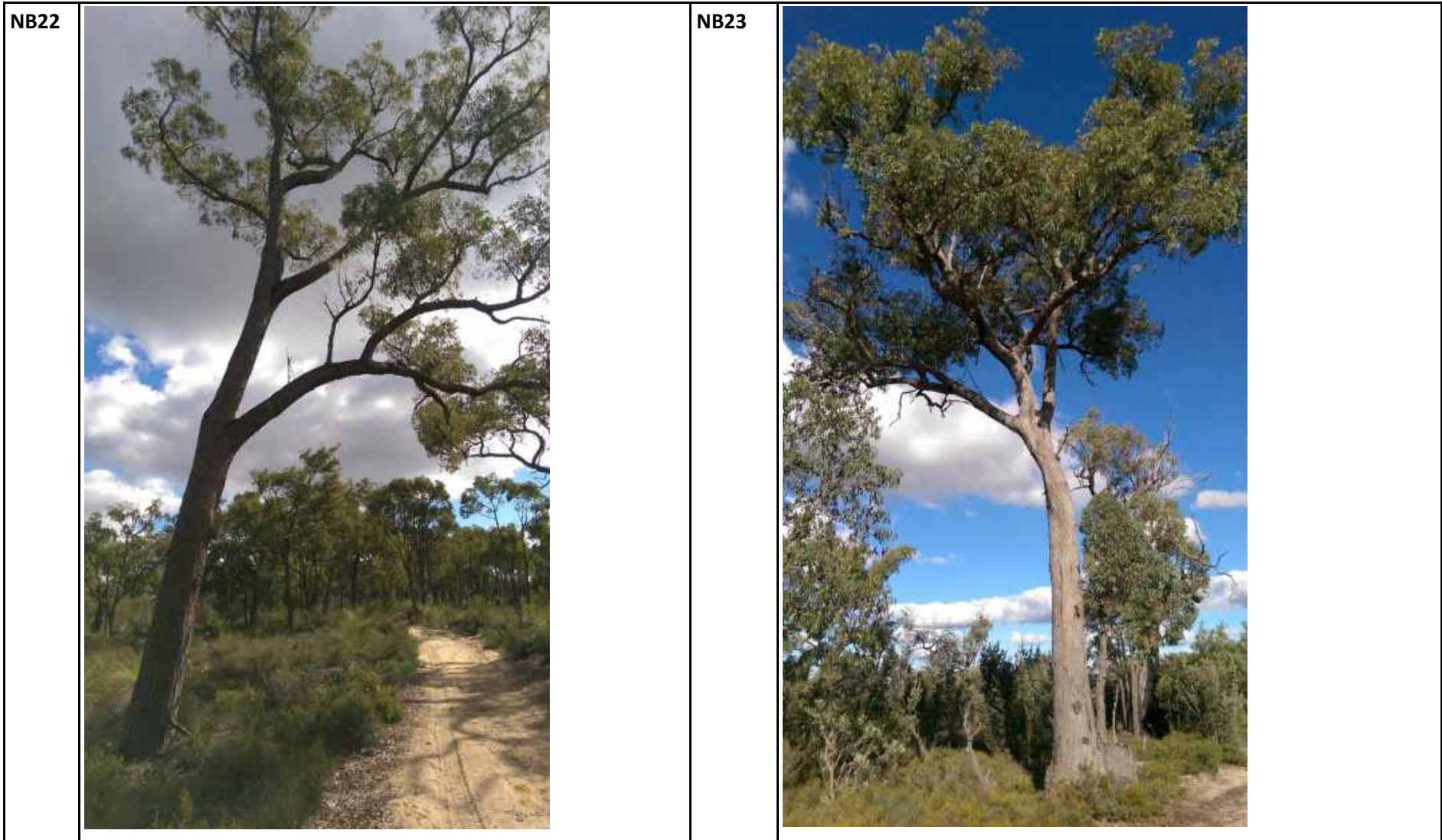
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Memo

Subject: Great Northern Highway Muchea to Wubin Upgrade Stage 2: Additional black cockatoo assessment for Muchea North

Memo

To: Jonathan Davies

From: Anna Leung

Date: 29 May 2018

Subject: Muchea North – assessment of Carnaby’s Cockatoo breeding trees at Lot M2091, Ippollo Road



Dear Todd,

This memo presents the results of the surveys of potential breeding trees for Carnaby’s black cockatoo (*Calyptorhynchus latirostris*) within Lot M2091 Ippollo Road (Figure 1).

BACKGROUND

Muchea North is part of the Great Northern Highway (GNH) Muchea to Wubin Upgrade Stage 2 Project and entails proposed upgrade works to the GNH between Old Gingin Road and Chittering Roadhouse, approximately 63 km north of Perth. The proponent for Muchea North is Main Roads Western Australia (‘Main Roads’) who, together with industry partners Arup and Jacobs, have formed the Integrated Project Team (IPT).

The Department of Environment and Energy (DoEE) has deemed Muchea North a controlled action under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (EPBC ref: 2016/7656), with a contributing factor being proposed impacts to Carnaby’s Cockatoo habitat. The species is listed as a matter of national environmental significance (NES) under the EPBC Act, with the conservation status of Endangered. It is also listed as Endangered under the *WA Wildlife Conservation Act 1950*.

Lot M2091 Ippollo Rd is a proposed offset site (as part of a more comprehensive offset package for Muchea North). Part of the site is an existing offset for the separate Northlink Project (areas hatched in green and orange in Figure 1; PDNH Offset Site and Tonkin Grade Separation (TDS) Offset Site respectively). The remainder of the site (area hatched in purple in Figure 1) is the proposed offset area for Muchea North.

Phoenix has previously conducted the following at Lot M2091 Ippollo Rd¹:

- identification suitable habitat trees for the erection of artificial nest boxes for Carnaby’s Cockatoo
- searches for evidence of foraging by Carnaby’s Cockatoo.

In addition, Coffey² conducted a breeding tree assessment at the site using a tree density survey. This survey identified areas of high, moderate and low tree densities within the Eucalypt Woodland at the site (Figure 2). Thirty trees with suitable hollows but no evidence of use were opportunistically recorded but this survey did not comprehensively map Carnaby’s Cockatoo potential breeding trees.

¹ Phoenix. 2017. *Memo: Great Northern Highway Muchea to Wubin Upgrade Stage 2: Carnaby's Black Cockatoo investigations Muchea North and Ippollo Road*. Phoenix Environmental Sciences Pty Ltd, Balcatta, WA. Unpublished memo prepared for Muchea to Wubin Integrated Project Team (Mainroads WA, ASJV).

² Coffey. 2015. *Flora, vegetation and fauna assessment. Lot M2091 Ippollo Road, Chittering*. Coffey Environments Australia Pty Ltd, Burswood, WA. Unpublished report prepared for Main Roads Western Australia.

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Muchea North – assessment of Carnaby’s Cockatoo breeding trees at Lot M2091, Ippollo Road

SCOPE

The scope of work was as follows:

- undertake an intensive survey for Carnaby’s Cockatoo potential breeding trees in the proposed Muchea North offset area of Lot M2091 (259 ha; intensive survey area in Figure 1)
- undertake low intensity plot-based sampling in the Northlink offset area of Lot M2091 (726.6 ha; low intensity survey area in Figure 1) and in the vicinity of Lot M2091 to provide additional contextual data.

METHODOLOGY

Site visits were undertaken on 18-20 April 2018 by zoologists with experience conducting black cockatoo habitat assessments.

For the intensive survey in the Muchea North offset area, the location of all potential breeding trees was recorded by differential global positioning system (DGPS) for accuracy. All trees of suitable species and meeting minimum diameter at breast height (DBH) measurements as per DSEWPaC³ were recorded in this survey area.

The low intensity plot based sampling of breeding trees in the Northlink offset area was conducted by selecting 1 ha plots within habitat demarcated by Coffey² (Figure 2) and counting the number of potential breeding trees within these. This number was extrapolated to the boundary of each habitat polygon. The boundaries of the habitat mapping were verified and altered where required to assist in accurate estimation of potential breeding trees.

Calculations of the number of potential breeding trees within the PDNH and TGS offset sites of the low intensity survey area were based on numbers of potential breeding trees within each polygon and extrapolated for that polygon rather than lumped into high, medium and low density categories.

RESULTS

A total of 85 potential breeding trees for Carnaby’s Cockatoo were recorded in the Muchea North offset area (Figure 3). Ten of these had hollows and seven of these were suitable for breeding. None had evidence of breeding. The majority of potential breeding trees (73) were Jarrah and the other 12 were Marri. All trees were located in areas mapped as Banksia Woodland by Coffey (2015); however, in the current survey, 7.17 ha of Banksia Woodland (which the trees were recorded in) was revised to Jarrah Eucalypt Woodland (5.57 ha), and Jarrah and Marri (1.8 ha) Eucalypt Woodland.

The remainder of the Muchea North offset area was confirmed to be Banksia Woodland with occasional eucalypt (*Eucalyptus todtiana*) not large enough to form suitable hollows for Carnaby’s Cockatoo.

Within the low intensity survey area, a total of 326 ha of eucalypt Woodland was mapped. Of this, 61.5 ha was Jarrah Woodland, 220.97 ha was Marri and Jarrah Woodland, and 43.52 ha was Marri Woodland. Minor

³ DSEWPaC. 2012. EPBC Act referral guidelines for three threatened black cockatoo species: Carnaby's Cockatoo (Endangered) *Calyptorhynchus latirostris*, Baudin's Cockatoo (Vulnerable) *Calyptorhynchus baudinii*, Forest Red-tailed Black cockatoo (Vulnerable) *Calyptorhynchus banksii naso*. Australian Government Department of Sustainability, Environment, Water, Populations and Communities, Parkes, ACT.

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Muchea North – assessment of Carnaby’s Cockatoo breeding trees at Lot M2091, Ipollo Road

revisions to Coffey’s 2015 habitat mapping replaced 8.05 ha of Banksia Woodland with Jarrah Woodland. The density of potential breeding trees within the Eucalypt Woodland habitats varied between two and 31 trees per hectare (Table 2; Figure 3). It is estimated that 5,893 potential breeding trees are located within the Northlink offset area. Of these, 5,178 are located in the PDNH offset site and 715 are located in the TGS offset site, which accounts for 36.11 ha of Eucalypt Woodland.

At least one tree with suitable breeding hollow had signs of use as a hollow; however, the presence of a “galah scar” located directly beneath the hollow, indicates of use by galahs rather than black cockatoos.

CONCLUSION

From the data collected during this survey, a total estimated number of 5,178 and 715 potential breeding trees are present in the PDNH and TGS Offset areas respectively.

The area of Eucalypt Woodland was increased by approximately 7.37 ha in the Muchea North offset area and 8.05 ha in the PDNH offset site, replacing Banksia Woodland in both instances.

Carnaby’s Cockatoo favour breeding in Wandoo (*Eucalyptus wandoo*) and Salmon Gum (*E. salmonophloia*) but are known to breed in Jarrah, Marri and other species of eucalypt to a lesser extent (SPRAT⁴). Jarrah and Marri were the dominant *Eucalyptus* tree species; however, most of the Marri present in the survey area did not meet the required DBH. Several suitable hollows and one with possible evidence of breeding were located in the survey area. Visiting the site during breeding season would confirm if any birds were actually using the area for breeding.

Yours Sincerely,

Anna Leung

Zoologist

Anna.leung@phoenixenv.com.au
08 6323 5410

⁴ Department of the Environment and Energy. 2018. *Species Profile and Threats Database*. Department of the Environment and Energy, Canberra, ACT. Available at: <http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl>

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Muchea North – assessment of Carnaby’s Cockatoo breeding trees at Lot M2091, Ipollo Road

Table 1 Potential breeding trees in the Muchea North offset area (intensive survey area)

Tree number	Hollow present	Hollow suitable	Breeding evidence	Hollow height	Species	DBH (mm)	Latitude	Longitude
HT001	No	No	No		<i>C. calophylla</i> (Marri)	500	-31.491548	115.978723
HT002	No	No	No		<i>E. marginata</i> (Jarrah)	550	-31.49185	115.978648
HT003	No	No	No		<i>E. marginata</i> (Jarrah)	600	-31.491978	115.978825
HT004	No	No	No		<i>E. marginata</i> (Jarrah)	500	-31.492103	115.978832
HT005	No	No	No		<i>E. marginata</i> (Jarrah)	900	-31.492167	115.9787
HT006	No	No	No		<i>E. marginata</i> (Jarrah)	750	-31.492284	115.97866
HT007	No	No	No		<i>E. marginata</i> (Jarrah)	650	-31.492203	115.978582
HT008	No	No	No		<i>E. marginata</i> (Jarrah)	600	-31.492539	115.978554
HT009	No	No	No		<i>E. marginata</i> (Jarrah)	750	-31.492638	115.978626
HT010	No	No	No		<i>C. calophylla</i> (Marri)	600	-31.492699	115.978653
HT011	No	No	No		<i>E. marginata</i> (Jarrah)	700	-31.493039	115.978795
HT012	No	No	No		<i>C. calophylla</i> (Marri)	700	-31.493242	115.978534
HT013	No	No	No		<i>E. marginata</i> (Jarrah)	500	-31.493415	115.978526
HT014	No	No	No		<i>E. marginata</i> (Jarrah)	600	-31.49352	115.978385
HT015	No	No	No		<i>E. marginata</i> (Jarrah)	700	-31.493666	115.978404
HT016	No	No	No		<i>E. marginata</i> (Jarrah)	600	-31.493758	115.978452
HT017	No	No	No		<i>E. marginata</i> (Jarrah)	600	-31.493604	115.978655
HT018	No	No	No		<i>E. marginata</i> (Jarrah)	500	-31.493822	115.97887
HT019	No	No	No		<i>E. marginata</i> (Jarrah)	700	-31.49384	115.978949
HT020	No	No	No		<i>E. marginata</i> (Jarrah)	600	-31.494177	115.978932
HT021	No	No	No		<i>E. marginata</i> (Jarrah)	600	-31.494256	115.978922
HT022	Yes	Yes	No	3 m	<i>E. marginata</i> (Jarrah)	500	-31.494392	115.978966
HT023	No	No	No		<i>E. marginata</i> (Jarrah)	700	-31.494485	115.978907
HT024	No	No	No		<i>E. marginata</i> (Jarrah)	750	-31.49448	115.978766
HT025	No	No	No		<i>E. marginata</i> (Jarrah)	500	-31.494706	115.978695
HT026	No	No	No		<i>C. calophylla</i> (Marri)	900	-31.491881	115.979269
HT027	No	No	No		<i>E. marginata</i> (Jarrah)	600	-31.49291	115.979152
HT028	No	No	No		<i>E. marginata</i> (Jarrah)	600	-31.492901	115.979028
HT029	No	No	No		<i>E. marginata</i> (Jarrah)	600	-31.493019	115.979295
HT030	No	No	No		<i>E. marginata</i> (Jarrah)	750	-31.493187	115.979299
HT031	No	No	No		<i>E. marginata</i> (Jarrah)	700	-31.493369	115.979274
HT032	Yes	Yes	No		<i>E. marginata</i> (Jarrah)	700	-31.493984	115.979319
HT033	No	No	No		<i>E. marginata</i> (Jarrah)	500	-31.494201	115.979142
HT034	No	No	No		<i>E. marginata</i> (Jarrah)	1000	-31.494335	115.979162
HT035	No	No	No		<i>E. marginata</i> (Jarrah)	500	-31.494652	115.979337

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Muchea North – assessment of Carnaby’s Cockatoo breeding trees at Lot M2091, Ippollo Road

Tree number	Hollow present	Hollow suitable	Breeding evidence	Hollow height	Species	DBH (mm)	Latitude	Longitude
HT036	No	No	No		<i>E. marginata</i> (Jarrah)	500	-31.494859	115.979293
HT037	No	No	No		<i>E. marginata</i> (Jarrah)	500	-31.494925	115.979386
HT038	No	No	No		<i>E. marginata</i> (Jarrah)	600	-31.495028	115.97929
HT039	Yes	No	No	6 m	<i>E. marginata</i> (Jarrah)	700	-31.495215	115.979306
HT040	Yes	No	No	5 m	<i>E. marginata</i> (Jarrah)	540	-31.495381	115.979219
HT041	Yes	Yes	No	10 m	<i>E. marginata</i> (Jarrah)	700	-31.495476	115.979348
HT042	Yes	Yes	No	7 m	<i>E. marginata</i> (Jarrah)	800	-31.495679	115.97938
HT043	Yes	No	No	7 & 8 m	<i>E. marginata</i> (Jarrah)	600	-31.496389	115.979201
HT044	No	No	No		<i>E. marginata</i> (Jarrah)	700	-31.496413	115.979226
HT045	No	No	No		<i>E. marginata</i> (Jarrah)	600	-31.496492	115.979323
HT046	No	No	No		<i>E. marginata</i> (Jarrah)	650	-31.496492	115.979407
HT047	No	No	No		<i>E. marginata</i> (Jarrah)	600	-31.496572	115.979021
HT048	No	No	No		<i>E. marginata</i> (Jarrah)	1000	-31.496488	115.978988
HT049	No	No	No		<i>E. marginata</i> (Jarrah)	900	-31.495857	115.978824
HT050	No	No	No		<i>E. marginata</i> (Jarrah)	500	-31.495836	115.978878
HT051	No	No	No		<i>E. marginata</i> (Jarrah)	700	-31.495518	115.979007
HT052	No	No	No		<i>E. marginata</i> (Jarrah)	700	-31.495393	115.978493
HT053	No	No	No		<i>E. marginata</i> (Jarrah)	500	-31.49503	115.978501
HT054	No	No	No		<i>E. marginata</i> (Jarrah)	700	-31.494902	115.97843
HT055	No	No	No		<i>E. marginata</i> (Jarrah)	600	-31.494826	115.97872
HT056	No	No	No		<i>E. marginata</i> (Jarrah)	700	-31.494752	115.978926
HT057	No	No	No		<i>E. marginata</i> (Jarrah)	600	-31.494915	115.978836
HT058	No	No	No		<i>E. marginata</i> (Jarrah)	500	-31.494715	115.97913
HT059	No	No	No		<i>E. marginata</i> (Jarrah)	1200	-31.485734	115.972155
HT060	No	No	No		<i>E. marginata</i> (Jarrah)	1090	-31.485826	115.972442
HT061	No	No	No		<i>E. marginata</i> (Jarrah)	1200	-31.485747	115.972686
HT062	No	No	No		<i>E. marginata</i> (Jarrah)	500	-31.485729	115.972623
HT063	No	No	No		<i>E. marginata</i> (Jarrah)	1200	-31.485945	115.972728
HT064	Yes	Yes	No	8 m	<i>E. marginata</i> (Jarrah)	1100	-31.486107	115.972834
HT065	Yes	Yes	No	8 m	<i>E. marginata</i> (Jarrah)	1000	-31.486161	115.972897
HT066	No	No	No		<i>E. marginata</i> (Jarrah)	1200	-31.486161	115.972981
HT067	No	No	No		<i>E. marginata</i> (Jarrah)	600	-31.486161	115.973024
HT068	No	No	No		<i>E. marginata</i> (Jarrah)	500	-31.48461	115.973305
HT069	No	No	No		<i>E. marginata</i> (Jarrah)	640	-31.485354	115.972511
HT070	No	No	No		<i>C. calophylla</i> (Marri)	700	-31.483947	115.973785
HT071	No	No	No		<i>C. calophylla</i> (Marri)	550	-31.484309	115.974397

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Muchea North – assessment of Carnaby’s Cockatoo breeding trees at Lot M2091, Ippolito Road

Tree number	Hollow present	Hollow suitable	Breeding evidence	Hollow height	Species	DBH (mm)	Latitude	Longitude
HT072	No	No	No		<i>C. calophylla</i> (Marri)	650	-31.484442	115.974934
HT073	No	No	No		<i>C. calophylla</i> (Marri)	800	-31.48479	115.975668
HT074	No	No	No		<i>E. marginata</i> (Jarrah)	800	-31.485614	115.972449
HT075	No	No	No		<i>E. marginata</i> (Jarrah)	780	-31.485412	115.97237
HT076	No	No	No		<i>E. marginata</i> (Jarrah)	1000	-31.485382	115.972335
HT077	No	No	No		<i>E. marginata</i> (Jarrah)	880	-31.485382	115.972477
HT078	No	No	No		<i>C. calophylla</i> (Marri)	680	-31.485184	115.972317
HT079	No	No	No		<i>E. marginata</i> (Jarrah)	620	-31.48433	115.97344
HT080	No	No	No		<i>C. calophylla</i> (Marri)	500	-31.484018	115.9733
HT081	No	No	No		<i>C. calophylla</i> (Marri)	600	-31.48395	115.973527
HT082	No	No	No		<i>C. calophylla</i> (Marri)	750	-31.476421	115.973752
HT083	No	No	No		<i>E. marginata</i> (Jarrah)	800	-31.485713	115.972362
HT084	Yes	Yes	No	10 m	<i>E. marginata</i> (Jarrah)	800	-31.495534	115.978841
HT085	No	No	No		<i>E. marginata</i> (Jarrah)	700	-31.495694	115.979015

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Muchea North – assessment of Carnaby’s Cockatoo breeding trees at Lot M2091, Iopollo Road


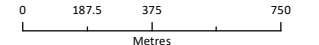
Table 2 Habitat tree density in the Northlink offset area (low intensity survey area)

Site	Habitat	Tree density/ha	Area (ha)	Estimated number of trees within habitat polygon
01	Marri and Jarrah Woodland	22	64.67	1423
02	Jarrah Woodland	14	6.55	92
03 and 11	Jarrah Woodland	22 (24 and 20)	26.33	579
04	Jarrah Woodland	14	12.51	175
05	Marri Woodland	4	3.73	15
06 and 07	Marri Woodland	5 (2 and 8)	35.64	178
08	Marri and Jarrah Woodland	16	16.51	264
09 and 18	Marri and Jarrah Woodland	22 (24 and 20)	31.43	691
10	Marri and Jarrah Woodland	31	22.43	695
12	Marri and Jarrah Woodland	16	14.90	238
13 and 14	Marri and Jarrah Woodland	23 (26 and 20)	19.71	453
15	Marri and Jarrah Woodland	16	22.46	359
16	Marri and Jarrah Woodland	12	9.85	118
17	Marri and Jarrah Woodland	15	4.13	62
19	Jarrah Woodland	30	5.09	153
20	Jarrah Woodland	6	11.01	66
21	Marri and Jarrah Woodland	13	0.77	10
22	Marri and Jarrah Woodland	4	7.34	29
23	Marri Woodland	4	1.09	4
24	Marri Woodland	20	3.57	71
25	Marri and Jarrah Woodland	32	6.73	215
Total			326.45	5,893



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Jacobs - Carnaby's Black Cockatoo breeding tree assesment, Iopollo Rd, GNH, Muchea to Wubin	
Project No	1201
Date	21-May-18
Drawn by	AL
Map author	AL
	
	
1:22,000 (at A4) GDA 1994 MGA Zone 50	






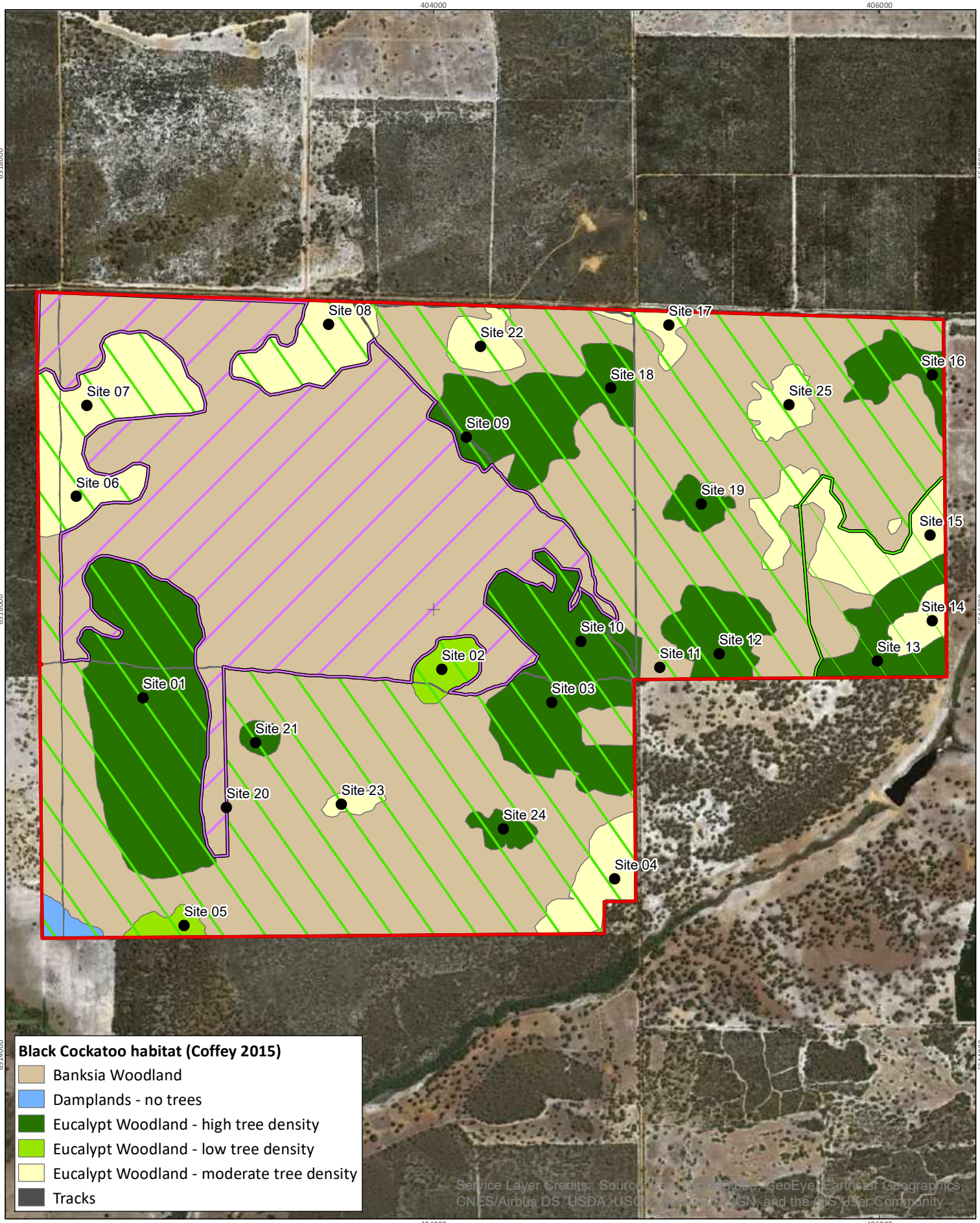
-  Lot M2091 Iopollo Rd, Chittering
- Survey areas**
-  Muchea North Offset Site Boundary - intensive survey area
- Northlink offset area - low intensity survey area**
-  PDNH Offset Site Boundary
-  Tonkin Grade Separation Offset Site Boundary

Figure 1
Survey area



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Black Cockatoo habitat (Coffey 2015)

- Banksia Woodland
- Damplands - no trees
- Eucalypt Woodland - high tree density
- Eucalypt Woodland - low tree density
- Eucalypt Woodland - moderate tree density
- Tracks

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Jacobs - Carnaby's Black Cockatoo breeding tree assesment, Iopollo Rd, GNH, Muecha to Wubin

Project No	1201
Date	14-May-18
Drawn by	AL
Map author	AL

0 187.5 375 750
Metres

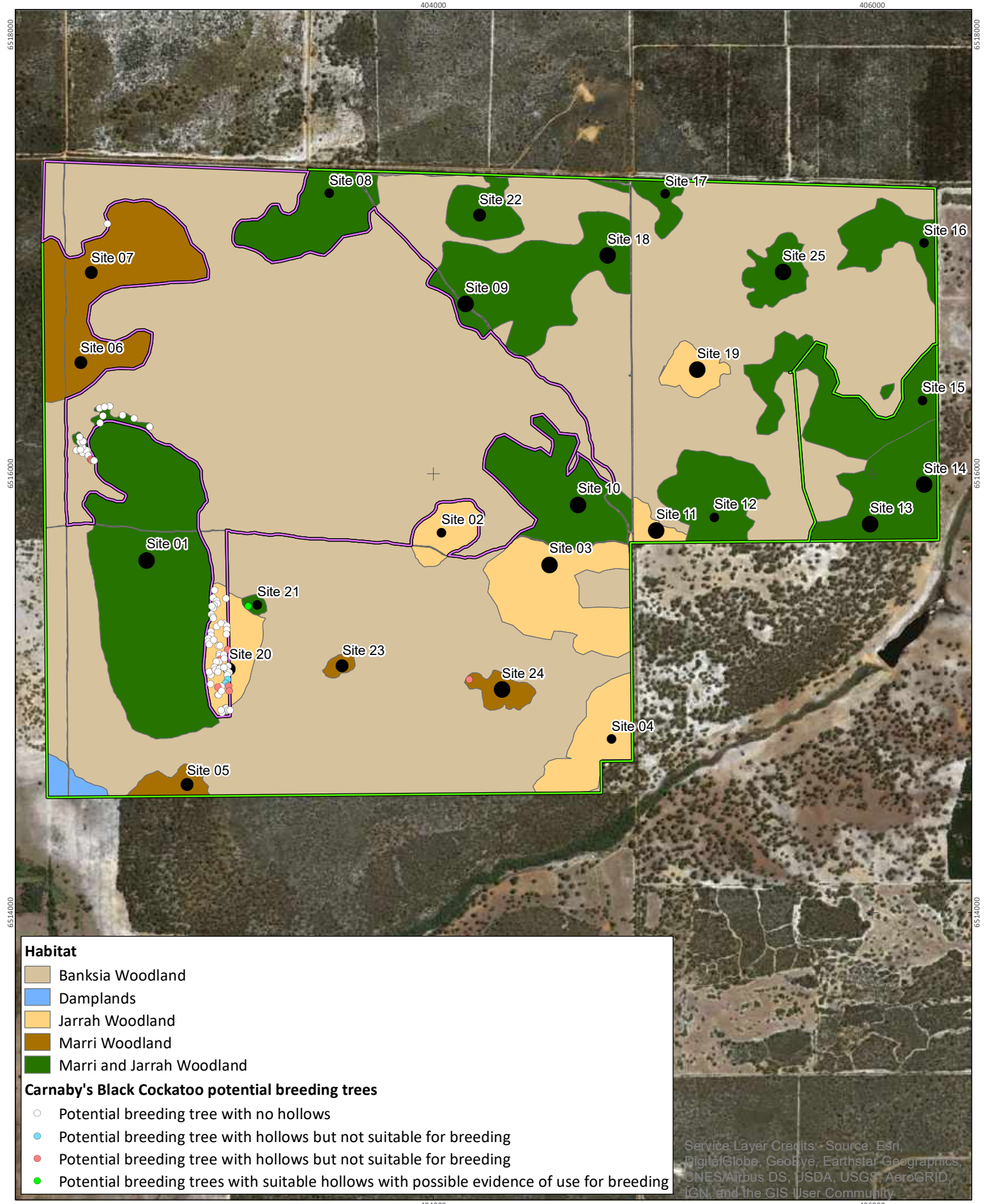
1:22,000 (at A4) GDA 1994 MGA Zone 50

- Lot M2091 Iopollo Rd, Chittering
- Survey areas**
- Muecha North Offset Site Boundary - Intensive survey area
- PDNH and TGS Offset Site Boundary - Low intensity survey area
- Low intensity survey site locations

Figure 2

Survey sites

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Habitat

- Banksia Woodland
- Damplands
- Jarrah Woodland
- Marri Woodland
- Marri and Jarrah Woodland

Carnaby's Black Cockatoo potential breeding trees

- Potential breeding tree with no hollows
- Potential breeding tree with hollows but not suitable for breeding
- Potential breeding tree with hollows but not suitable for breeding
- Potential breeding trees with suitable hollows with possible evidence of use for breeding

Service Layer Credits: - Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Jacobs - Carnaby's Black Cockatoo breeding tree assesment, Iopollo Rd, GNH, Muchea to Wubin	
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1:22,000 (at A4) GDA 1994 MGA Zone 50	

- Muchea North Offset Site Boundary
- PDNH and TGS Offset Site Boundary

Low intensity survey sites and potential breeding trees per hectare

- High density
- Low density
- Moderate density

Figure 3

Potential breeding trees and habitat in the survey area

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MEMORANDUM

Date	28 May 2018	Title	Black-cockatoo Nesting Tree Survey Results – Banovich Road Offset Site
Ref.	ASJV18002/01	Distribution	Todd Jess Integrated Project Team
Author	Kellie Bauer-Simpson Principal Ecologist	Review	Mike Bamford Supervising Zoologist

Background

Main Roads Western Australia (Main Roads) is upgrading the 218 km section of Great Northern Highway (GNH) between Muchea and Wubin. Jacobs and Arup together have formed a joint venture, formerly called ASJV, to partner with Main Roads (now together, the Integrated Project Team (IPT)) for the delivery of the upgrade project. The improvements to be made include town bypasses, wider roads, more passing lanes, flattening crests, easing curves, safer roadsides, more rest stops and additional facilities for heavy vehicles. These works will significantly improve safety and amenity and facilitate the future movement of road trains along this section of highway.

Focused Vision Consulting Pty Ltd (FVC) was originally commissioned by ASJV in 2016 to conduct biological assessments of a range of route options for the Bindoon bypass section of the Muchea to Wubin upgrades of the Great Northern Highway. A range of studies have continued to be undertaken throughout the study area since the initial 2016 assessments, alongside FVC's partner consultants, Bamford Consulting Ecologists (BCE).

Following on from studies within the project area, offset sites are being considered and assessed. One such site is situated on Banovich Road, Hill River. In particular, the site is likely to be secured to offset a shortfall of Black-cockatoo potential nesting trees provided by other offset site/s for the Muchea North section of the GNH project. The IPT commissioned FVC (with BCE) to undertake a Black-cockatoo nesting tree survey of a section of the Banovich Road offset site (**Figure 1**).

'Potential nesting trees' are trees of a suitable species which may not yet be nesting/hollow-bearing trees, but based on trunk diameter (diameter at breast height (DBH)), could provide hollows within the next 50 years (Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) 2012).

This correspondence presents the findings of the field assessment for potential nesting trees within the designated section of the site.




0 250 500 750 1000 m

GDA 94 / MGA Zone 50



Figure 1 - Study Area

Legend

 Study Area



Methodology

The field assessment was conducted over three days, between 17 – 19 April 2018, by Senior Zoologists with significant experience in surveys for Black-cockatoos and their habitat; Tim Gamblin and Kath Chuk, assisted by Senior Botanist/Ecologists, Lisa Chappell and Gaby Martinez.

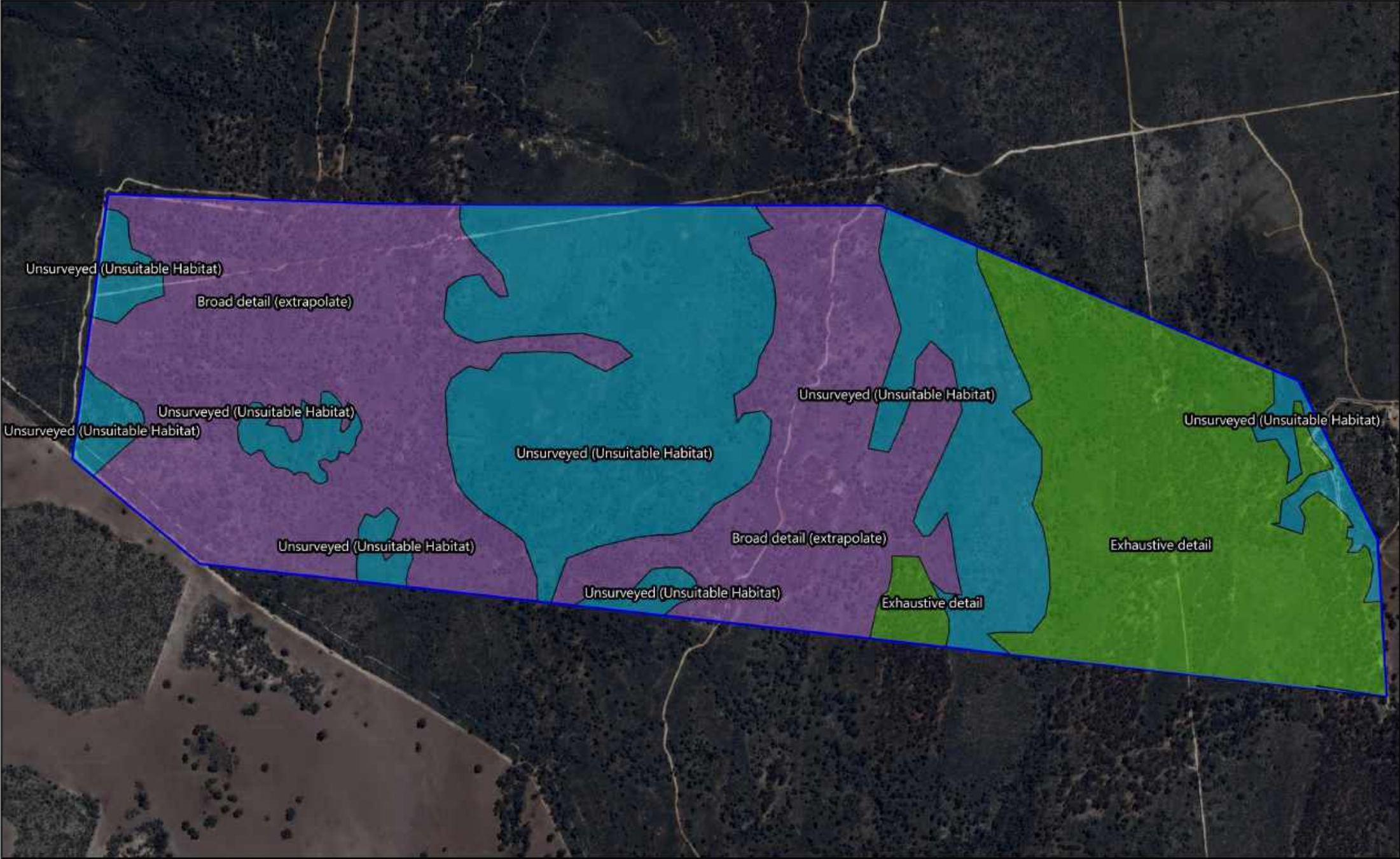
The designated study area, totalling 312 hectares was surveyed in exhaustive detail across 73 hectares within the eastern third of the site, and in broad detail through selected other areas of the remaining 131 hectares of suitable habitat. The broad detail survey was carried out via a series of representative traverses. This approach was utilised to make the best use of available field time. Approximately 108 hectares (35%) of the designated survey area has been inferred as unsuitable habitat for supporting Black-cockatoo nesting or potential nesting trees. The varying levels of survey detail employed and areas of unsuitable habitat are presented in **Figure 2**.

The Commonwealth Department of the Environment and Energy (DEE; formerly the Department of Sustainability, Environment, Water, Population and Communities) provides guidelines for the referral of actions that may result in impact to Black-cockatoos to the DEE (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). In addition, survey methodology followed the recommendations listed on the DEE's Species Profile and Threats Database (DEE 2018).

Within the survey area, the following information was recorded for every suitable tree¹ (predominantly Wandoo, *Eucalyptus wandoo* and Marri, *Corymbia calophylla*) with a diameter at breast height (DBH) equal to or greater than 300 mm for Wandoo or 500 mm for other species:

- tree location
- tree species
- life status
- DBH
- 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 1**.

¹ the draft revised EPBC Act referral guidelines (DEE 2017) stress that any tree species may provide suitable hollows.



0 0.25 0.5 0.75 1 km
 GDA 94 / MGA Zone 50

Figure 2 - Survey Detail



- Legend**
- Study Area
 - Broad detail (Extrapolated)
 - Exhaustive detail
 - Unsurveyed (Unsuitable Habitat)



Table 1 Ranking System for Black-cockatoo Potential Nesting Trees

As per DEE (2017) 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*).

Rank	Description of tree and hollows/activity
1	Active nest observed; adult (or immature) bird seen entering or emerging from hollow.
2	Hollow of suitable size and angle (i.e. near-vertical) visible with chew marks around entrance.
3	Potentially suitable hollow visible but no chew marks present; or potentially suitable hollow present (as suggested by structure of tree, such as large, vertical trunk broken off at a height of >10m).
4	Tree with large hollows or broken branches that might contain large hollows but hollows or potential hollows 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.
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.
x	Where a hollow that is (otherwise) potentially suitable for black-cockatoo nesting has been colonised by feral Honey Bees (<i>Apis mellifera</i>), and therefore rendered unusable, the nest-tree rank is preceded by 'x' (e.g. x2, x3, x4).

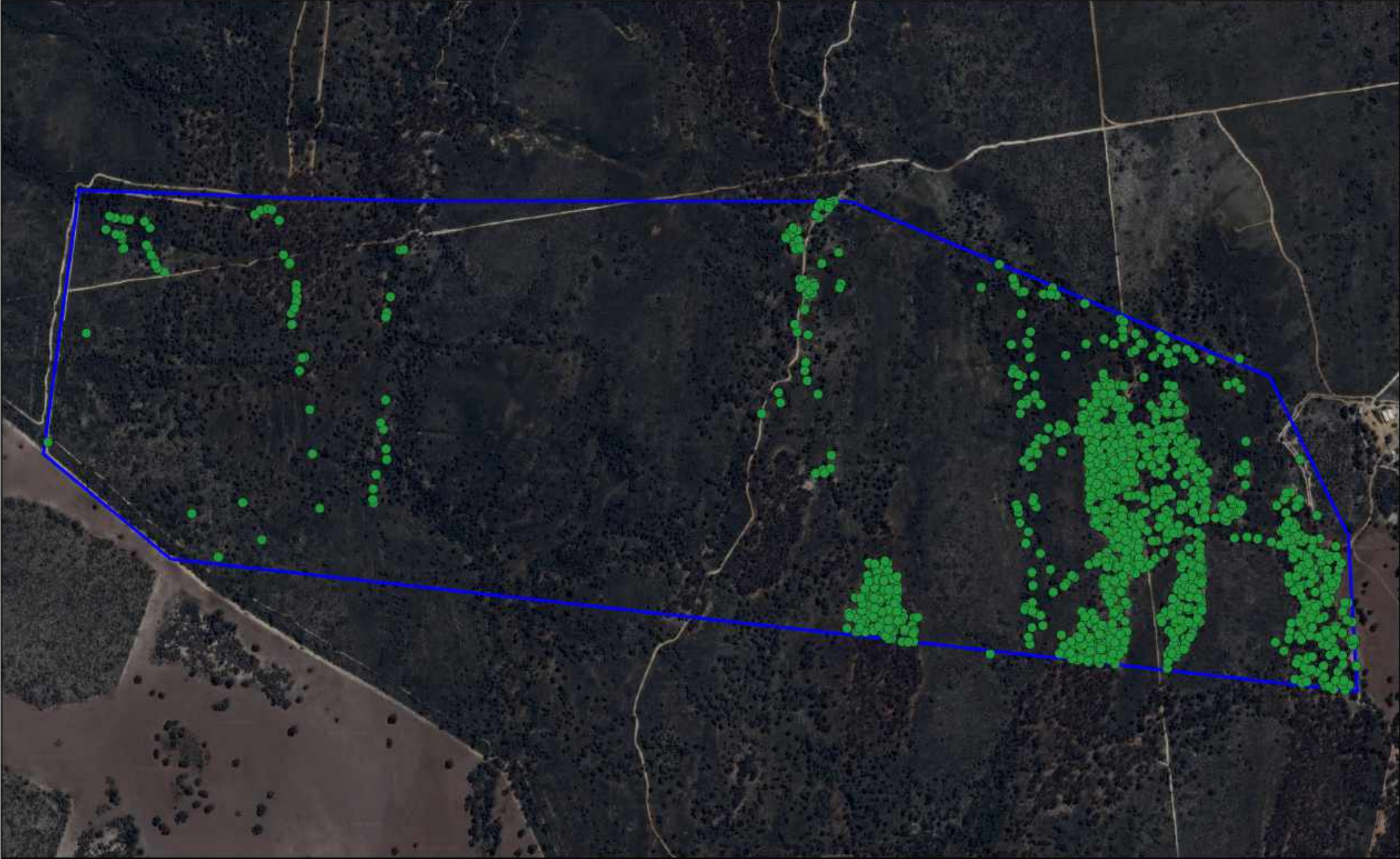
BCE has also developed a tree measurement protocol, based on Commonwealth guidelines which is outlined in **Appendix 1**.

Results

A total of 1,637 trees considered potential current or future nesting trees were recorded within the areas surveyed within the study area (**Table 2, Figure 3**).

Table 2 Summary of Recorded Potential Nesting Trees

Category	Species/Number of Trees				TOTAL	% of Grand Total
	Marri	Wandoo	Coastal Blackbutt	Unknown Species (dead)		
1 – Active nest/s	-	-	-	-	-	-
2 – Potential hollow with chew marks	2	2	-	-	4	0.24
3 – Potential hollow, no chew marks	34	174	2	-	210	12.83
4 – Potential hollow, unsuitable orientation	-	-	-	-	-	-
5 – Sufficient DBH, no observable chew marks	135	1,279	2	7	1,423	86.93
TOTAL	171	1,455	4	7	1,637	
% of Grand Total	10.45	88.88	0.24	0.43		



0 0.25 0.5 0.75 1 km
GDA 94 / MGA Zone 50

Figure 3 - Habitat Trees



Legend
Study Area
Habitat Tree



The habitat trees present across the site are predominantly *Eucalyptus wandoo* (Wandoo) (approximately 89% of those recorded), with approximately 10% of those recorded *Corymbia calophylla* (Marri) and a small number (four trees) of *Eucalyptus todtiana* (Coastal Blackbutt) recorded that are potentially suitable as nesting trees for Black-cockatoos.

Most of the recorded trees were observed to present a sufficient DBH (500 mm or greater), but with no observable hollows, with only 214 trees (approximately 13%) of those recorded observed to support hollows. No active nests were observed.

Within the areas of exhaustive survey detail, as presented in **Figure 2**, a total of 1,501 potential nesting trees were recorded. This equates to 20.56 potential nesting trees per hectare, which, if applied to the remaining suitable habitat areas (those surveyed in broad detail), equates to 2,694 trees across the 131 hectares. Therefore, the total estimated Black-cockatoo potential nesting trees across the designated survey site is concluded to be approximately 4,195.

There was no direct evidence of any Black-cockatoo activity on site during the field survey, including no evidence of foraging, nor use of tree hollows for nesting. Chew marks observed on four trees, may be attributable to Black-cockatoos, although this result is not definitive. A lack of direct evidence of Black-cockatoo activity on site during the April survey is not necessarily indicative of a lack of suitable habitat, as April is not a suitable time to observe Black-cockatoos in the area, and it is very possible that Black-cockatoos utilise the site at other times of the year (K. Chuk, pers. comm.).

A biological survey undertaken 2016 (GHD), of the entire 1,993 ha Hill River property, recorded Carnaby's Black-cockatoos via observations of birds (89 individuals), actual breeding events (10 birds recorded in hollows) with an additional eight records of hollows considered highly likely as being used (but not confirmed), five records of feeding behaviour and one location of roosting.

Conclusion

The targeted Black-cockatoo habitat tree assessment has surveyed approximately 36% of the suitable habitat within the designated study area in exhaustive detail. The results have determined that the site supports significant numbers of Black-cockatoo habitat trees (potential nesting trees), with more than 4,000 trees likely to be supported by the site, and 1,637 confirmed and recorded. Therefore, the site is considered valuable habitat for the species.

References

DEE (2018). *Calyptorhynchus latirostris* in Species Profile and Threats Database. Department of the Environment. Available from: <http://www.environment.gov.au/sprat>

DEE (2017). Revised draft referral guideline for three threatened black cockatoo species: Carnaby's Cockatoo, Baudin's Cockatoo and the Forest Red-tailed Black-Cockatoo. Department of the Environment and Energy, Commonwealth of Australia, 2017, Canberra, Australian Capital Territory.

DSEWPaC (2012). EPBC Act referral guidelines for three threatened black cockatoo species: Carnaby's cockatoo (endangered) *Calyptorhynchus latirostris*, Baudin's cockatoo (vulnerable) *Calyptorhynchus baudinii*, Forest red-tailed black cockatoo (vulnerable) *Calyptorhynchus banksii naso*. Department of Sustainability, Environment, Water, Population and Communities, Canberra, Australian Capital Territory.

GHD (2016). Main Roads Western Australia Hill River Offset Property Biological Survey. Perth, Western Australia.

Closing

Should you require further information or clarification regarding the information provided in this report, please do not hesitate to contact the undersigned.

Best regards,

Kellie Bauer-Simpson
Director & Principal Ecologist/Environmental Manager
Focused Vision Consulting Pty Ltd

Appendix 1 Bamford Consulting Ecologists Black-cockatoo nesting-tree assessment protocol

Bamford Consulting Ecologists base black-cockatoo nesting-tree assessments on Federal guidelines (DEE 2017; DotE 2018a, b, c) but also refer to the following when undertaking field surveys.

Measuring DBH

While black-cockatoos generally nest towards the crown of a tree, the diameter of a tree at breast-height (DBH) can be indicative of the likelihood of hollow-formation in the upper trunk and can be used in the assessment of the 'value' of a tree to breeding black-cockatoos. A DBH threshold of 500 mm (or 300 mm for Wandoo, *Eucalyptus wandoo*, and Salmon Gum, *E. salmonophloia*) is commonly used to delineate 'potential' nest-trees (DotE 2018a, b, c), however the tree has to be *functionally capable of supporting a nest hollow* and there are several exceptions where trees that meet a strict DBH threshold are excluded (e.g. those with low-forking into narrow-diameter trunks, or those that have been hollowed-out and 'opened' by fire). Thus some discretion needs to be used when assessing trees.

The international standard for 'breast height' is 1.3 m (James and Shugart Jr 1970).

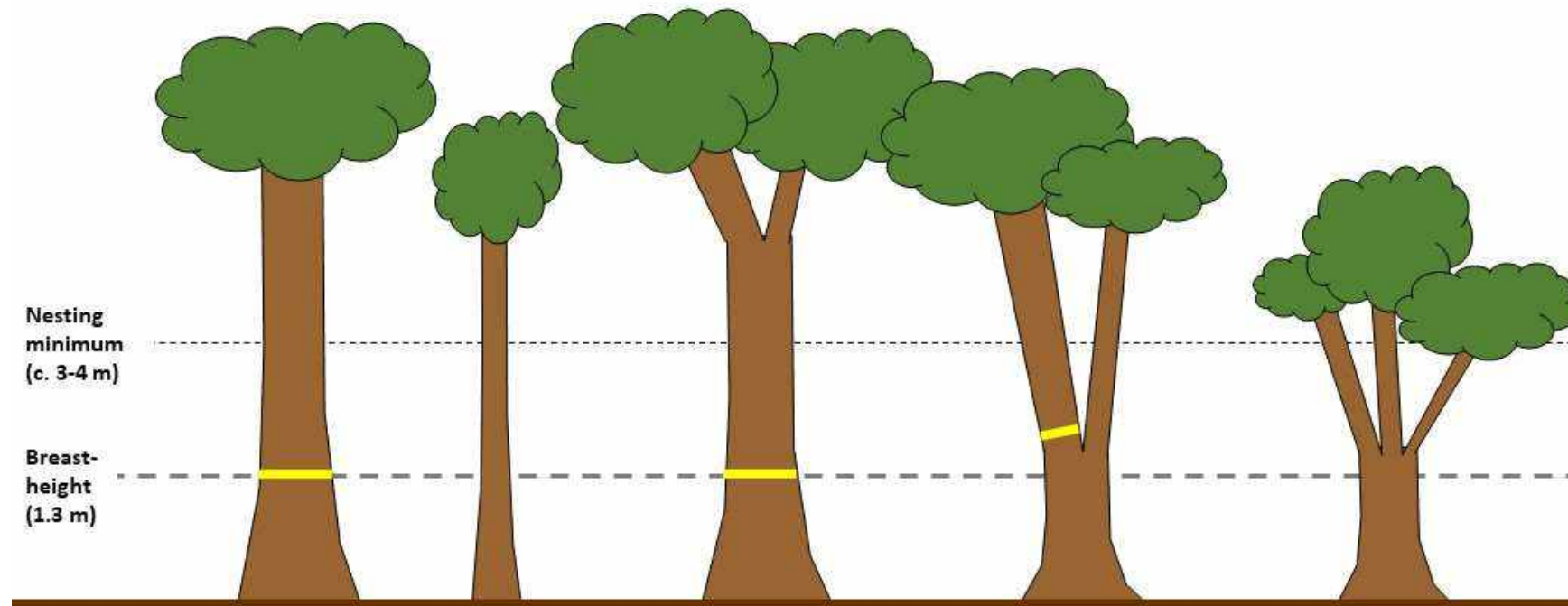
Only occasionally are trees close to perfectly cylindrical. As such, wherever possible, DBH should be 'representative' of the tree. In cases where the tree is approximately oval in cross-section, BCE measures the diameter of the shorter axis. Note that other methods such as circumference, or the quadratic average of the long and short axes are used in some applications, but logistic constraints generally require a more pragmatic approach. DBH should be reflective of the trunk above the nesting threshold (see below). Where a tree spreads at the base along one axis, the axis that best represents the trunk above is chosen for measurement.

Nest height minima

For Carnaby's Black-Cockatoo, the minimum height of known nests is c. 3 m (Saunders 1979). For Forest Red-tailed Black-Cockatoo, the minimum height of a known nest is 6.5 m (Johnstone *et al.* 2013a). Thus, a 3-4 m threshold seems a pragmatic "general" one to use for the purposes of field surveys where both species are likely and multiple tree species are under consideration.

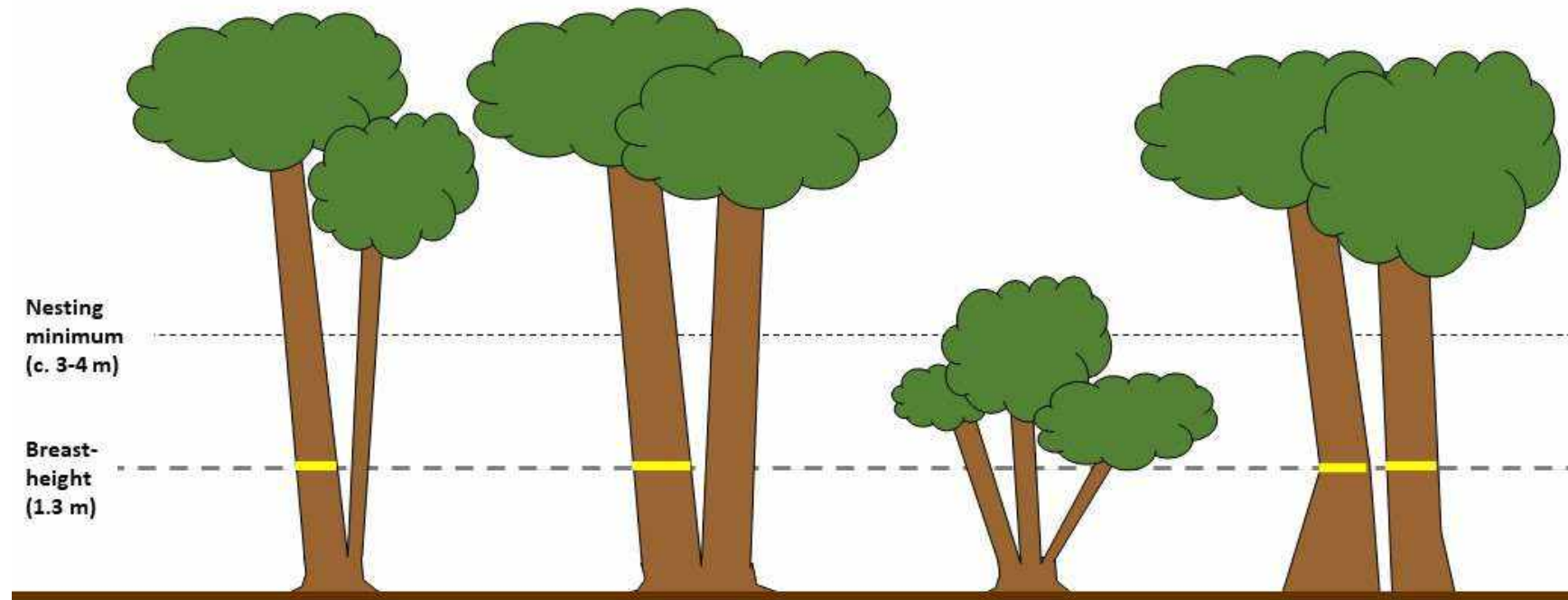
Tree forms

Quite obviously, trees have a range of forms and growth-habits. These can occasionally affect black-cockatoo nesting-tree surveys. As such, the following table has been developed (with reference to the information above) to guide tree assessment.



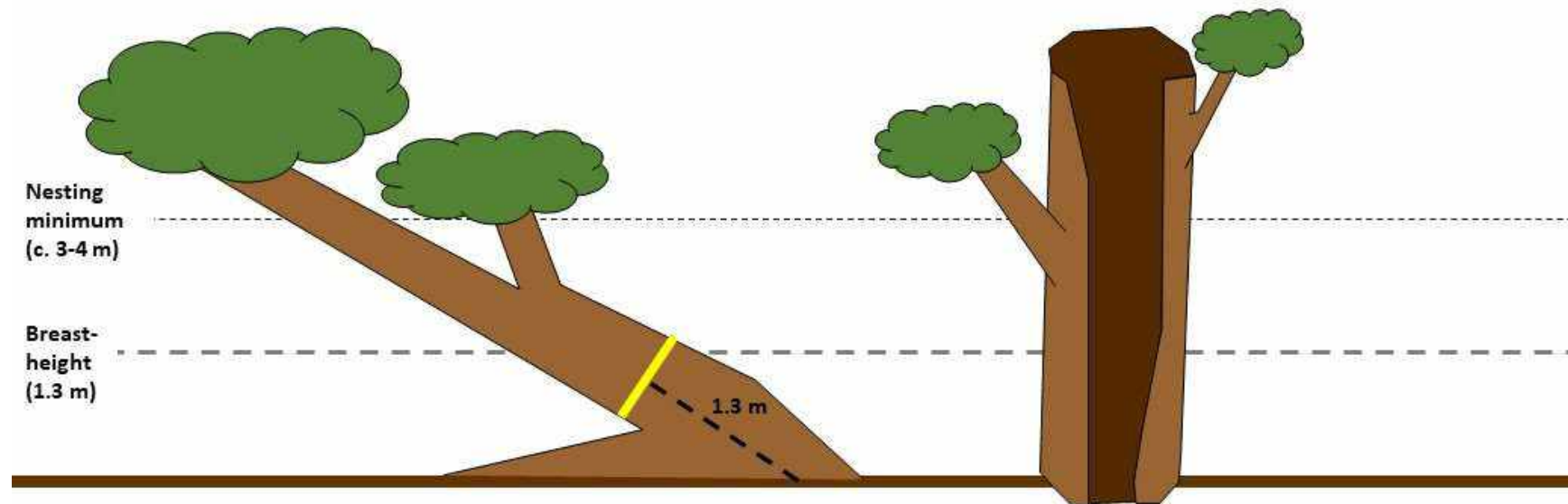
Tree Description:	Straight trunk. DBH > 500 mm*.	Straight trunk. DBH < 500 mm*.	Trunk forks above 3 m. DBH > 500 mm*.	Trunk forks between 1.3 m & 3 m. Diameter of at least one trunk above fork > c. 500 mm*.	Trunk forks between 1.3 m & 3 m. DBH > 500 mm* but <u>no</u> trunks above fork have diameter > c. 500 mm*.
Actions:	Measure DBH. Record species, life status and score for hollows. Waypoint tree.	Do not record.	Measure DBH. Record species, life status and score for hollows. Waypoint tree.	Measure/estimate diameter of <u>widest</u> trunk above fork. Note number of trunks. Record species, life status and score for hollows. Waypoint tree.	Do not record.

* Or 300 mm DBH for Wandoo, Salmon Gum.



Tree Description:	Trunk forks below 1.3 m. Diameter of <u>one</u> trunk above fork > 500 mm*.	Trunk forks below 1.3 m. Diameter of <u>multiple</u> trunks above fork > 500 mm*.	Trunk forks below 1.3 m. DBH of all trunks < 500 mm*.	Two <u>separate</u> trees in very close proximity. Both with DBH > 500 mm.
Actions:	Measure DBH of relevant trunk above fork. Note number of trunks. Record species, life status and score for hollows. Waypoint tree.	Measure DBH of <u>widest</u> trunk above fork. Note number of trunks. Record species, life status and score for hollows. Waypoint tree.	Do not record.	For <u>both</u> trees... Measure DBH. Record species, life status and score for hollows. Waypoint <u>each</u> tree (i.e. 2 separate records).

* Or 300 mm DBH for Wandoo, Salmon Gum.



Tree Description:	Trunk leans dramatically. Diameter > 500 mm* at 1.3m from centre of tree base.	Trunk has been burnt out internally to create an <u>open</u> half-pipe shape (no potential nesting sites). DBH > 500 mm*.
Actions:	Measure diameter at 1.3 m from the central base point, along the midline of the tree. Record species, life status and score for hollows. Waypoint tree.	Do not record.

* Or 300 mm DBH for Wandoo, Salmon Gum.

Attachment 9: Notification of commencement of action



mainroads
WESTERN AUSTRALIA

Enquiries: John Braid (9323 6183)
Our Ref: 13/7463
Your Ref: EPBC 2016/7656

27 September 2018

Gregory Manning
Assistant Secretary
Assessments (WA, SA, NT) and Post Approvals Branch
Department of the Environment and Energy
GPO Box 787
Canberra ACT 2601

Dear Mr Manning

Great Northern Highway Muchea North, WA – EPBC Referral 2016/7656 – Notification of commencement of action

I refer to the decision made by Department of Environment and Energy (DoEE) regarding the referral of the Great Northern Highway Upgrade Project (Muchea North) Western Australia, under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC 2016/7656).

Approval was granted on 10 August 2018 provided the proposal is undertaken in accordance with the conditions specified in the approval document.

In accordance with Condition 10 of the approval, Main Roads Western Australia (Main Roads) wishes to inform the Department that the proposed action in the above mentioned referral commenced on 21 September 2018.

If you require any further information, please contact John Braid who will be the contract person responsible for the administration of the approval decision on 9323 6183 or john.braid@mainroads.wa.gov.au.

Yours sincerely

Norm Fox
Director – Infrastructure Delivery Directorate

Attachment 10: Notification to the Department of CEMP revision



mainroads
WESTERN AUSTRALIA

Enquiries: John Braid (08) 9323 6183
Our Ref: 13/7463
Your Ref: EPBC 2016/7656

25 October 2018

Gregory Manning
Assistant Secretary
Assessments (WA, SA, NT) and Post Approvals Branch
Department of the Environment and Energy
GPO Box 787
Canberra ACT 2601

Dear Mr Manning

**EPBC 2016/7656 Great Northern Highway: Muchea to Wubin Upgrade Stage 2 –
Muchea North WA – Notification of Revision of Approved Construction Environmental
Management Plan**

Main Roads Western Australia (Main Roads) has commenced the Muchea North (EPBC 2016/7656) action. In applying the approved Muchea North Construction Environmental Management Plan (CEMP) during clearing and construction activities an issue regarding one Management Measure relating to Revegetation (Table 5-1: Environmental Management Implementation Schedule) has been identified.

Currently, the Management Measure states that "*Topsoil from areas infected or potentially infected with *Phytophthora dieback* will not be used in revegetation activities*".

Dieback survey of the Muchea North project area (Terratree 2016; enclosed with this correspondence) determined 14.68% of the area is Dieback Infested and 72.45% of the area is Dieback Uninterpretable. Application of the current Management Measure during clearing and construction activities would result in the following issues and risks:

- 87% of topsoil from areas infected or potentially infected with dieback will require removal off site for disposal
- Insufficient site-won topsoil will be available for revegetation works
- 87% of topsoil requirements will need to be imported.

Main Roads proposes to amend the Management Measure to the following:

*"Topsoil for revegetation/landscaping must be sourced from areas with the same or better level of evaluated *Phytophthora dieback* contamination category. Dieback free topsoil may be used in any area; topsoil taken from Dieback Uninterpretable areas may only be used in Dieback Uninterpretable or Dieback Infested areas; topsoil taken from Dieback Infested areas may only be used in Dieback Infested areas."*

Application of the amended Management Measure will ensure the following:

- Soil, mulch, fill and plant matter retained from Dieback Infested areas will only be used for revegetation and landscaping within Dieback Infested areas
- Soil, mulch, fill and plant matter retained from Dieback Uninterpretable areas will only be used for revegetation and landscaping within Dieback Uninterpretable areas



- All plant and equipment shall be cleaned free of soil and vegetative material before entering Dieback Free areas and any soil, mulch, fill and plant matter retained from Dieback Free areas will be used in Dieback Free zones (and if surplus topsoil is available from Dieback Free zones, this topsoil can be used in Dieback Uninterpretable areas)

Application of the amended Management Measure would enable Main Roads to use topsoil from Uninterpretable areas for revegetation activities across the site, excluding dieback free areas.

In accordance with EPBC 2016/7656 Condition 14 the above information has been provided to explain the differences between the revised and approved CEMP. Main Roads considers that taking the action in accordance with the revised CEMP would not be likely to have a new or increased impact.

Please find enclosed the revised CEMP, for your records, with amendment to the relevant Management Measure made as tracked changes. If you require any further information please contact John Braid on 9323 6183 or john.braid@mainroads.wa.gov.au.

Yours sincerely

Norm Fox
Project Director – Infrastructure Delivery Directorate

Enc:

- *Muchea North Construction Environmental Management Plan – Rev. 4*
- *Phytophthora Dieback Assessment of Great Northern Highway (Muchea-Chittering), Terratree 2016*