Appendix A – Banovich Road, Hill River – Review of Offset Values

Memorandum

12 December 2019

To	Main Roads Western Australia		
Copy to			
From	GHD	Tel	
Subject	Hill River Banovich Road Property – Offset Review	Job no.	6138302

1 Introduction

1.1 Background

Main Roads Western Australia (Main Roads) proposes to extend Mitchell Freeway from Hester Avenue to Romeo Road, including an upgrade to Wanneroo Road from Dunstan Road to Trian Road (the Proposal, EPBC 2018/8367). The Proposal will impact a Commonwealth listed threatened ecological community (TEC) and Black Cockatoo habitat as a result of native vegetation clearing.

Main Roads has previously acquired an offset property on Banovich Road in Hill River, near Jurien Bay. Several sections of this property have been approved to offset significant residual impacts associated with Main Roads projects (Figure 1). One approximately 240 ha portion of the Hill River offset property is currently being considered as an offset which may or may not be required to offset impacts associated with a separate Main Roads project. Currently the Hill River offset property contains 1035 hectares (ha) unallocated as offset land (Figure 1).

Main Roads engaged GHD Pty Ltd (GHD) to prepare an offset strategy for the Proposal, including outlining the biological attributes of the remaining unallocated offset portions of the Hill River property.

1.2 Location

The offset property is located at Lot 1, 1395 Banovich Road, Hill River, and is approximately 20 km east/ northeast of the Jurien Bay town site. The offset property is 1,993 ha, of which 1035 ha remain unallocated and is the subject of this memorandum.

1.3 Memorandum scope and limitations

This memorandum determines the remaining biological attributes (specifically for Black Cockatoo) within the unallocated area through review of the biological survey and associated data for the offset property (see Hill River Offset Property, Biological Survey – GHD 2016). The assumptions and limitation of this survey also apply to this memorandum. It is currently expected that approximately 240 ha of this site will be utilised as an offset towards Carnaby's Black Cockatoo impacts resulting from the Proposal.

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2 Offset area attributes

2.1 Vegetation and flora

2.1.1 Vegetation types and condition

There are 12 vegetation types mapped within the remaining unallocated land (Figure 2). The unallocated land is dominated by *Eucalyptus, Corymbia* and or mixed woodlands interspersed by small patches of heathland. The most restricted vegetation type is *Allocasuarina microstachya* heathland. At the south eastern extent of the offset area is a large patch of modified vegetation previously cleared for pasture species.

The vegetation condition within the offset area is rated from Pristine to Completely Degraded. The majority of the offset area is rated Very Good and above.

Vegetation types, and their extent and condition are shown in Table 1.

2.1.2 Conservation significant communities

Of the vegetation types present within the offset area, three are considered conservation significant (as reported by GHD 2016). These communities include:

- VT01 – representative of the Lesueur-Coomallo Floristic Community D1 Threatened Ecological Community (TEC) – Listed as Critically Endangered under WA criteria
- VT03 – representative of the Lesueur-Coomallo Floristic Community M2 (*Melaleuca preissiana* woodland) (PEC) – DBCA listed Priority 1
- VT04 – representative of the Lesueur-Coomallo Floristic Community DFGH (PEC) – DBCA listed Priority 1

No TECs listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) occur within the offset area (GHD 2016).

2.1.3 Other significant vegetation

The vegetation within the offset area (excluding highly disturbed/cleared areas) is considered significant vegetation (reported by GHD 2016 and defined by EPA 2016). The vegetation is largely in pristine condition, 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 considered a refuge for a number of conservation significant flora that occur throughout the offset area in a variety of vegetation types.

2.2 Fauna

2.2.1 Carnaby's Black Cockatoo

Carnaby's Cockatoo (*Calyptorhynchus latirostris*) is listed as Endangered under the EPBC Act and under the WC Act. Carnaby‘s Cockatoo were observed flying throughout the offset property, including from, to and over the survey area (GHD 2016). GHD (2016) estimated the density of potential breeding trees at the 1,993 ha property based on tree plots. The tree plots comprised a 50 m x 50 m (0.25 ha) plots at fourteen plot locations, including ten Wandoo woodland locations and four Marri woodland locations. Four of the tree plots lie within the north-east portion of the 1035 ha unallocated land. The tree plot survey recorded an average of 13 Wandoo potential breeding trees (DBH > 300 mm) per Wandoo woodland plot, or 52 trees per ha, and an average of six Marri potential breeding trees (DBH > 500 mm) per Marri woodland plot, or 24 trees per ha (GHD 2016).

The survey area contains actual and potential breeding, foraging and roosting habitat for Carnaby's Cockatoo as presented in Figures 3 and 4 and described in Table 2.

3 References

Environmental Protection Authority (EPA) 2016, *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment*, Perth, Environmental Protection Authority.

GHD 2016, *Hill River Offset Property Biological Survey*. Unpublished report prepared for Main Roads.

Table 1 Vegetation type, extent and condition in the remaining unallocated land and proposed offset area

Vegetation type	Condition within remaining un-allocated land					Total within remaining un-allocated land	Total in proposed offset area
	Pristine	Excellent	Very good	Degraded	Completely Degraded		
Allocasuarina microstachya heathland (VT01)	0.11					**0.11**	
Melaleuca preissiana open woodland (VT03)	1.20	2.45				**3.65**	**1.20**
Melaleuca platycalyx heathland and *Eucalyptus wandoo* woodland (VT04)	29.27					**29.27**	
Eucalyptus todtiana, *Banksia attenuata* and *B. menziesii* woodland (VT05)	82.59		2.11	1.14		**85.84**	**11.35**
Xanthorrhoea and Kingia heathland (VT06)	128.37					**128.37**	**6.22**
Melaleuca rhaphiophylla woodland (VT07)	3.09	10.87	10.57			**24.53**	**3.09**
Ecdeiocolea monostachya herbland (VT08)	1.02					**1.02**	
Marri *(Corymbia calophylla)* woodland (VT09)	294.17	14.63				**308.80**	**103.81**
Eucalyptus wandoo woodland (VT10)	18.97	166.84				**185.81**	**91.24**
Banksia attenuata open heathland (VT11)	6.00					**6.00**	**6.00**
Mixed heath with isolated clumps of mallee (VT12)	16.55					**16.55**	**16.55**
Pasture with emergent trees (VT14)					245.58	**245.58**	
Total	**581.33**	**14.63**	**12.68**	**1.14**	**245.58**	**1035.52**	**239.47**

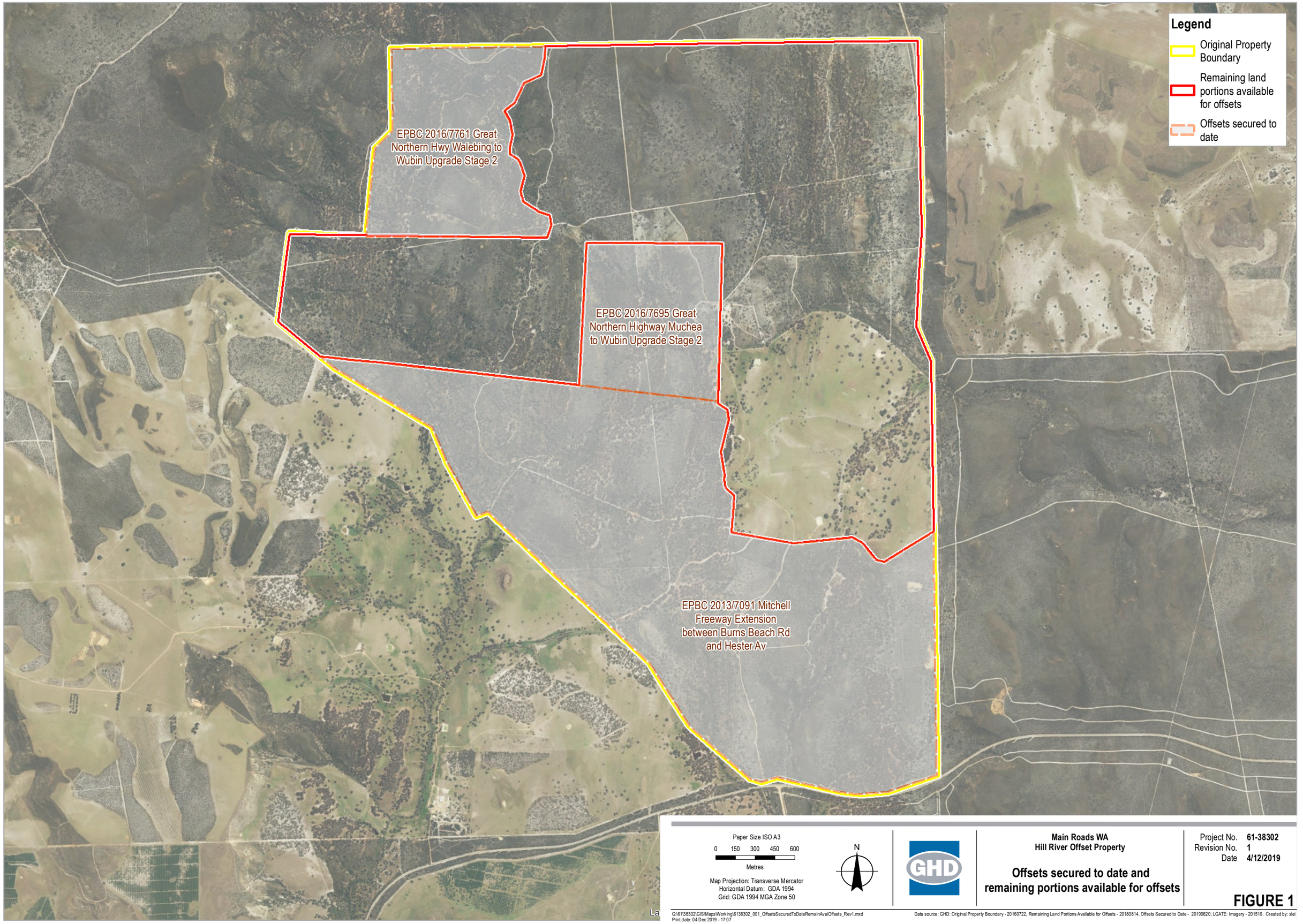
Table 2 Type and extent of Carnaby's Black Cockatoo habitat within the unallocated land and proposed offset

Habitat type	Description	Extent (ha)	Total within unallocated land
Actual breeding	Two actual breeding events (pairs in hollows either nesting or preparing for nesting) were recorded within the project area. An additional four trees with hollows were considered highly likely to support actual breeding due to the evidence presented at the time of the survey (GHD 2016). All breeding activity was recorded in Wandoo only.	523.88 ha of breeding habitat is within the unallocated land based on GHD (2016) data, 215.08 ha of wandoo woodland (VT04 and VT10) and 308.80 ha of Mari woodland (VT09). Estimated approximately 11,200 Wandoo potential breeding trees and approximately 7,400 Mari potential breeding trees based on densities recorded in tree plots.	532.88 ha
Potential breeding	All Wandoo and Marri woodland is considered potential breeding habitat for Carnaby's Black Cockatoo. Based on tree density plot data it is estimated there are 52 Wandoo trees per ha that are considered potential breeding trees (DBH > 300 mm). Based on tree density plot data it is estimated there are 24 Marri trees per ha that are considered potential breeding trees (DBH > 500 mm).	Proposed 240 ha offset area contains 195.05 ha breeding habitat including 91.24 ha Wandoo woodland (VT04 and VT10) and 103.81 ha Marri woodland (VT09). Proposed offset estimated to contain approximately 4700 Wandoo and 2500 Marri potential breeding trees.	
Foraging	Evidence of feeding was observed on *Banksia attenuata* that was growing in the Low heathlands on sandy soils habitat type. Wandoo and Marri woodlands, Low heathlands on lateritic soils and *Eucalyptus todtiana, Banksia attenuata/ menziesii* low open woodland are all considered potential foraging habitat for Carnaby's Black Cockatoo.	Unallocated land contains 765.18 ha of foraging habitat incluing: 215.08 ha Wandoo woodland (VT04 & VT10) 309.80 ha Marri woodland (VT09) 128.37 ha Xanthorrhoea and Kingia heathland (VT06)[1] 6.00 ha *Banksia attenuata* open heathland (VT11)[2] 85.84 ha *Eucalyptus todtiana, Banksia attenuata/ menziesii* low open woodland (VT05)	765.18 ha

[1] Including Xanthorrhoea, Banksia and Hakea species providing foraging habitat.

		21.10 ha scattered trees of Wandoo and Marri in Paddock (VT14)[3] Proposed 240 ha offset contains 218.62 ha of foraging habit, including 195.05 ha of Wandoo and Marri woodland (VT04, VT10, VT09) and 23.57 ha of other foraging habitat (VT05, VT06, VT11).	
Roosting	Wandoo woodland is considered potential roosting habitat for Carnaby's Black Cockatoo.	Unallocated land contains 215.08 ha Wandoo woodland (VT04 & VT10) Proposed 240 ha offset contains 91.24 ha Wandoo woodland.	215.08 ha

[3] The remaining 224.48 ha of VT14 comprises cleared paddock that does not provide foraging habitat.



Paper Size ISO A3

0 150 300 450 600

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

Main Roads WA
Hill River Offset Property

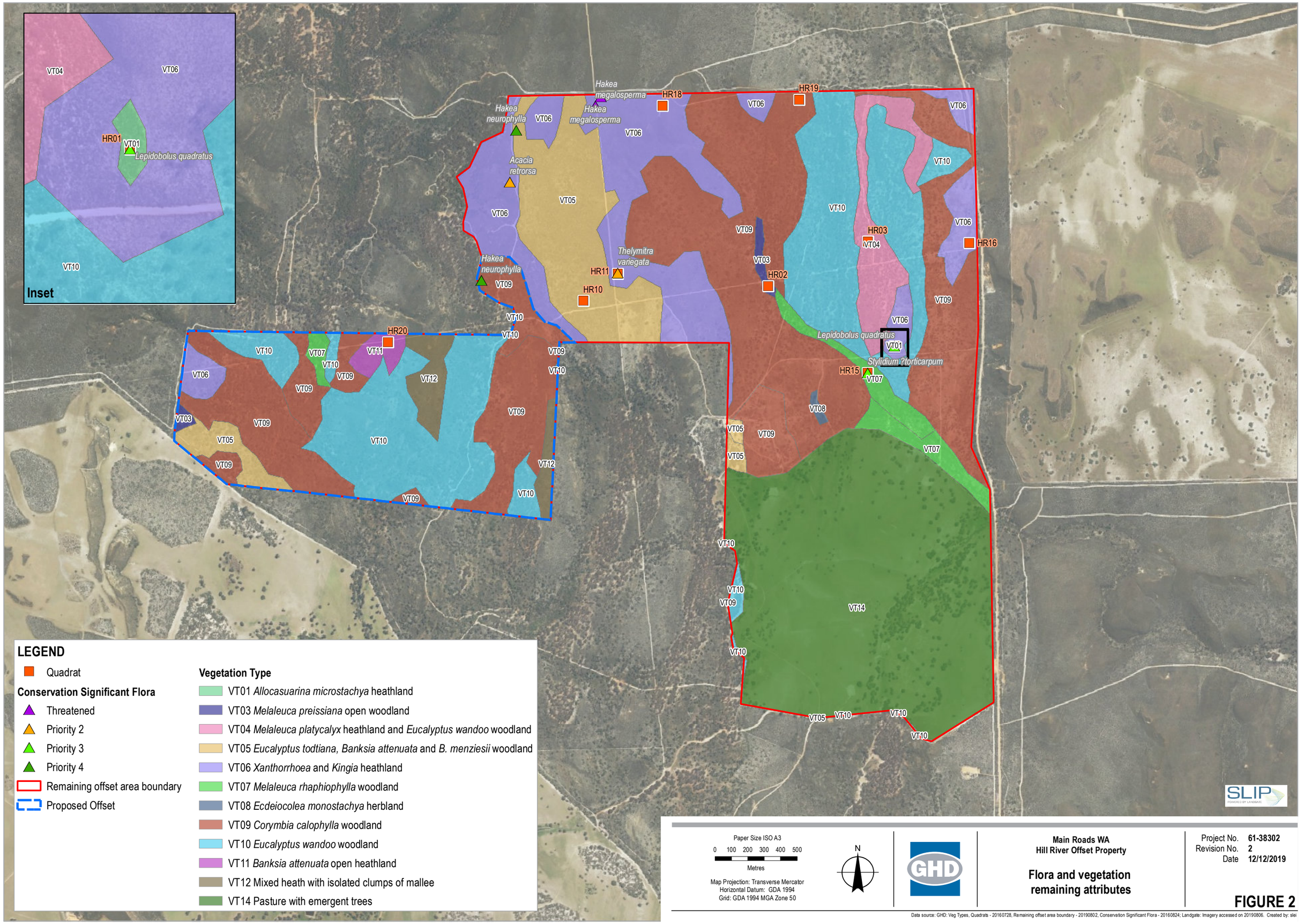
Offsets secured to date and remaining portions available for offsets

Project No. **61-38302**
Revision No. **1**
Date **4/12/2019**

FIGURE 1

G:\61\38302\GIS\Maps\Working\6138302_001_OffsetsSecuredToDateRemainAvaiOffsets_Rev1.mxd
Print date: 04 Dec 2019 - 17:07

Data source: GHD: Original Property Boundary - 20160722, Remaining Land Portions Available for Offsets - 20180814, Offsets Secured to Date - 20190620; LGATE: Imagery - 201510. Created by: slei


Inset
VT04
VT06
HR01
VT01
Lepidobolus quadratus
VT10
Hakea megalosperma
HR18
HR19
Hakea neurophylla
Acacia retrorsa
Thelymitra variegata
HR11
HR10
HR02
HR03
HR16
HR20
Lepidobolus quadratus
Stylidium ?torticarpum
HR15
VT14
SLIP
LEGEND
Quadrat
Conservation Significant Flora
Threatened
Priority 2
Priority 3
Priority 4
Remaining offset area boundary
Proposed Offset
Vegetation Type
VT01 Allocasuarina microstachya heathland
VT03 Melaleuca preissiana open woodland
VT04 Melaleuca platycalyx heathland and Eucalyptus wandoo woodland
VT05 Eucalyptus todtiana, Banksia attenuata and B. menziesii woodland
VT06 Xanthorrhoea and Kingia heathland
VT07 Melaleuca rhaphiophylla woodland
VT08 Ecdeiocolea monostachya herbland
VT09 Corymbia calophylla woodland
VT10 Eucalyptus wandoo woodland
VT11 Banksia attenuata open heathland
VT12 Mixed heath with isolated clumps of mallee
VT14 Pasture with emergent trees
Paper Size ISO A3
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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50
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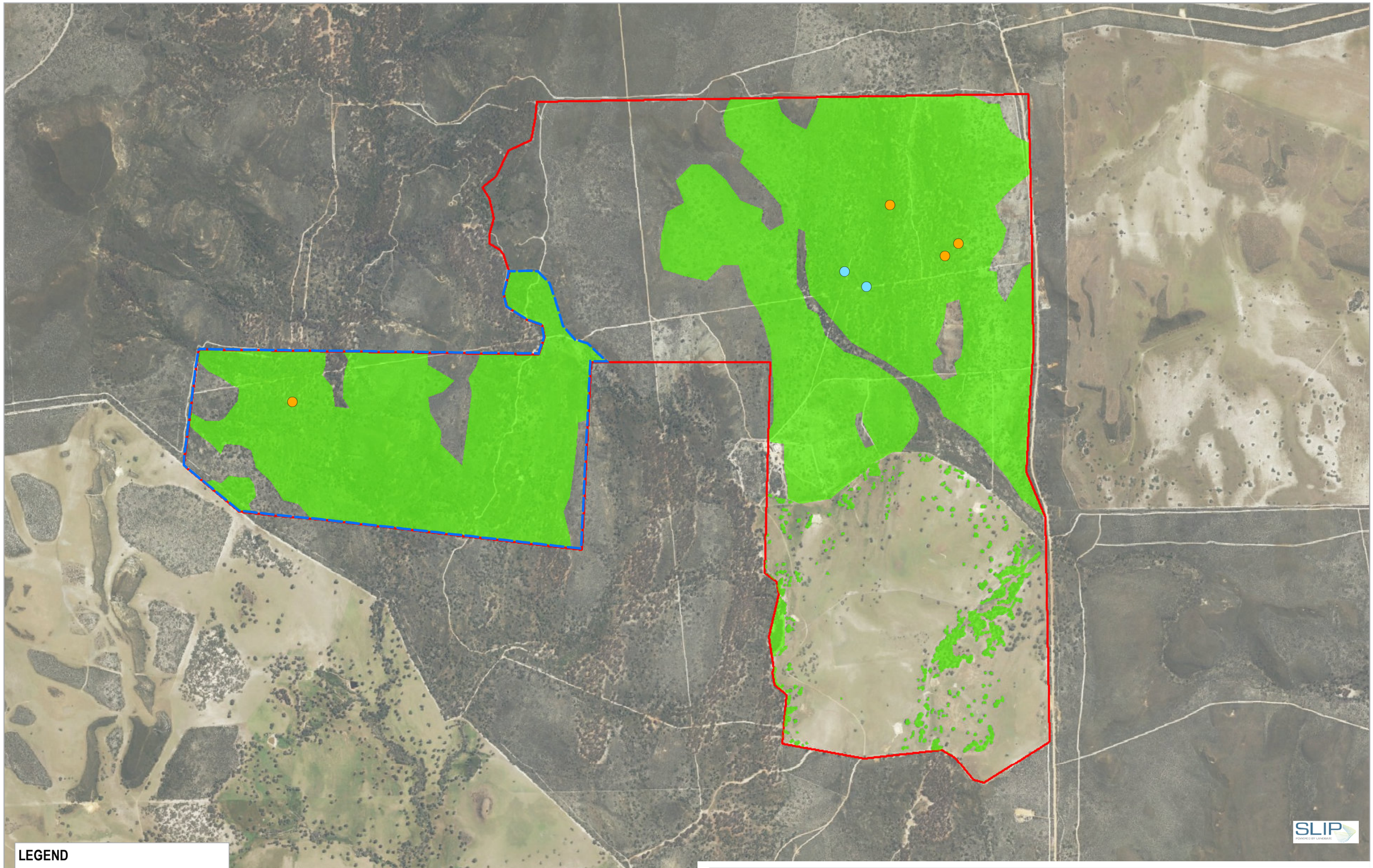
GHD
Main Roads WA
Hill River Offset Property
Flora and vegetation remaining attributes
Project No. 61-38302
Revision No. 2
Date 12/12/2019
FIGURE 2
Data source: GHD: Veg Types, Quadrats - 20160728, Remaining offset area boundary - 20190802, Conservation Significant Flora - 20160824; Landgate: Imagery accessed on 20190806. Created by: slei



Paper Size ISO A3

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

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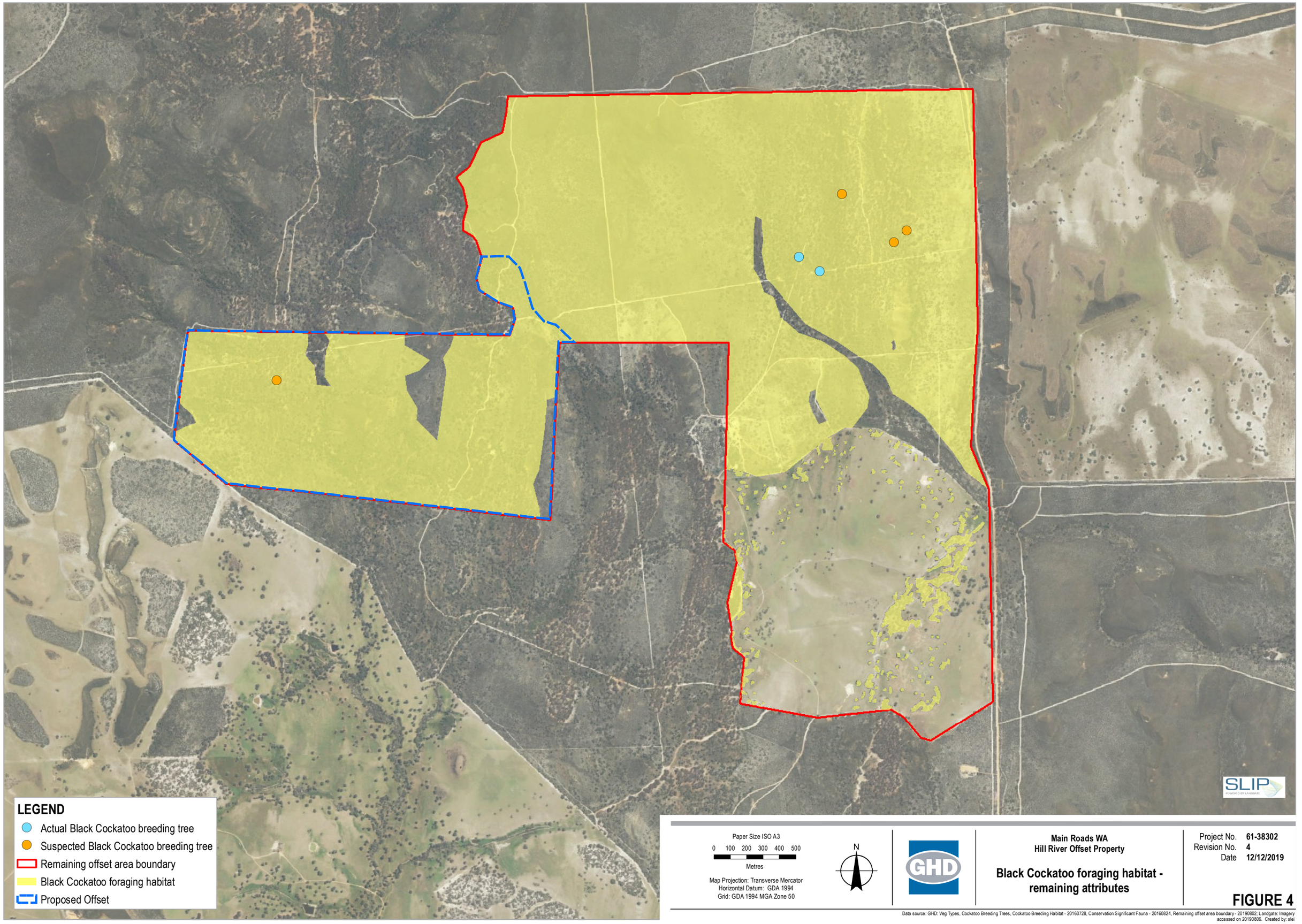
Main Roads WA
Hill River Offset Property

Black Cockatoo breeding habitat - remaining attributes

Project No. **61-38302**
Revision No. **4**
Date **12/12/2019**

FIGURE 3

Data source: GHD: Veg Types, Cockatoo Breeding Trees, Cockatoo Breeding Habitat - 20160728, Conservation Significant Fauna - 20160824, Remaining offset area boundary - 20190802; Landgate: Imagery accessed on 20190806. Created by: slei



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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

Main Roads WA
Hill River Offset Property

Black Cockatoo foraging habitat - remaining attributes

Project No. 61-38302
Revision No. 4
Date 12/12/2019

FIGURE 4

Data source: GHD: Veg Types, Cockatoo Breeding Trees, Cockatoo Breeding Habitat - 20160728, Conservation Significant Fauna - 20160824, Remaining offset area boundary - 20190802; Landgate: Imagery accessed on 20190806. Created by: slei

Appendix B – Ashworth Road, Gingin – Survey Interim Report

ABN 25 605 804 500 www.focusedvision.com.au

MEMORANDUM

Date	4 December 2019	**Title**	Lots 1921 and 2342 Ashworth Road Gingin, Interim Report – Banksia Woodland Key Results
Ref.	MRWA19004_IREP_RevB	**Distribution**	Marni Baetge Environment Officer
Author	Adrian Barrett Botanist/Ecologist	**Review/ Authorisation**	Kellie Bauer-Simpson Principal Ecologist

1. Background

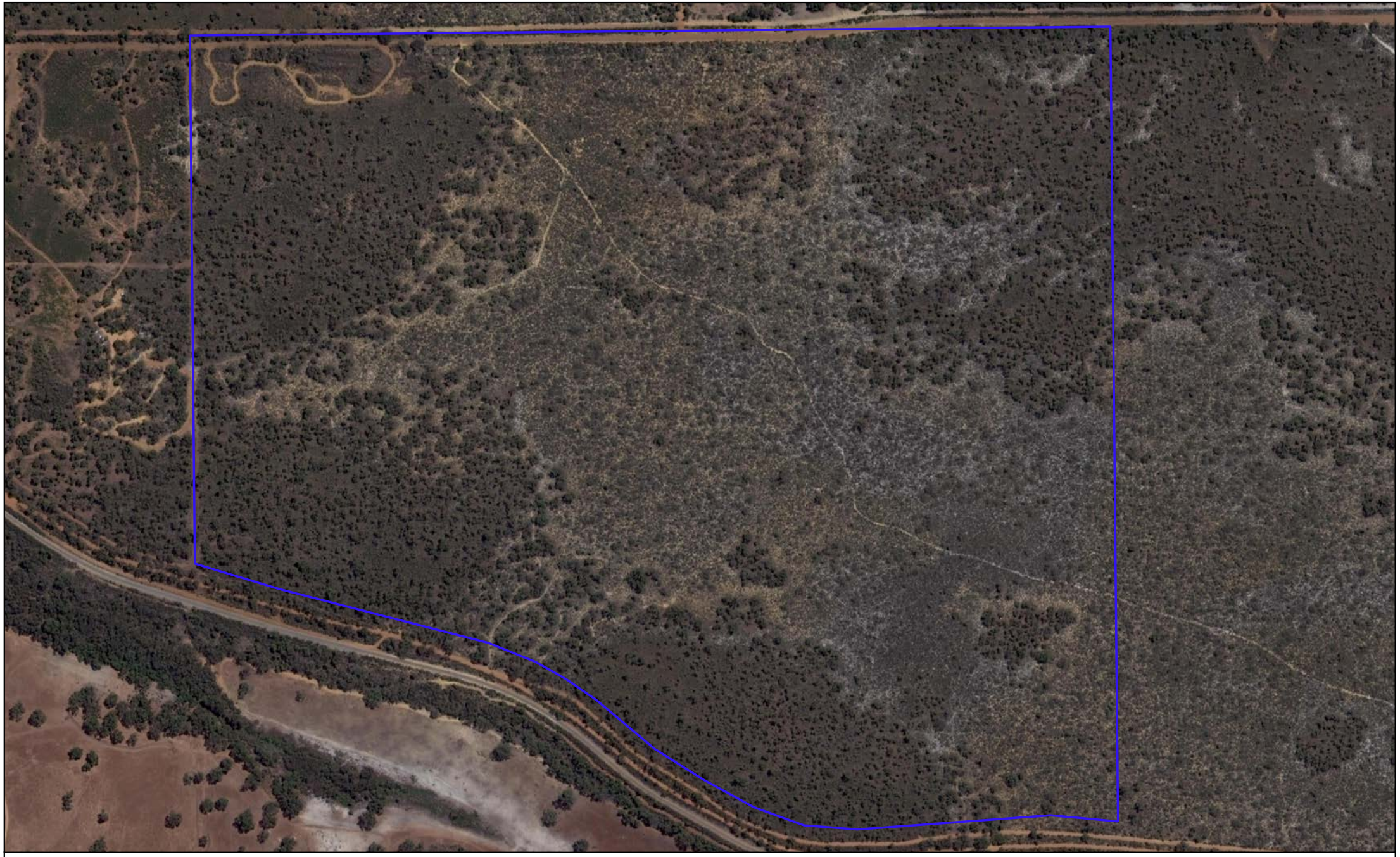
Main Roads Western Australia (Main Roads) undertakes various infrastructure projects across Western Australia. Residual environmental impacts resulting from project actions may be offset with land of equal or better conservation value. Land vested with the Commissioner of Main Roads may be used to offset impacts to the *Banksia Woodlands of the Swan Coastal Plain* Threatened Ecological Community (BWSCP TEC).

A number of properties have been vested under Main Roads' authority for gravel extraction and rock quarrying purposes that are no longer utilised for material extraction. Since some of the areas are vegetated, they may be suitable as land offsets.

Focused Vision Consulting Pty Ltd (FVC) was commissioned by Main Roads to undertake a desktop assessment, detailed vegetation survey and targeted Black Cockatoo habitat assessment at Lots 1921 and 2342 Ashworth Road Gingin (the study area; **Figure 1**). Both Lots form gravel reserve number 24560, vested with the Commissioner of Main Roads. The study area covers approximately 109.94 ha.

Main Roads requested this interim report to provide preliminary information regarding the Banksia woodland present at the site, with content to include:

- whether the 'Banksia woodland' present is representative of BWSCP TEC
- the Floristic Community Types (FCTs) present
- the condition of the BWSCP TEC (if/where BWSCP TEC is present)
- whether the BWSCP TEC forms part of a larger patch and the extent of that patch.



0 125 250 375 500 m

GDA 94 / MGA Zone 50

Legend

Study Area

Figure 1 - Study Area

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2. Methodology

As part of the full scope, a detailed flora and vegetation assessment was undertaken within the study area during spring 2019, consisting of two separate surveys at the study area (early spring and late spring), with a focus on Banksia woodland. The first phase of the field assessment was undertaken between 16-18 September, and the second phase on 5-6 November 2019. In total, 33 quadrats were established and assessed, in order to define vegetation present and to assist with spatial mapping.

The field assessment also included selective targeted searches for Threatened and Priority flora potentially occurring within the study area.

Vegetation units were defined by statistical analysis using PATN software in combination with on-ground observation. Results are preliminary at this stage as some specimens collected from the second phase of field studies are still in the process of being formally identified. Vegetation units within the study area (local) were defined using species by quadrat data incorporating presence/absence and foliage cover of the dominant species in each stratum (i.e. upper, middle and lower strata). To determine affinities with regional FCTs as defined by Gibson *et al.* (1994) and Keighery *et al.* (2012), statistical analysis compared presence/absence of species from quadrat data against the Gibson *et al.* (1994) and Keighery *et al.* (2012) datasets.

3. Interim Results and Conclusions

Threatened and Priority Flora

Preliminary identification of specimens collected from phase 1 within the study area identified one Priority 4 flora species, *Hypolaena robusta*. No Threatened flora are confirmed to have been recorded within the study area, not is it expected that any of the unidentified specimens will be confirmed as Threatened flora.

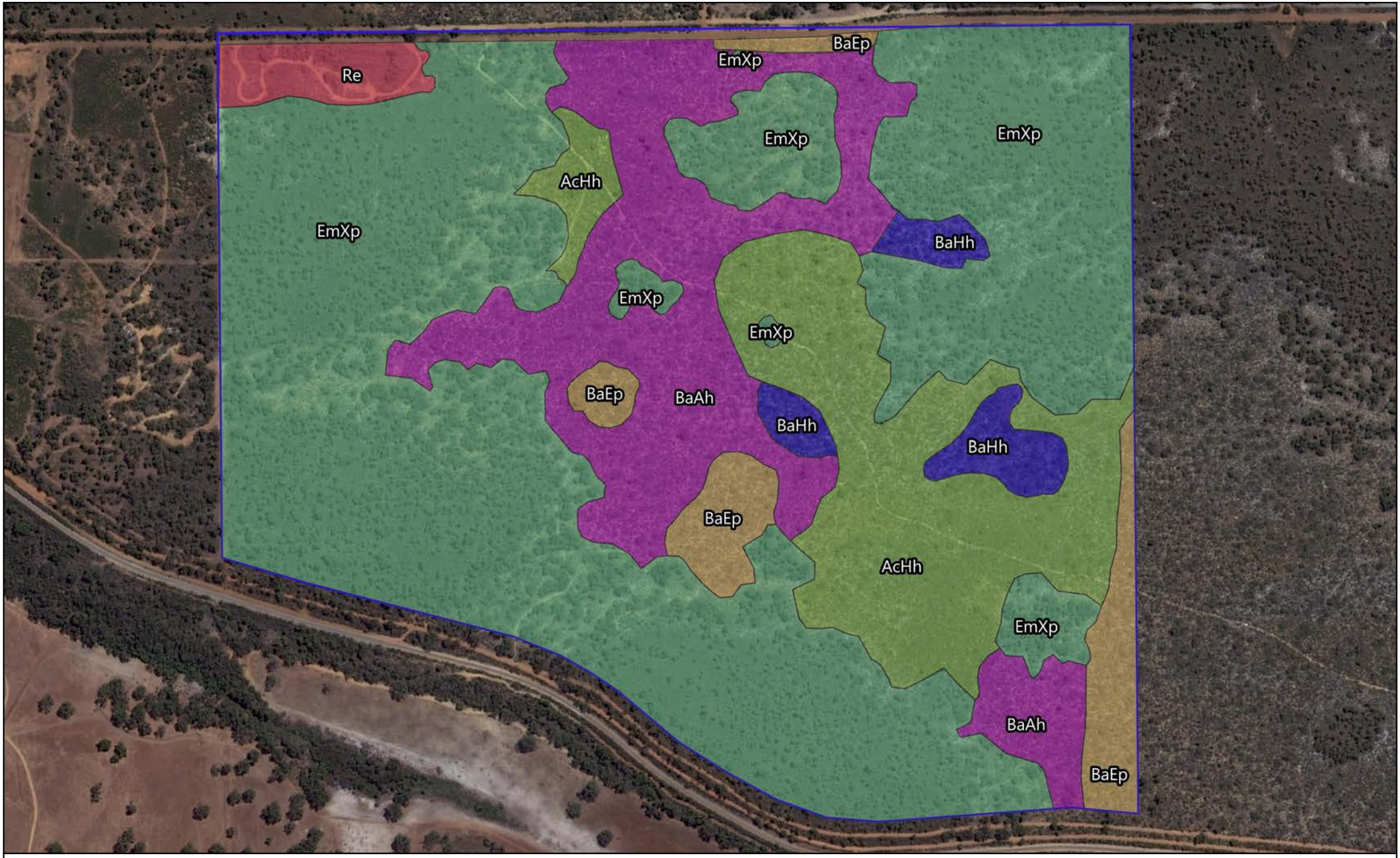
Vegetation Units

Six vegetation units were defined and mapped within the study area. These consist of three Banksia woodlands, an *Adenanthos cygnorum* Scrub with isolated Banksias, a *Banksia sessilis* regrowth community and a Jarrah forest community (**Table 1**, **Figure 2**). A brief description of each is presented in **Table 1**.

Table 1 – Summary of Vegetation Units

Code	Vegetation Community	Area (Ha)	Proportion (%)	No. of Quadrats
AcHh	*Adenanthos cygnorum* Scrub, with occasional *Banksia attenuata* and *Banksia menziesii,* over *Allocasuarina humilis* Low Scrub, over *Hibbertia hypericoides* and *Calothamnus sanguineus* Dwarf Scrub.	16.53	15.03	8
BaAh	*Banksia attenuata, Banksia menziesii* and *Eucalyptus todtiana* Open Low Woodland A, over *Allocasuarina humilis* Low Scrub, over *Mesomelaena pseudostygia* Very Open Tall Sedgeland.	18.91	17.20	11
BaEp	*Banksia attenuata, Banksia menziesii* and *Eucalyptus todtiana* Low Woodland A, over *Eremaea pauciflora* Low Heath, over *Mesomelaena pseudostygia* Very Open Tall Sedgeland.	5.25	4.78	4
BaHh	*Banksia attenuata, Banksia menziesii* and *Eucalyptus todtiana* Low Woodland A, over *Xanthorrhoea preissii* Open Low Woodland B, over *Hibbertia hypericoides* Open Dwarf Scrub.	2.86	2.60	3
EmXp	*Eucalyptus marginata* and *Corymbia calophylla* Woodland, over *Xanthorrhoea preissii* Low Woodland B, over *Hibbertia hypericoides* and *Calothamnus sanguineus* Open Dwarf Scrub.	63.01	57.31	7
Re	*Banksia sessilis* Thicket (Regrowth)	2.12	1.15	0

A 1.27 ha portion on the northern boundary of the study area comprised a cleared access road that was not surveyed.



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GDA 94 / MGA Zone 50

Figure 2 - Vegetation Units

Legend

- Study Area
- AcHh
- BaAh
- BaEp
- BaHh
- EmXp
- Re

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MRWA19004 03 Decemberl 2019

Interim Banksia Woodland TEC Results

Banksia Woodland Diagnosis

Four of the six vegetation communities containing Banksia species potentially representative of the BWSCP TEC were assessed to confirm this. Vegetation communities were assessed in accordance with the key diagnostic characters, as stipulated in the Conservation Advice (Threatened Species Scientific Committee (TSSC) 2016). Results have determined that all of the vegetation units dominated by banksia in the overstorey are representative of the BWSCP TEC and vegetation unit AcHh is also somewhat (weakly) representative of the TEC (**Table 3**). The weaker result for this unit is due to the lack of typical species in the various strata, in some of the more degraded areas of vegetation unit AcHh.

Table 2 - BWSCP TEC Characterisation

Key Character (see key)	Vegetation Unit			
	AcHh	BaAh	BaEp	BaHh
a).	+	+	+	+
b).	+/-	+	+	+
c).	+	+	+	+
d).				
e).	+/-	+	+	+
f).	+/-	+	+	+
g).	+/-	+	+	+
Diagnosis as BWSCP	**Somewhat**	**Confirmed**	**Confirmed**	**Confirmed**

Key:

a) Swan Coastal Plain or Jarrah Forest location
b) Soils and landform either deep Bassendean, Spearwood or occasionally Quindalup sands, sandy colluvium, Aeolian sands of the Ridge Hill Shelf or Whicher Scarp
c) Distinctive upper sclerophyllous layer dominated by *Banksia attenuata, Banksia menziesii, Banksia ilicifolia* or *Banksia prionotes*
d) With (although can be without) an emergent tree layer of *Corymbia calophylla, Eucalyptus marginata* or *Eucalyptus gomphocephala*
e) With (although can be without) other trees including *Eucalyptus todtiana, Nuytsia floribunda, Allocasuarina fraseriana, Callitris arenaria, Callitris pyramidalis* or *Xylomelum occidentale*
f) Understorey/mid-ground sclerophyllous shrub layer including mostly Asteraceae, Dilleniaceae, Droseraceae, Ericaceae, Fabaceae, Haemodoraceae, Iridaceae, Myrtaceae, Orchidaceae, Proteaceae, Restionaceae
g) Herbaceous ground layer including mostly Apiaceae, Asteraceae, Cyperaceae, Haemodoraceae, Poaceae, Restionaceae, Stylidiaceae

Based on the outcomes of the BWSCP TEC diagnosis, the extent of this TEC has been mapped and is presented in **Figure 3**. This area of BWSCP occupies 43.53 ha (39.59%) of the 109.94 ha site.

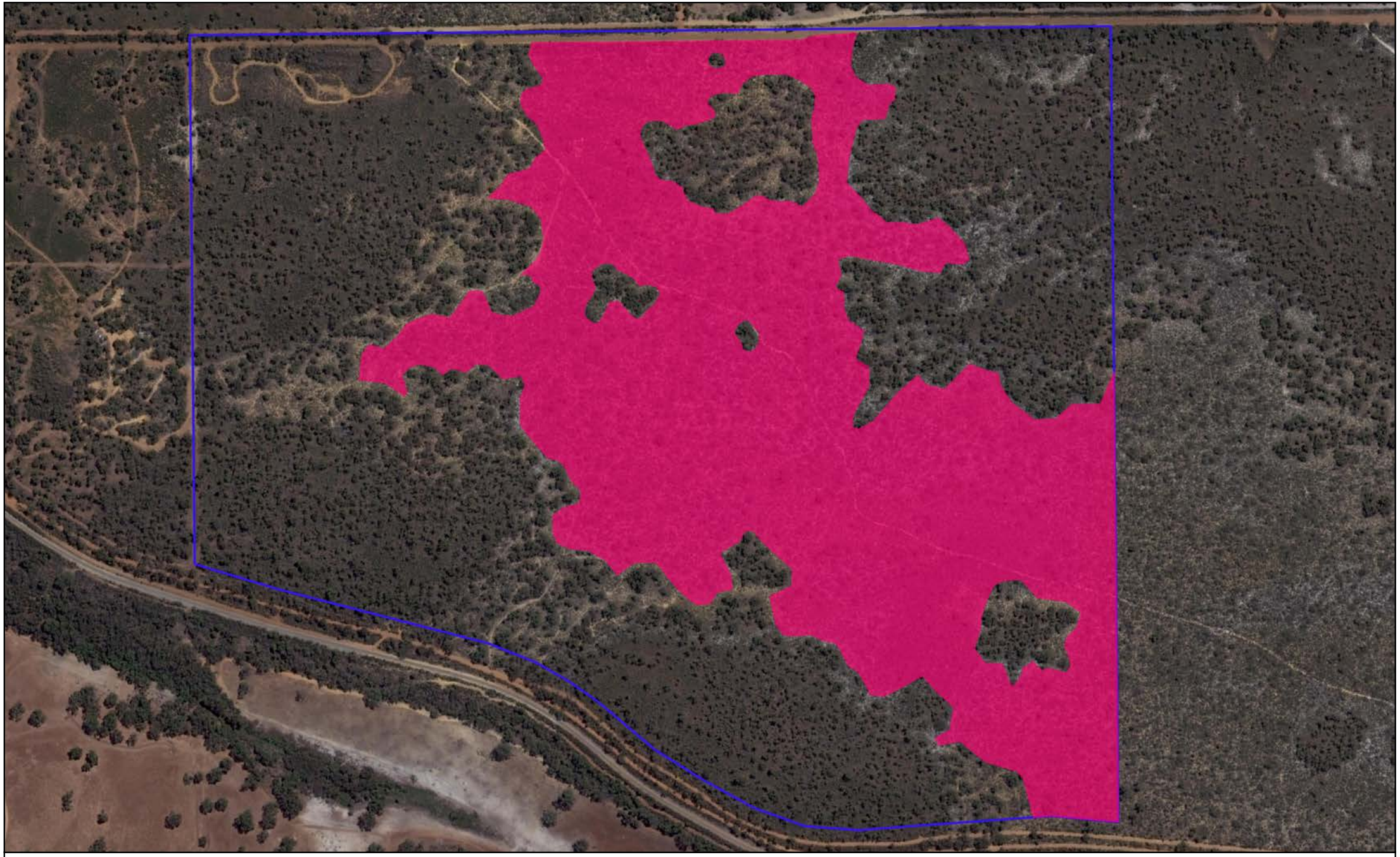

Figure 3 - Banksia Woodland Extent

Banksia Woodland Condition

The condition of the vegetation within the study area ranges from 'Completely Degraded to Degraded' (CD-D) to 'Very Good to Excellent' (VG-Ex). The majority of the vegetation within the study area is considered to be in 'Very Good to Excellent' condition. Most (40.50%) of the Banksia woodland within the site is in 'Very Good to Excellent' condition and ranges from 'Degraded to Good' to 'Very Good to Excellent' (**Table 2**, **Figure 4**).

Table 3 – Vegetation Condition of the Banksia Woodland within the Study Area

Condition Category	Area (ha) within Study Area	% of Study Area
Degraded - Good	0.71	1.62
Good	8.46	19.44
Good – Very Good	8.54	19.62
Very Good	8.19	18.81
Very Good – Excellent	17.63	40.50
TOTAL	**43.53**	**100**

While the AcHh community has been concluded to be representative of the BWSCP TEC, its inclusion is considered marginal. Areas supporting this vegetation units are overall in poorer condition than most of the remaining areas of Banksia woodland at the site. Observations within this community noted recent Banksia tree deaths and historic deaths noted as dead trees on the ground (**Plate 1**), suggesting the previous community consisted of a denser Banksia canopy. This community is likely in transition from either the BaAh or BaEp communities to a shrubland/scrub dominated by *Adenanthos cygnorum,* colonises and dominates disturbed areas.

The observed degradation (tree deaths, invasion of *Adenanthos cygnorum* and loss of community structure where *Adenanthos cygnorum* dominates) may be the result of drought, as the vegetation most affected is in locations higher in the landscape, where the depth to regionally lowering groundwater would be greatest. An historic fire at the site, impacts from past activities in the area, disease or a combination of these may have exacerbated the degradation of the community.

In some of the more affected locations, vegetation condition is considered to be 'Degraded to Good' (**Figure 4**). Other areas of the AcHh vegetation unit in better condition would be expected to possibly continue to decline with a drying climate and as the disturbance opportunist, *Adenanthos cygnorum* continues to proliferate.

Plate 1 - Banksia tree deaths within Vegetation Unit AcHh

Floristic Community Type

Preliminary results comparing quadrat data from the three Banksia woodland vegetation units and the *Adenanthos cygnorum* Scrub unit with quadrat data from regional FCTs (Gibson *et al.* 1994; Keighery *et al.* 2012), using PATN™ (Belbin 1995) showed closest affinity with FCT SCP09 and some affinity with FCT SCP23c. Other targeted Banksia woodland studies conducted in the region by FVC at Beermullah and Orange Springs have also concluded equivalence to SCP09 (Kellie Bauer-Simpson, pers. comm.). It is therefore concluded that the entire extent of Banksia woodland within the study area (**Figure 3**) is representative of FCT SCP09.

Figure 4 - Banksia Woodland Condition

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Banksia Woodland Patch

The Banksia woodland within the study area is connected to a larger patch of Banksia woodland. Including the Banksia woodland vegetation units identified within the study area, this broader patch is approximately 375.29 ha in size. The spatial extent of this Banksia woodlands patch is presented in **Figure 5**.

The Banksia woodland patch is situated in a region of significant historical disturbance, primarily for agriculture. The patch is relatively isolated in the local context, with more significantly sized patches present to the north, south and west of the mapped patch. The patch that encompasses the Banksia woodland within the study area is some of the eastern-most Banksia woodland in the region, which is evident in pre-European vegetation mapping (Beard 1990).

The Conservation Advice specifies minimum patch sizes based on vegetation condition as follows (TSSC 2016):

- Pristine - no minimum patch size
- Excellent – 0.5 ha
- Very Good – 1 ha
- Good – 2 ha.

To be considered a Matter of National Environmental Significance (MNES) protectable under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), a Banksia woodland patch must meet at least the 'Good' condition category as outlined in the Conservation Advice (TSSC 2016), based on the conservative average condition across the patch. Based on the condition and size of the Banksia patch associated with the study area, the Banksia woodlands within the study area are considered eligible for inclusion as the BWSCP TEC.

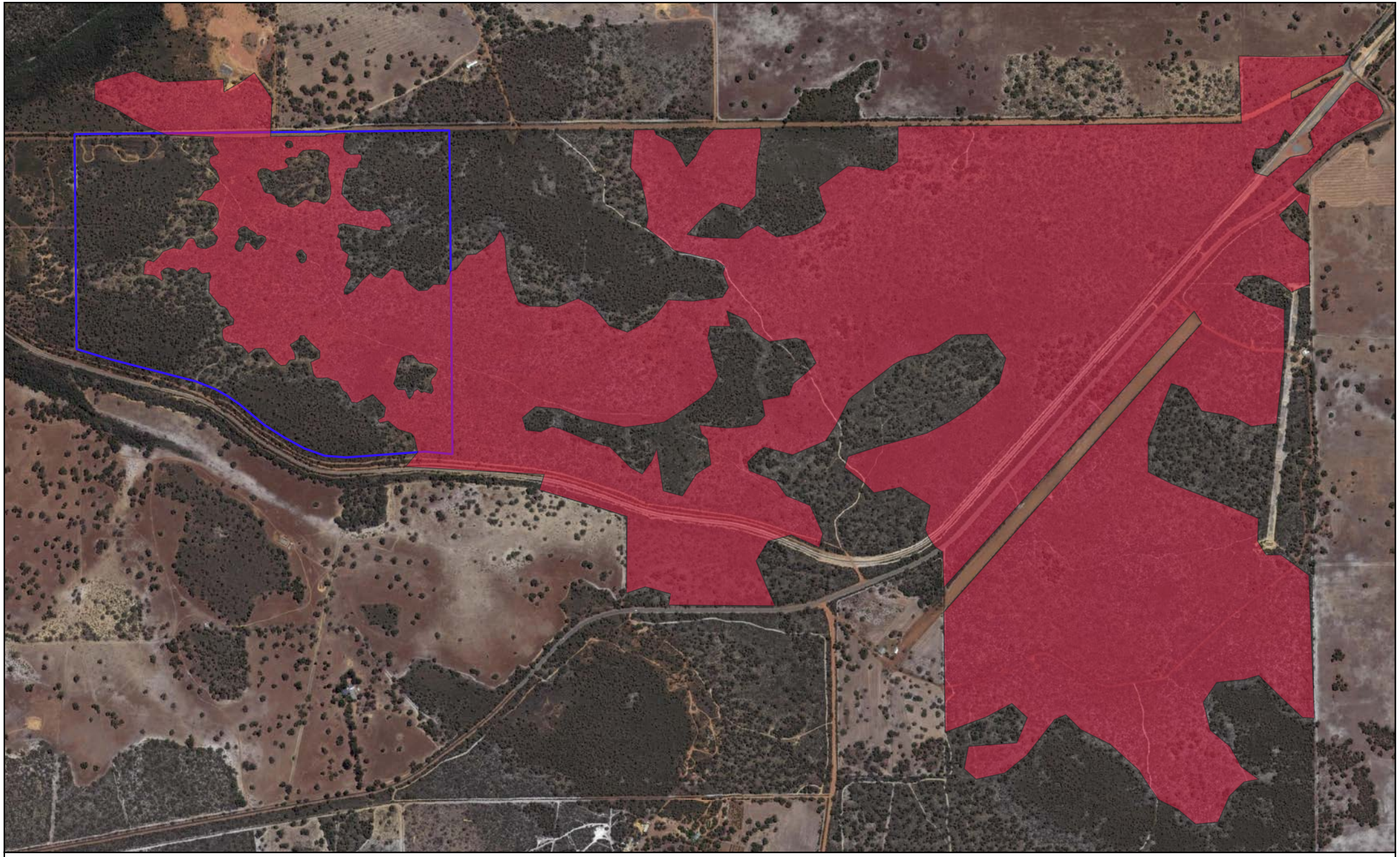

Figure 5 - Banksia Woodland Patch

FOCUSED VISION consulting

4. 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
Principal Ecologist/Environmental Manager
Focused Vision Consulting Pty Ltd

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Appendix C – Murdoch University Research Proposal

10 April 2019

Re: Murdoch University Research Proposal - Conservation Management for the long-term survivorship of black cockatoos endemic to the south-west of Western Australia: the application of telemetry to determine spatial ecology on the Perth-Peel Coastal Plain, south-west forest region and key breeding sites in response to a changing environment.

Researchers in the Conservation Medicine Program in the College of Science, Health, Engineering and Education at Murdoch University have been studying the health, ecology and demographics of Western Australia's three species of black cockatoos for over 10 years. Over the last five years we have undertaken a world first study involving satellite and GPS tracking of Carnaby's cockatoos, Baudin's cockatoos and forest red-tailed black cockatoos across their distribution ranges, to identify key habitat areas and migratory movements, about which much remains unknown. This research was funded by the Department of Communities, Newmont, South32, PTI Architecture and DBCA, and was undertaken in collaboration with The University of Amsterdam, Perth Zoo and Kaarakin Black Cockatoo Conservation Centre. This initial research project involved tracking of 84 black cockatoos, and their associated flocks, and produced over 140,000 GPS location fixes, 33,000km of track movement and over 2.8M accelerometer records. This initial research demonstrated that our methodology is proven and that we can obtain data on black cockatoo flock movement at spatial and temporal scales that have previously been unattainable. It has laid the foundation for the proposed new research project, *Conservation Management for the long-term survivorship of black cockatoos endemic to the south-west of Western Australia: the application of telemetry to determine spatial ecology on the Perth-Peel Coastal Plain, south-west forest region and key breeding sites in response to a changing environment,* which we hope to be able to commence in July this year (see attached). The data generated through this project will assist in identifying key habitats and areas for conservation/revegetation, determining threatening processes for black cockatoo species across their range, and informing decision making in relation to conservation and land management planning at both State and Federal government levels. This proposed research project addresses major priority Actions in the Carnaby's Cockatoo Recovery Plan and the Forest Black Cockatoo Recovery Plan, and is fully supported by the Chairs of the Carnaby Cockatoo Recovery Team and the Forest Black Cockatoo Recovery Team.

Three industry partners have proposed contributing funding towards this project in relation to their offset packages. The total cost of the five year research project is $3,239,664, with the industry partners proposing to provide funding as follows:

- **Main Roads WA (Year 1 - $406,970)** linked to offsets including the proposed Kalamunda-Roe 8 Highway extension and Mitchell Freeway North extension.
- **PTA WA (Years 2-5 - $1,092,381 with focus on tracking on the Perth-Peel Coastal Plain)** linked to rail extension projects for the proposed Thornlie Cockburn Link, Yanchep Rail Extension Part 2 and Morley- Ellenbrook Line.
- **Talison Lithium (Years 2-5 - $1,092,381 with focus on tracking in the south-west forest region of Greenbushes and key Carnaby's cockatoo breeding sites across the distribution range)** linked to the proposed expansion of the Greenbushes Lithium mine.
- **Murdoch University (Years 1-5 $647,932)** has committed to providing 20% contribution of the project costs.

Whilst each of the proposed industry contributions funds distinct components of the overall project associated with their offset package, the strength of this proposed collaboration lies in the complete project being funded over the five year period, which will provide critical data to inform decision makers in relation to habitat use and conservation management of Carnaby's cockatoos, Baudin's cockatoos and forest red-tailed black cockatoos across their distribution range.

Development and biodiversity conservation are not mutually exclusive. Perth and regional areas in the south-west of WA are undergoing rapid and extensive development, and conservation management of black cockatoos could provide a strong model for how development and conservation can be managed synergistically. Part of what makes Perth and the south-west of WA special is the unique and endemic biodiversity, which we are fortunate to have in our urban and regional areas; including our endangered and iconic black cockatoos. We hope that the Department of Environment and Energy will support the proposals by Main Roads WA, PTA WA and Talison Lithium to include the proposed funding as part of their offset packages, as the conservation outcomes associated with this project will provide decision makers with the data and knowledge required to manage these three threatened black cockatoo species, all of which are Matters of National Environmental Significance, for decades into the future.

Please do not hesitate to be in touch if you have any further queries.

Yours sincerely,

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Kim Williams, Regional Leader Nature Conservation, SW Region, DBCA/ Chair of Forest Black Cockatoo Recovery Team

Conservation management for the long-term survivorship of black cockatoos endemic to the south-west of Western Australia: the application of telemetry to determine spatial ecology on the Perth-Peel Coastal Plain, south-west forest region and key breeding sites in response to a changing environment

A/Professor Kristin Warren[1], Dr Jill Shephard[1], Dr Lian Yeap[1], Dr Bethany Jackson[1], Dr Rebecca Vaughan-Higgins[1], Rebecca Donaldson[1], Dr David Mitchell[2], Dr Geoff Barrett[2], Rick Dawson[2], Dr Peter Mawson[2], Dr Denis Saunders[3], Professor Willem Bouten[4]

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Summary

Western Australia's three endemic black cockatoo species, Carnaby's cockatoos (*Calyptorhynchus latirostris*), Baudin's cockatoos (*Calyptorhynchus baudinii*) and forest red-tailed black cockatoos (*Calyptorhynchus banksii naso*) are threatened and receive special protection as Matters of National Environmental Significance (MNES) under the Environment Protection and Biodiversity Conservation Act (1999) [1-7]. Threats to species survivorship for these black cockatoos are well documented, and include habitat loss and modification, urban and industrial expansion, disease, displacement by competing species, and climate shifts[1-2](Figure 1). Despite significant research to date[8-13], key information required to address the National Recovery Plan remains outstanding.

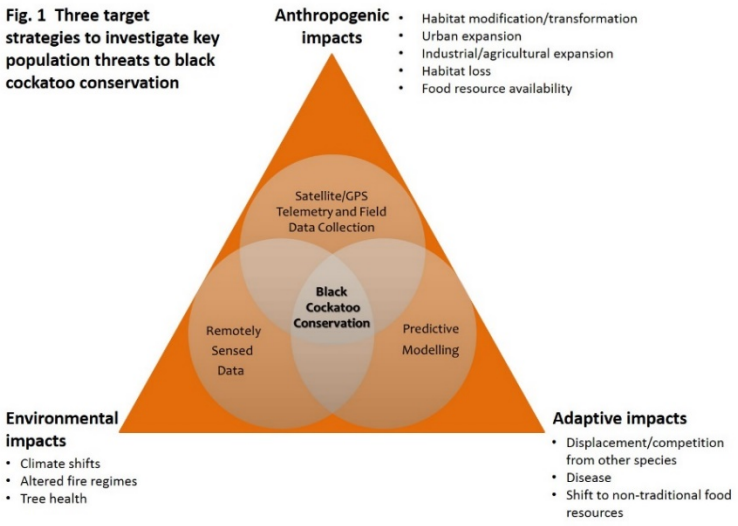

Fig. 1 Three target strategies to investigate key population threats to black cockatoo conservation

Background and Significance

Black cockatoos are iconic species in the Western Australian landscape. People hold strong cultural associations with them, and they are well placed to function as flagship species for habitat conservation. All three species occupy a large area of habitat in the south-west of Western Australia, including populations that inhabit the Perth-Peel Coastal Plain; with Carnaby's cockatoos typically migrating from inland breeding areas to coastal habitat during the non-breeding season, Baudin's cockatoos migrating from wintering sites in the Darling Ranges to southern breeding sites, and forest red-tailed black cockatoos moving between the Perth-Peel Coastal Plain and the Darling Ranges. All three species also have populations that inhabit the south-west forests in the southern part of their distribution range, which do not migrate to the Perth-Peel Coastal Plain.

Carnaby's cockatoos are listed as Endangered under Australian Federal law (*Environment Protection and Biodiversity Conservation Act 1999)* and internationally by the IUCN[1,4]. At the state level they are listed as Endangered under the Western Australia *Biodiversity Conservation Act 2016*[5]. The species has undergone an estimated 50% decline over the last 5 decades[1], including an estimated average decline of 5% per annum across the Perth-Peel Coastal Plain over the last nine years[13]. Overall this has contributed to a suggested 30% range contraction[1], and significant loss of breeding populations[1,13].

Forest red-tailed black cockatoos have declined in range by 30% as a result of habitat loss and have suffered a marked decline in population numbers since the 1950s[2,9,10]. The species is listed as Vulnerable under Australian Federal law (*Environment Protection and Biodiversity Conservation Act 1999)* and under the Western Australia *Biodiversity Conservation Act 2016*[5]. The forest red-tailed black cockatoo fits the IUCN Red List Criteria for Vulnerable due to a projected or suspected decline in the population of more than 30% within the next 10 years or three generations[2].

Baudin's cockatoos are listed as Endangered at the Federal Level (*Environment Protection and Biodiversity Conservation Act 1999),* and at the State Level (*Biodiversity Conservation Act* 2016)[5]. The population has been in decline over the last 50 years, however in the last eleven years there has been a dramatic decline (over 90%) in the numbers recorded at traditional autumn-winter roost sites in the northern Darling Range[15]. Additionally, in 2017 there were unexpectedly few records of large flocks of this species in the south-west[15].

The Carnaby's Cockatoo Recovery Plan[1] lists six priority Actions that must be undertaken to meet the Plan's objectives; and the Forest Black Cockatoo Recovery Plan[2] lists 13 Actions. The Actions listed in both these Recovery Plans have remained largely out of reach, as they have required information about the species' ecology, movement patterns and habitat use/selection which can only be obtained by large-scale tracking of wild flocks. Our team has developed and tested an approach enabling us to track wild flocks using satellite and GPS tags at both local population and landscape scales; allowing us to collect a suite of hitherto unknown ecological information. Accordingly, this proposed project will address and inform all six priority Actions from the Carnaby's Cockatoo Recovery Plan, and seven of the priority Actions in the Forest Black Cockatoo Recovery Plan.

Threatening processes for Western Australia's black cockatoos are exacerbated by the rapidly increasing urban and industrial development in the Perth-Peel region and the south-west of Western Australia[3]. Perth's human population is projected to nearly double to 3.5 million by 2050[3], emphasising the need to understand flock movements and habitat use, and identify critical feeding and breeding sites; which still remain largely unknown despite early attempts using direct observation[8-13,16-19]. There is an apparent mismatch between legislative intent and management action as insufficient knowledge exists about basic behavioural ecology across spatial scales, and which habitats are integral to long-term retention of black cockatoos.

Our tracking research, which identifies habitat use and flock movements through the landscape, can assist with identifying key habitats and areas for conservation/revegetation. Our research team is in a strong position to work alongside government to identify areas of habitat that are high-use, and to inform decisions regarding which areas are most appropriate to conserve and manage to halt black cockatoo population declines.

Our research team at Murdoch University has developed a novel tracking methodology for black cockatoos using GPS and satellite telemetry[20-21]. Together this will enable researchers to obtain movement, behavioural and ecological data at both the extent and spatial scale (local population and landscape scales) required to inform conservation and land management planning.

Three industry partners have proposed funding for this project in relation to their offset packages – Main Roads Western Australia, the Public Transport Authority (PTA) of Western Australia and Talison Lithium.

Main Roads WA are responsible for the building and provision of road infrastructure and operations in relation to improvement in road efficiency, as well as maintenance of the State's major government roads, bridges and road verges. *Funding for Year 1 of this research project is linked to offsets including the proposed Kalamunda-Roe 8 Highway extension and Mitchell Freeway North extension*.

The Government of Western Australia has embarked on the delivery of METRONET, considered to be Perth's most ambitious public transport program, which aims to address sustainability issues in the city through the optimisation of existing rail capacity and building new rail systems. The rail extensions currently underway, and those that are proposed, will impact on remnant vegetation that our current tracking work indicates is important black cockatoo habitat. Various rail projects will affect all three black cockatoo species as follows: Thornlie-Cockburn Link - Carnaby's cockatoo, forest red-tailed black cockatoo; Yanchep Rail Extension Part 1 - Carnaby's cockatoo, forest red-tailed black cockatoo; Yanchep Rail Extension Part 2 - Carnaby's cockatoo, forest red-tailed black cockatoo; Morley-Ellenbrook Line - Carnaby's cockatoo, forest-red tailed cockatoo; Byford Rail Extension - Carnaby's cockatoo, forest-red tailed cockatoo, Baudin's cockatoo; Midland Line Rail Extension and new Midland Station - Carnaby's cockatoo, forest-red tailed cockatoos; and, Karnup Station - Carnaby's cockatoo, forest red-tailed black cockatoo. *The funding component from PTA in Year 2-5 is linked to proposed rail extension projects for the Thornlie Cockburn Link, Yanchep Rail Extension Part 2 and Morley-Ellenbrook Line.*

Talison Lithium Australia Pty Ltd has been operating the Greenbushes Lithium mine, in the Greenbushes region in south-west WA, for over 30 years. Talison Lithium is proposing to expand its operations at this mine site to increase the production of spodumene ore and lithium mineral concentrate. *The funding component from Talison Lithium in Year 2-5 is linked to the proposed expansion of the Greenbushes Lithium mine.*

These industry partners have indicated that they are committed to sustainable development; they aim to minimise and manage potential environmental impacts and work with the Federal Department of Environment and Energy in relation to environmental approval and offset requirements.

Development and biodiversity conservation are not mutually exclusive. Perth is undergoing rapid and extensive development, and could be a strong model for how development and conservation can be managed synergistically. A large part of what makes Perth special is its unique and endemic biodiversity, which we are fortunate to have in our urban areas; including endangered and iconic black cockatoos. As Perth develops, it will be important to implement effective efforts to ensure the conservation management of our threatened species. For black cockatoos, this will mean identifying and protecting important habitat on the Perth-Peel Coastal Plain, alongside creation of replacement habitat, to ensure no net habitat loss across their distribution range.

Proposed Research

This project aims to utilise innovative tracking methodologies to undertake a movement ecology study of Western Australia's three threatened black cockatoo species, to determine habitat use and threatening processes in modified landscapes. We will track the three species of black cockatoos on the Perth-Peel Coastal Plain and in the south-west forest region of Greenbushes, and additionally – given the importance of the Perth-Peel Coastal Plain for Carnaby's cockatoos during the non-breeding season – we will track Carnaby's cockatoos at key breeding sites to better understand migratory movement dynamics of this species across its distribution range. We will also undertake health research on Carnaby's cockatoos to better understand the potential role of disease as a threatening process for this species. Several potential pathogens associated with avian disease have been found in wild Carnaby's cockatoo nestlings in south-western Australia, including: (1) psittacine beak and feather disease (a listed Key Threatening Process for endangered parrots, Commonwealth EPBC Act 1999); (2) polyoma virus; and, (3) *Chlamydia* sp. The clinical significance of these diseases for species survival remains unknown[22]. The Murdoch team has also been involved in the investigation of Carnaby's cockatoo Hindlimb Paralysis Syndrome (CHiPs) in adult Carnaby's cockatoos, likely associated with toxicity events involving birds exposed to agricultural chemicals at breeding sites. Each year a number of Carnaby's cockatoos that have migrated back to the Perth-Peel Coastal Plain following the breeding season, are observed with clinical symptoms suggestive of delayed organophosphate neuropathy. This disease is also suspected to have caused two mass mortality events at a key Wheatbelt breeding site (2009, 2012), resulting in a population crash at this site of > 90% of breeding birds, and functional extirpation of this important breeding population[23].

This research will use remote sensing to produce predictive modelling of black cockatoo population movements and habitat use, in association with existing and emerging threats across key range areas. The project offers a novel approach: it combines (a) satellite/GPS derived movement data from our innovative tracking system; (b) other remotely sensed landscape data (e.g. vegetation, water); and (c) existing fire and climate models, to identify crucial habitat characteristics and regions most resilient to impacts of threatening processes (fire, climate shifts, habitat modification, tree health, disease, urban expansion). The data and information they generate will allow collaborators to develop policies and take action to manage land changes, and build resilience into modified landscapes to address black cockatoo declines.

Objectives of the Study

In this study we adopt a multidisciplinary approach (Fig. 1) to meet the following five objectives: **1)** Characterise black cockatoo movement and habitat use across the Perth-Peel Coastal Plain and in the south-west forest region of Greenbushes for all three black cockatoo species; **2)** Study known Carnaby's cockatoo breeding sites, focussing on characterising habitat suitability, food resource availability and selection, nestling health, specific threatening processes and fledgling dispersal routes; **3)** Identify new breeding sites in inland or southern areas for all three species based on migratory movement of birds to breeding grounds; **4)** Apply new ecotoxicology methods to investigate CHiPs toxicity cases, particularly in the agricultural zone; and **5)** predictively model survivorship scenarios for all three species of black cockatoo using movement, habitat use and threats.

Methods and Analytical Framework to meet Objectives

Obj 1 and Obj 3 – ***Flock Movements and Habitat Use across the PPCP; south-west forest region of Greenbushes; New Breeding Sites (Carnaby's cockatoo, Baudin's cockatoo and forest red-tailed black cockatoo)***

- Double mounted Satellite and GPS tracking – 16 black cockatoos tracked on the Perth-Peel Coastal Plain per annum for four years - 8 Carnaby's cockatoos (4 individuals released into two different resident flocks), 4 Baudin's cockatoos and 4 forest red-tailed black cockatoos released into resident wild flocks on the Perth-Peel Coastal Plain and in south-west forest region of Greenbushes* – use of Switching State-Space Models [24], First-Passage Time Analysis [25] and GIS to model movement behaviour, habitat selection and foraging strategies. *The number of releases of black cockatoos equates to a total of 10 releases on the Perth-Peel Coastal Plain i.e. 6 for Carnaby's cockatoos, 2 for forest red-tailed black cockatoos, 2 for Baudin's cockatoos) and 6 releases in the south-west forest region of Greenbushes i.e. 2 for Carnaby's cockatoos, 2 for forest red-tailed black cockatoos, 2 for Baudin's cockatoos; fewer Baudin's cockatoos present for rehabilitation and whilst it is likely there will be birds from this species undergoing rehabilitation that will enable a number of release groups, in the event that there are insufficient Baudin's cockatoos to have four release groups over the duration of the project, additional Carnaby's cockatoos or forest red-tailed black cockatoos will be released instead based on discussion with the industry partners and DBCA.

Obj 2 – ***Known Breeding Sites and Dispersal Routes (Carnaby's cockatoo)***

- GPS tracking and Satellite tracking – 9 breeding sites across the distribution range – 3 sites per annum for three years, with each site monitored in the subsequent year through field observations by research staff. Numbers of birds tracked: 4 adult breeding birds per site per year (i.e. 12 birds per year), each double mounted (UvA-BiTS and Telonics tags). This will include sites currently monitored by DBCA and Birdlife Australia (e.g. Coomallo Creek, Borden, Lake King, Stennetts Lake), and new sites (e.g. Kojonup and 4 additional sites identified by the tracking work) – Use of Switching State-Space Models, Calculation of Utilisation Distributions and associated Home Range estimators to identify and quantify high use habitat for feeding and watering; Examination of ecological linkages across identified habitat parameters using spatially explicit models (e.g. GLMs, GAMs, Maxent, Random Forests) to assess linkages between bird movement and specific habitat features (including travel

distances to foraging and watering sites). These data will also be used in comparative studies between sites/regions and to inform predictive modeling.

- Energetics – combined analysis using GPS accelerometer derived activity budgets and caloric benefit of identified food species determined by Bomb Calorimetry.
- Nestling health - 20 nestlings per site - 60 nestlings per year. Screening for: i) psittacine beak and feather disease (key threatening process), ii) polyoma virus, iii) *Chlamydia* sp. (present in nestlings in south-western Australia).
- Ground surveys – identification of new nest hollows, assessment of hollow condition, inventory of current and potential future threats at each site.

Obj 3 – *Identify new breeding sites* – see Obj 1 above

Obj 4 – *CHiPs toxicity (Carnaby's cockatoo)*

- Application of new ecotoxicology methods to investigate CHiPs toxicity – catastrophic mass mortality events in 2009 and 2012 led to functional extirpation of a key breeding site in the Wheatbelt[23]. Separation Science (e.g. GC-MS) targeting agricultural pesticides undertaken. Samples will include environmental samples, eggshells and cadavers (in the event of further mortality events; CHiPs clinical cases).

Obj 5 – *Predictive modelling of perturbation scenarios (Carnaby's cockatoo, forest red-tailed black cockatoo and Baudin's cockatoo)*

- Realised movement, habitat use, food and water resources will be modelled in a predictive framework (e.g. using Ensemble Species Distribution Modelling[26] against various perturbation scenarios including: habitat loss, habitat modification due to climate shifts, fire impacts, and forecast land-use transformation through urban and industrial expansion to identify landscape critical for supporting species survivorship in the long-term [modelled in 10yr increments for 50-100yrs]). Existing fire and climate models exist. Ensemble modelling allows the prioritisation of habitat according to competing ecological hypotheses and is an excellent tool for guiding conservation management under large-scale disturbance scenarios.

Projected Conservation Management Outcomes

This project will deliver major new flock movement and habitat use information and conservation outcomes. Since 2015, our research team has successfully deployed 84 tags and generated over 140,000 GPS location fixes, 33,000 km of track movement and over 2.8M accelerometer records. The methodology is proven, and facilitates black cockatoo flock movement characterisation at spatial and temporal scales previously unattainable. The proposed research builds on this existing success, with a clear focus on conservation and management of all three black cockatoo species on the Perth-Peel Coastal Plain and the south-west forest region of Greenbushes, as well as at key Carnaby's cockatoo breeding sites across the species distribution range.

<u>We envisage the following direct conservation management outcomes:</u>

1. Identification and prioritisation of key habitat resources, including food, water and vegetation corridors, to maximise the retention of critical conservation value habitat for the long-term retention of Carnaby's cockatoos, Baudin's cockatoos and forest red-tailed black cockatoos across their distribution range.
2. Characterisation of appropriate roosting habitat for all three species of black cockatoo, particularly on the Perth-Peel Coastal Plain – this is important as it is not necessarily synonymous with appropriate feeding or nesting habitat.
3. Characterisation of optimal provisioning distances based on energetics work to inform future offset purchases.
4. Identification of new breeding sites (and nest hollow identification) for all three species of black cockatoo, facilitating additional long-term monitoring and protection of stronghold populations, and informing the purchase of off-set land.
5. Additional knowledge about key threatening processes (disease, displacement spp., pesticide exposure etc) on Perth-Peel Coastal Plain, in the south-west forest region and at breeding sites.
6. Additional knowledge about critical habitat resources and the overall health of breeding populations at key Carnaby's cockatoo breeding sites, which is required to ensure appropriate long-term conservation management of these sites.
7. Correlation of realised species movement ecology with existing PVA models.
8. Facilitation of consultation with local government to maximise future urban and peri-urban design to retain birds on the Perth-Peel Coastal Plain and maximise conservation management.
9. Continued liaison with stakeholder groups which consult with private landowners and industry, to manage properties and to maximise landscape and habitat integrity suitable to sustain black cockatoo populations over the long-term.

This project has been developed in collaboration with DBCA to meet the requirements of the EPBC Act Referral Guidelines for the three black cockatoo species[4], as well as priority Actions and recommendations from the national Carnaby's Cockatoo Recovery Plan[1]; Forest Black Cockatoo Recovery Plan[2]; Matters of National Environmental Significance (MNES) Significant Impact Guidelines[4-7]; and the Consideration of MNES by the WA land use planning system Discussion Paper[6].

<u>In addition, this project will meet the following recommendations from the MNES Paper:</u>

- Will address the Government of Western Australia's MNES Discussion Paper recommendations[4-7] to identify key areas within a region to sustain threatened populations, including collecting sufficient spatial information to inform assessments

and provide clarification on aspects of MNES guidelines with respect to Carnaby's cockatoo, Baudin's cockatoo and forest red-tailed black cockatoo conservation.

- Will contribute substantially towards the Government of Western Australia's preferred option for addressing Carnaby's cockatoo, Baudin's Cockatoo and forest red-tailed black cockatoo conservation in line with the EPBC Act, through identification of critical habitat, areas under threat and areas for potential offsets[4].

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Budget (2019-2024)

Item	Yr1 2019-2020	Yr2 2020-2021	Yr3 2021-2022	Yr4 2022-2023	Yr5 2023-2024
Research Fellow 1.0 FTE (ACSLC 01)	$149,811	$156,276	$162,965	$170,058	$176,670
Research Associate 0.4 FTE (Yr1); 0.6 FTE (Yr2-4); 0.4 FTE (Yr5) (Level 8/Step 1)	$50,088	$79,161	$84,135	$88,798	$60,944
Research Assistant - 1.0 FTE (Yr1), 1.5 FTE (Year 2-4) Level 2/Step 5, 1.0 FTE (Yr 5)	$71,271	$109,881	$114,240	$119,164	
Casual Research Assistance (Field/Veterinary Capacity) - Breeding Site work	$20,000	$20,000	$20,000	$20,000	
PhD Industry Partner Scholarship - ecology		$15,000	$15,000	$15,000	$7,500
PhD Industry Partner Scholarship - ecotoxicology		$15,000	$15,000	$15,000	$7,500
Kaarakin - staff assistance and maintenance of birds	$25,000	$25,000	$25,000	$25,000	
Transmitters: Breeding sites - Total of 9 sites in study - 3 breeding sites per year - 4 adult Carnaby's cockatoos (UvA-BiTS and Telonics) per site/year i.e. 12 birds per year @$4,500 per bird, plus customs charges @$2,000 p.a.		$56,000	$56,000	$56,000	
Transmitters: 16 black cockatoos per annum released onto the PPCP or Greenbushes region as outlined in proposal. Birds will be double-mounted (GPS and satellite) - $4,500 per bird - 8 Carnaby's cockatoos - 4 birds released into two flocks p.a., 4 Baudin's cockatoos released into one flock p.a., 4 forest red-tailed black cockatoos released into one flock p.a., plus customs charges $2,000 p.a.	$72,000	$72,000	$72,000	$72,000	
Vehicle use/maintenance p.a. 12,000 km (Year 1,5), 30,000km (Year 2-4) @ 70c/km	$15,000	$21,000	$21,000	$15,000	$15,000
Health testing costs: 20 nestlings per site - 60 nestlings per year @ $250 per nestling + 16 rehabilitated birds p.a. @$250 per bird		$19,000	$19,000	$19,000	
Accommodation - Breeding Fieldwork - $2,500 per site		$7,500	$7,500	$7,500	
General Accommodation and Travel - tracking	$5,000	$5,000	$10,000	$10,000	
Platform Costs	$10,000	$10,000	$10,000	$10,000	$10,000
Bomb Caliormetry costs		$5,000	$5,000	$5,000	
Separation Science - contaminants, toxicity study		$25,000	$25,000	$25,000	
Base station x 2		$20,000			
Goniometer		$12,000			
Training, Conference Travel, Publication Charges		$6,000	$6,000	$6,000	
Clinical Consumables/Misc Field Equipment	$10,000	$10,000	$10,000	$10,000	
Salary Overheads (30%)	$80,543	$101,510	$113,982	$117,540	$65,127
Total	$508,713	$790,328	$791,822	$806,060	$342,741
Murdoch University Contribution	$101,743	$158,066	$158,364	$161,212	$68,548
Main Roads (Yr 1); PTA and Talison 50:50 Contribution (Yr 2-5)	$406,970	$632,262	$633,458	$644,848	$274,193

Total (2019-2024):	**$3,239,664**
Murdoch University Total (2019-2024)	$647,932
Main Roads (Yr 1)	$406,970
PTA (50:50 with Talison) (Yr 2-5)	1,092,381
Talison (50:50 with PTA) (Yr 2-5)	1,092,381

Table D-1 Assessment of Murdoch University Black Cockatoo Research Proposal against criteria in Appendix A of *Environmental Protection and Biodiversity Conservation Act 1999* Environmental Offsets Policy (DSEWPaC 2012)

No.	EPBC Act Offsets Policy Appendix A Criteria for research and educational programs	Application to Murdoch University Black Cockatoo Research Proposal
A suitable research program must:		
1.	Endeavour to improve the viability of the impacted protected matter.	The research will provide significant information on flock movement and habitat use of Carnaby's Black Cockatoo, Baudin's Black Cockatoo and Forest Red-tailed Black Cockatoo. It will provide • Identification and prioritisation of key habitat resources (food, water and vegetation corridors) for the long term retention of Carnaby's Black Cockatoo, Baudin's Black Cockatoo and Forest Red-tailed Black Cockatoo across their distribution range. • Identification of roosting habitat for all three species • Identification of new breeding sites (and nest hollow information) for all three species • Additional knowledge about critical habitat resources and the overall health of breeding populations at key Carnaby's Black Cockatoo breeding sites. The information will assist Regulators in the assessment and, where appropriate, approval of proposals across the distribution of Carnaby's Black Cockatoo, Baudin's Black Cockatoo and Forest Red-tailed Black Cockatoo
2	Be targeted towards key research as identified in the relevant Commonwealth approved recovery plan, threat abatement plan, conservation advice, ecological character description, management plan or listing document.	The Research Proposal will address and inform all six priority actions in the Carnaby's Cockatoo Recovery Plan (DEC, 2012) and seven of the 13 priority actions in the Forest (Baudin's and Red-tailed) Black Cockatoo Recovery Plan (DEC, 2007).
3	Be undertaken in a transparent, scientifically robust and timely manner	The Research Proposal covers a five year period. Interim and Annual reports will be provided to Grantors, DotEE and the Chairs of the Black Cockatoo Recovery Teams. An annual progress meeting will be held to outline results to date. Data will be provided on request to Grantors, DotEE, Recovery Teams and to Birdlife Australia. Stakeholder consultation (including industry, state government agencies, local government and NGOs) will be documented in the interim and annual reports. The methodology will be scientifically robust. The proposed methodology has been peer reviewed by the Chairs of the Black Cockatoo Recovery Teams, key collaborators at DBCA, Perth Zoo and Dr Denis Saunders (CSIRO). The results will be published in a peer reviewed, international scientific journal.
4.	Be undertaken by a suitably qualified individual or organisation in a manner approved by the Department	The Research Proposal will be undertaken by researchers from Murdoch University, DBCA, CSIRO, Perth Zoo and the University of Amsterdam (A/Prof Kris Warren, Dr Jill Shephard, Dr Lian Yeap, Dr

		Bethany Jackson, Dr Rebecca Vaughan-Higgins, Rebecca Donaldson, Dr David Mitchell,, Dr Geoff Barnett, Rick Dawson, Dr Dens Saunders, Prof Willem Bouten). Over the past 5 years the Research Team has successfully undertaken research related to Black Cockatoo health and movement ecology utilising satellite, GPS and accelerometer tags, in partnership with a range of industry, government and non-government organisations.
5.	Consider best practice research methods	Members of the team have applied the research techniques to tracking Palm Cockatoos in the Weipa Cape York region, and to tracking White Storks, Sooty Terns and Common Noddys in Europe. The research team has diverse expertise comprising wildlife veterinarians and ecologists. The team is uniquely positioned to undertake the Black Cockatoo research that can be delivered through tracking technology as there are no other Australian (or international) groups who are able to undertake the research
The Proponent (Main Roads) is required to		
1.	Select an institution or an individual host through an internationally available open tender process or provide evidence that the program can be undertaken in-house.	While an international open tender process was not used to select the Research team led by Murdoch University, the Research Team has undertaken previous research on Black Cockatoos that has proven the methodology and that they can obtain spatial and temporal data on Black Cockatoo flock movement. Earlier research on Black Cockatoos has been published/ been accepted for publication in the Australian Field Ornithology Journal (Yeap et al, 2017) and in the Journal of Wildlife Management (Rycken et al, 2018). The Research Team is considered to be uniquely placed to undertake the research.
2	Provide updates on progress and key findings to the department through periodic reporting	Copies of the Interim (Jan 2020, 2021, 2022, 2023 and 2024), Annual (August 2020, 2021, 2022, 2023) and Final reports (Aug 2024) will be provided to DotEE by Grantors. A Progress Meeting will be held annually throughout the five-year research program with representatives of the Research Team, Main Roads, Talison, PTA, DotEE and the Chairs of the Carnaby's and Forest (Baudin and Red-tailed) Black Cockatoo Recovery Teams to detail key findings.
3.	Ensure the funds are managed appropriately and that auditable financial records are kept and maintained	Research funds will be managed in accordance with Murdoch University's financial policy. Auditable financial records will be kept by Murdoch University's Finance Department and by A/Professor Kirsten Warren. As and if required, financial expenditure on the Research Program may be audited by Main Roads, Talison or PTA (at the Grantor's expense) to verify expenditure of funds under the Research Proposal.

4.	Apply a 'no surprises' policy to the publication, whereby research publications and outputs are provided to the department at least 5 working days before release	Any research publications resulting from the Research Proposal will be provided by Murdoch University (through Main Roads) to DotEE at least five days prior to public release.
Research Programs		
1.	Be tailored to at least postgraduate level; however there is scope to include other educational levels in educational programs	The Research Proposal involves the employment of a Post-Doctoral Research Fellow, who will be employed from Years 1-5 and will be responsible for project management (together with A/Prof Warren), complex analysis and modelling and supervision of PhD students. There will be two PhD students: one will focus on movement ecology and habitat use by the three species, and the other will focus on movement and habitat use by Carnaby's Cockatoos at breeding sites.
2.	Present findings that can be peer reviewed.	The finding will be published in a peer reviewed, international journal. In addition, the Interim and Annual reports, and the Final Report will be provided to the Chairs of the Carnaby's Black Cockatoo and the Forest Black Cockatoo Recovery Teams. The Chairs of the Recovery Teams will also attend the Annual Progress meetings
3.	Publish findings in an internationally recognised, peer-reviewed scientific journal or be of a standard that would be acceptable for publication in such a journal. Publications should be submitted to free open-access journals. Data and information collected should have creative commons licensing and be free and accessible.	Research findings will be published in peer-reviewed, internationally recognised scientific journals, which are open source. The journals may include Movement Ecology, Conservation Biology, Pacific Conservation Biology, Wildlife Research, Ecohealth, PLoS One and the Journal of Wildlife Management. Where appropriate, or as specified by the journals, data products will be made available through repositories such as DRYAD, FigShare etc Roosting data will be provided to Birdlife Australia as part of the Great Cocky Count. Data will be provided to DotEE and other stakeholders on request
4.	Research outputs should inform future management decisions on the protected matter and, where possible, be readily applicable to other similar matters (species groupings etc).	The Research Proposal has been designed in consultation with DBCA and the Carnaby's Black Cockatoo Recovery Team and the Forest (Baudin and Red-Tailed) Black Cockatoo Recovery Team to address key priority actions for future management of the three species. This research will address and inform all six priority actions in the Carnaby's Cockatoo Recovery Plan (DEC, 2012) and seven of the 13 priority actions in the Forest (Baudin's and Red-tailed) Black Cockatoo Recovery Plan (DEC, 2007). It will provide critical data which will assist Regulators in the assessment and, where appropriate, approval of proposals across the distribution of Carnaby's Black Cockatoo, Baudin's Black Cockatoo and Forest Red-tailed Black Cockatoo.

Appendix D - Preliminary offset calculations

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

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat	Yes		**Area**	132.1	Hectares	
			Quality	**9**	Scale 0-10	
			Total quantum of impact	118.86	Adjusted hectares	
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
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

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
Ecological Communities																				
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)**									
Threatened species habitat																				
Area of habitat	Yes	118.86	Adjusted hectares	Offset Site 1 - Hill River	**Time over which loss is averted (max. 20 years)**	20	**Start area (hectares)**	219	**Risk of loss (%) without offset**	15%	**Risk of loss (%) with offset**	5%	21.90	90%	19.71	15.53	30.53	25.68%	No	$1,762,500.00	
									Future area without offset (adjusted hectares)	186.2	**Future area with offset (adjusted hectares)**	208.1								
					Time until ecological benefit	1	**Start quality (scale of 0-10)**	**9**	**Future quality without offset (scale of 0-10)**	**8**	**Future quality with offset (scale of 0-10)**	**9**	1.00	90%	0.90	0.89				
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**	**% of impact offset**	**Minimum (90%) direct offset requirement met?**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																			
Condition of habitat Change in habitat condition, but no change in extent	No																			
Threatened species																				
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

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	118.863	30.53	25.68%	**No**	$1,762,500.00	$102,263,223.70	$104,025,723.70
Area of community	0				$0.00		$0.00
					$1,762,500.00	**$102,263,223.70**	**$104,025,723.70**

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

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat	Yes		**Area**	132.1	Hectares	
			Quality	**9**	Scale 0-10	
			Total quantum of impact	118.86	Adjusted hectares	
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
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

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
Ecological Communities																				
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)**									
Threatened species habitat																				
Area of habitat	Yes	118.86	Adjusted hectares	Offset Site 2 - Gingin	**Time over which loss is averted (max. 20 years)**	20	**Start area (hectares)**	109	**Risk of loss (%) without offset**	50%	**Risk of loss (%) with offset**	5%	49.05	90%	44.15	34.78	50.69	42.64%	No	$1,762,500.00
									Future area without offset (adjusted hectares)	54.5	**Future area with offset (adjusted hectares)**	103.6								
					Time until ecological benefit	1	**Start quality (scale of 0-10)**	**9**	**Future quality without offset (scale of 0-10)**	**5**	**Future quality with offset (scale of 0-10)**	**9**	4.00	90%	3.60	3.56				
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**	**% of impact offset**	**Minimum (90%) direct offset requirement met?**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																			
Condition of habitat Change in habitat condition, but no change in extent	No																			
Threatened species																				
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

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	118.863	50.69	42.64%	**No**	$1,762,500.00	$20,968,942.17	$22,731,442.17
Area of community	0				$0.00		$0.00
					$1,762,500.00	**$20,968,942.17**	**$22,731,442.17**

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	FRTBC
EPBC Act status	Vulnerable
Annual probability of extinction Based on IUCN category definitions	**0.2%**

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
Ecological communities						
Area of community	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat	Yes		**Area**	105	Hectares	
			Quality	**6**	Scale 0-10	
			Total quantum of impact	63.00	Adjusted hectares	
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
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
Ecological Communities																				
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)**									
Threatened species habitat																				
Area of habitat	Yes	63.00	Adjusted hectares	Offset Site 2 - Gingin	**Time over which loss is averted (max. 20 years)**	20	**Start area (hectares)**	63	**Risk of loss (%) without offset**	50%	**Risk of loss (%) with offset**	5%	28.35	90%	25.52	24.52	28.10	44.60%	No	$1,762,500.00
									Future area without offset (adjusted hectares)	31.5	**Future area with offset (adjusted hectares)**	59.9								
					Time until ecological benefit	1	**Start quality (scale of 0-10)**	**8**	**Future quality without offset (scale of 0-10)**	**5**	**Future quality with offset (scale of 0-10)**	**8**	3.00	90%	2.70	2.69				
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**	**% of impact offset**	**Minimum (90%) direct offset requirement met?**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																			
Condition of habitat Change in habitat condition, but no change in extent	No																			
Threatened species																				
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	63	28.10	44.60%	**No**	$1,762,500.00	$18,098,968.12	$19,861,468.12
Area of community	0				$0.00		$0.00
					$1,762,500.00	**$18,098,968.12**	**$19,861,468.12**

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	Banksia Woodlands of the SCP TEC
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

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community	Yes		**Area**	50.07	Hectares	
			Quality	7	Scale 0-10	
			Total quantum of impact	35.05	Adjusted hectares	
Threatened species habitat						
Area of habitat	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
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

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
Ecological Communities																					
Area of community	Yes	35.05	Adjusted hectares	Offset Site 2 - Gingin	**Risk-related time horizon (max. 20 years)**	20	**Start area (hectares)**	44	**Risk of loss (%) without offset**	50%	**Risk of loss (%) with offset**	5%	19.80	90%	17.82	14.04	17.10	48.79%	No	$658,000.00	
									Future area without offset (adjusted hectares)	22.0	**Future area with offset (adjusted hectares)**	41.8									
					Time until ecological benefit	1	**Start quality (scale of 0-10)**	8	**Future quality without offset (scale of 0-10)**	5	**Future quality with offset (scale of 0-10)**	8	3.00	90%	2.70	2.67					
Threatened species habitat																					
Area of habitat	No				**Time over which loss is averted (max. 20 years)**		**Start area (hectares)**		**Risk of loss (%) without offset**		**Risk of loss (%) with offset**										
									Future area without offset (adjusted hectares)	0.0	**Future area with offset (adjusted hectares)**	0.0									
					Time until ecological benefit		**Start quality (scale of 0-10)**		**Future quality without offset (scale of 0-10)**		**Future quality with offset (scale of 0-10)**										
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**		**% of impact offset**	**Minimum (90%) direct offset requirement met?**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																				
Condition of habitat Change in habitat condition, but no change in extent	No																				
Threatened species																					
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

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	0				$0.00		$0.00
Area of community	35.049	17.10	48.79%	**No**	$658,000.00	$5,008,076.74	$5,666,076.74
					$658,000.00	**$5,008,076.74**	**$5,666,076.74**

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

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat	Yes		**Area**	132.1	Hectares	
			Quality	**9**	Scale 0-10	
			Total quantum of impact	118.86	Adjusted hectares	
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
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

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
Ecological Communities																				
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)**									
Threatened species habitat																				
Area of habitat	Yes	118.86	Adjusted hectares	Offset Site 3 - Confidential	**Time over which loss is averted (max. 20 years)**	20	**Start area (hectares)**	190	**Risk of loss (%) without offset**	15%	**Risk of loss (%) with offset**	5%	19.00	90%	17.10	13.47	25.14	21.15%	No	$1,762,500.00	
									Future area without offset (adjusted hectares)	161.5	**Future area with offset (adjusted hectares)**	180.5								
					Time until ecological benefit	1	**Start quality (scale of 0-10)**	**8**	**Future quality without offset (scale of 0-10)**	**7**	**Future quality with offset (scale of 0-10)**	**8**	1.00	90%	0.90	0.89				
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**	**% of impact offset**	**Minimum (90%) direct offset requirement met?**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																			
Condition of habitat Change in habitat condition, but no change in extent	No																			
Threatened species																				
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

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	118.863	25.14	21.15%	**No**	$1,762,500.00	$184,540,538.09	$186,303,038.09
Area of community	0				$0.00		$0.00
					$1,762,500.00	**$184,540,538.09**	**$186,303,038.09**

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	FRTBC
EPBC Act status	Vulnerable
Annual probability of extinction Based on IUCN category definitions	**0.2%**

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
Ecological communities						
Area of community	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat	Yes		**Area**	105	Hectares	
			Quality	**6**	Scale 0-10	
			Total quantum of impact	63.00	Adjusted hectares	
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
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
Ecological Communities																				
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)**									
Threatened species habitat																				
Area of habitat	Yes	63.00	Adjusted hectares	Offset Site 3 - Confidential	**Time over which loss is averted (max. 20 years)**	20	**Start area (hectares)**	190	**Risk of loss (%) without offset**	15%	**Risk of loss (%) with offset**	5%	19.00	90%	17.10	16.43	29.29	46.50%	No	$1,762,500.00
									Future area without offset (adjusted hectares)	161.5	**Future area with offset (adjusted hectares)**	180.5								
					Time until ecological benefit	1	**Start quality (scale of 0-10)**	**9**	**Future quality without offset (scale of 0-10)**	**8**	**Future quality with offset (scale of 0-10)**	**9**	1.00	90%	0.90	0.90				
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**	**% of impact offset**	**Minimum (90%) direct offset requirement met?**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																			
Condition of habitat Change in habitat condition, but no change in extent	No																			
Threatened species																				
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	63	29.29	46.50%	**No**	$1,762,500.00	$15,770,390.41	$17,532,890.41
Area of community	0				$0.00		$0.00
					$1,762,500.00	**$15,770,390.41**	**$17,532,890.41**

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	Banksia Woodlsnds of the SCP TEC
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

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community	Yes		**Area**	50.07	Hectares	
			Quality	**7**	Scale 0-10	
			Total quantum of impact	35.05	Adjusted hectares	
Threatened species habitat						
Area of habitat	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
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

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
Ecological Communities																				
Area of community	Yes	35.05	Adjusted hectares	WA Offsets Fund	**Risk-related time horizon (max. 20 years)**	20	**Start area (hectares)**	140	**Risk of loss (%) without offset**	15%	**Risk of loss (%) with offset**	5%	14.00	90%	12.60	9.93	18.52	52.85%	No	$658,000.00	
									Future area without offset (adjusted hectares)	119.0	**Future area with offset (adjusted hectares)**	133.0								
					Time until ecological benefit	1	**Start quality (scale of 0-10)**	**8**	**Future quality without offset (scale of 0-10)**	**7**	**Future quality with offset (scale of 0-10)**	**8**	1.00	90%	0.90	0.89				
Threatened species habitat																				
Area of habitat	No				**Time over which loss is averted (max. 20 years)**		**Start area (hectares)**		**Risk of loss (%) without offset**		**Risk of loss (%) with offset**									
									Future area without offset (adjusted hectares)	0.0	**Future area with offset (adjusted hectares)**	0.0								
					Time until ecological benefit		**Start quality (scale of 0-10)**		**Future quality without offset (scale of 0-10)**		**Future quality with offset (scale of 0-10)**									
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**	**% of impact offset**	**Minimum (90%) direct offset requirement met?**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																			
Condition of habitat Change in habitat condition, but no change in extent	No																			
Threatened species																				
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

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	0				$0.00		$0.00
Area of community	35.049	18.52	52.85%	**No**	$658,000.00	$3,799,385.88	$4,457,385.88
					$658,000.00	**$3,799,385.88**	**$4,457,385.88**

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Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	H. Morgan, R. Lupton	D. Farrar		D. Farrar		9/9/2019
1	H. Morgan	D. Farrar		D. Farrar		12/12/2019

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