APPENDIX C

Black Cockatoo and Banksia Woodlands TEC Assessment

Our Ref: 2123AA

04/04/2017

Kris Kennedy
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Dear Kris,

Black Cockatoo Habitat Assessment and Desktop Banksia Woodlands of the Swan Coastal Plain TEC Assessment - Lots 11 and 74 Beenyup Road, Banjup.

1. Introduction and Background

360 Environmental is pleased to provide Aigle Royal Developments with this letter report to provide information in relation to the Black Cockatoo habitat assessment and desktop Banksia Woodlands of the Swan Coastal Plain Threatened Ecological Community (BW TEC) assessment for Lots 11 and 74 Beenyup Road, Banjup (Survey Area) (Figure 1).

In February 2015, 360 Environmental undertook a level 2 flora survey and identified a total of 145 taxa from 45 families in the Survey Area (360 Environmental 2015). Of these, a number of species are considered to be Black Cockatoo habitat and others are considered to be species included in the Banksia Woodland TEC. Subsequently a Black Cockatoo habitat assessment and BW TEC desktop assessment were commissioned.

1.1. Background to Black Cockatoos

All three Black Cockatoo species that occur in the south west (this includes the Perth metropolitan area) are listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act): Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) is listed as Endangered, the Forest Red-tailed Black Cockatoo (FRTBC [*Calyptorhynchus banksii naso*]) and Baudin's Black Cockatoo (*Calyptorhynchus baudinii*) are classified as Vulnerable. All three Black Cockatoos have suffered a substantial decline in numbers and breeding distribution in the past 50 years (Johnstone & Storr 1998). Direct causes of population decline include the large numbers shot by orchardists (mainly associated with Baudin's Black Cockatoo), clearing and fragmentation of habitat (especially the loss of breeding hollows), the impact of hollow competitors including the Galah (*Cacatua roseicapilla*), corellas including Butler's Corella (*Cacatua pastinator butleri*), Australian Shelduck (*Tadorna tadornoides*), Australian Wood Duck (*Chenonetta jubata*), the feral European honey bee (*Apis mellifera*), and also vehicle strikes. Around 60% of the original vegetation on the Swan Coastal Plain has been cleared and up to 85% in other parts of the south-west region for agriculture (crops), meat production, dairying, farms, orchards, vineyards, pine plantations, mining, timber and wood chipping, cities and towns. At present, extensive tracts of uncleared land only remain in State forest and conservation reserves and what is left of remnant vegetation (in roadside verges etc.) is often disturbed to a varying degree (Johnstone & Kirkby 2011).

The south-west region is now a severely fragmented landscape and the further loss of foraging habitat, the lack of suitable breeding sites, climate change, and alterations in the landscape led to significant changes in forest structure. Almost every part of the Jarrah-Marri forest has been logged in the past, and most present day trees are too young to form hollows, and competition with exotic species, exacerbate the future conservation of Carnaby's Black Cockatoo, FRTBC's and Baudin's Black Cockatoo (Johnstone & Kirkby 2011).

The distribution of all three Black Cockatoo species can be seen in the 2014 Department of the Environment and Energy (DEE) distribution maps in Appendix A. The Survey Area is within the known distribution of Carnaby's Black Cockatoo and FRTBC; however, it is on the western extremity of Baudin's Cockatoo. Nevertheless, all three species of Black Cockatoo have been included for consideration in this document, particularly given that they are all highly mobile and the DEE distribution maps are indicative only. In addition there is some difficulty in distinguishing between Carnaby's Black Cockatoo and Baudin's Black Cockatoo, particularly when on the wing, therefore it advisable to include both species.

1.2. Background to BW TEC

BW TEC was listed (16 September 2016) as an Endangered community under the EPBC Act. A Level 2 flora and vegetation assessment of the Survey Area was undertaken prior to this listing (360 Environmental 2015), thus determination of whether the BW TEC is present in the Survey Area needed to be determined.

The BW TEC is restricted to the Swan Coastal Plain Interim Biogeographic Regionalisation for Australia (IBRA) and immediate adjacent areas. These include the Dandaragan plateau from Jurien Bay in the North, to Dunsborough in the South, and north/east on the Whicher and Darling Escarpments. The BW TEC typically has a prominent tree layer of Banksia species with scattered Eucalypts and other tree species present within or emerging above the Banksia canopy with a species rich understorey.

Key diagnostic characteristics and condition thresholds are used to determine whether a remnant of BW TEC when being surveyed. These are: location and physical environment, structure, composition and condition. Other parameters also include minimum patch size, cover of native species and native plant species diversity.

2. Objectives

The objective of the Black Cockatoo habitat assessment was to:

- Identify and determine the type and extent of habitat (breeding and foraging) suitable for Black Cockatoos in the Survey Area with reference to the EPBC Act referral guidelines for three threatened Black Cockatoo species (DSEWPaC 2012).

The objective of the BW TEC assessment was to:

- Compare and analyse the existing Level 2 flora and vegetation survey data with the key diagnostic characteristics and condition thresholds of the BW TEC to determine if the banksia woodlands in the Survey Area would be considered favourable for National protection.

3. Methods

3.1. Black Cockatoo Habitat Assessment

This Black Cockatoo habitat assessment was undertaken on 9 February 2017. The assessment involved traversing the Survey Area on foot; any trees meeting each of the

following criteria for potential breeding were recorded and electronically logged using a hand held Global Positioning System (GPS) unit:

- Native trees (e.g. [Marri [*Corymbia calophylla*], Jarrah [*Eucalyptus marginata*], Tuart [*E. gomphocephala*] etc.);
- Diameter at breast height (DBH) > 500 mm (>300 mm for Wandoo [*E. wandoo*] and Salmon [*E. salmonophloia*] Gum) regardless of the presence or absence of hollows;
- Trees were placed in the following size class categories:
  - A = 500 – 1000 mm DBH
  - B = 1000 – 2000 mm DBH
  - C = >2000 mm DBH

The Black Cockatoo habitat assessment involved assessing the habitat for tree and shrub species known to be important dietary items e.g. Marri and *Banksia sp*. It also included looking for:

- Evidence of feeding (chewed cones, seed and nut material); and
- Opportunistic observations of Black Cockatoos in the Survey Area.

3.2. TEC Assessment

The results of the statistical (multivariate) analysis and data interpretation from the Level 2 flora and vegetation report (360 Environmental 2015) were used to determine which areas of the Survey Area are sub-communities of the BW TEC. The mapping of condition and vegetation association boundaries was overlaid to determine the amount of banksia woodland for each condition category.

4. Results

4.1. Black Cockatoos

During the Black Cockatoo habitat assessment, no Black Cockatoos were observed flying over or heard in the Survey Area.

4.1.1. Potential Breeding Trees

Two species of Eucalypts, Jarrah and Flooded Gum (*E. rudis*) recorded in the Survey Area are considered Black Cockatoo potential breeding habitat. The current Survey Area contains 19 potential breeding trees with a DBH of more than 500 mm (Jarrah [11] and

Flooded Gum [8]). The dimensions and the locations of these 19 potential breeding trees are displayed in Table 1 and Figure 2.

No hollows observed from the ground were considered to be large enough at the entrances (i.e. >100 mm) or deep enough to be considered as potential breeding hollows.

Table 1: Black Cockatoo Potential Breeding Trees

*Co-Ordinates are in UTMs (GDA 94)

No.	Species	DBH	Height (M)	*Easting	*Northing	Comments
1	Jarrah	B	12	0393358	6441096	Stag, lots of fallen branches
2	Jarrah	A	12	0393384	6441087	Stag
3	Jarrah	A	10	0393444	6441095	Stag
4	Jarrah	A	12	0393471	6441009	
5	Jarrah	A	12	0393480	6441025	Stag
6	Jarrah	A	12	0393480	6441025	Stag
7	Jarrah	A	12	0393500	6441001	Shallow hollow
8	Jarrah	A	14	0393367	6441084	Splits at 4m
9	Jarrah	A	15	0393537	6441295	
10	Flooded Gum	A	17	0393565	6441205	
11	Flooded Gum	A	17	0393565	6441205	
12	Flooded Gum	A	16	0393549	6441201	
13	Flooded Gum	A	16	0393528	6441200	
14	Flooded Gum	A	16	0393567	6441189	
15	Flooded Gum	A	16	0393567	6441197	
16	Flooded Gum	A	16	0393567	6441197	
17	Flooded Gum	A	17	0393575	6441198	5 branches
18	Jarrah	A	14	0393065	6441270	
19	Jarrah	A	8	0393055	6441288	

4.1.2. Foraging Habitat

During the assessment a total of 14.73 ha of foraging habitat was identified.

Two species of Eucalypts recorded in the Survey Area; Jarrah and Flooded Gum are known dietary items of Black Cockatoos and as such are considered foraging habitat. This foraging habitat includes trees that are also potential breeding trees with a DBH of >500 mm (see Table 1 on the previous page). Other known foraging species present in the Survey Area included *Banksia attenuata*, *B. menziesii*, *B. ilicifolia*, *Allocasuarina fraseriana* and *Xanthorrhoea preissii*. These species are important foraging habitat for all three species of Black Cockatoo.

A small quantity of foraging evidence was found in the form of chewed Banksia cones and chewed Allocasuarina nuts (Plates 1 and 2).

Plate 1: Black Cockatoo Foraging Evidence - Chewed Banksia Cones

Plate 2: Black Cockatoo Foraging Evidence - Chewed Allocasuarina Nuts

4.2. Threatened Ecological Community

4.2.1. Vegetation Associations

Thirteen natural vegetation associations were recorded in the Survey Area. Descriptions of these are provided in Table 2.

Table 2: Vegetation Association Descriptions and their Extent in the Survey Area.

Vegetation Association Code	Description	Area (ha)
BaBm(a)	Low Woodland of *Banksia attenuata, Banksia menziesii, Allocasuarina fraseriana, Eucalyptus marginata* over *Kunzea glabrescens, Acacia pulchella, Hibbertia hypericoides, Xanthorrhoea preissii, Bossiaea eriocarpa* and *Conostylis aculeata*.	2.42
BaBm(b)	Low Woodland of *Banksia attenuata, Banksia menziesii, Allocasuarina fraseriana* over *Kunzea glabrescens, Dasypogon bromeliifolius, Hibbertia subvaginata, Calytrix fraseri* and *Bossiaea eriocarpa*.	4.37
AfEmBi	Open Woodland of *Allocasuarina fraseriana*, *Eucalyptus marginata* and *Banksia ilicifolia* over *Xanthorrhoea preissii*, *Dasypogon bromeliifolius*, *Bossiaea eriocarpa*, *Gompholobium tomentosum* and *Phlebocarya ciliata.*	1.47
BiKg	Woodland of *Banksia ilicifolia* and *Banksia attenuata* over *Kunzea glabrescens*, *Xanthorrhoea preissii*, *Dasypogon bromeliifolius* and *Desmocladus flexuosus*.	1.12
ErMp	Woodland of *Eucalyptus rudis* and *Melaleuca preissiana* over *Kunzea glabrescens, Xanthorrhoea preissii, Adenanthos cygnorum* and *Hypocalymma angustifolium*.	1.14
KgHa	Low Open Woodland of *Melaleuca preissiana* and *Melaleuca rhaphiophylla* over *Kunzea glabrescens, Hypocalymma angustifolium, Astartea scoparia, Melaleuca teretifolia, Meeboldina scariosa* and *Lepidosperma longitudinale.*	3.32
MpKg	Low Open Woodland of *Melaleuca preissiana* over *Kunzea glabrescens, Hakea varia, Acacia pulchella* var. *glaberrima, Calothamnus lateralis* var. *lateralis* and *Meeboldina coangustata*.	2.86
MrBa	Low Closed Forest of *Melaleuca rhaphiophylla* over *Baumea articulata*.	2.80
MtMr	*Closed Tall Scrub of Melaleuca teretifolia, Melaleuca rhaphiophylla, Meeboldina coangustata and Juncus capitatus.*	1.24

Vegetation Association Code	Description	Area (ha)
MrMl	*Low Woodland of Melaleuca rhaphiophylla over Melaleuca lateritia, Astartea scoparia, Meeboldina coangustata, Lepidosperma longitudinale and Juncus pallidus.*	3.64
Ec	Ecotone of *Banksia ilicifolia* and *Banksia menziesii* over *Kunzea glabrescens, Dasypogon bromeliifolius* and *Phlebocarya ciliata.*	0.8
Ha	Closed Heath of *Hypocalymma angustifolium, Kunzea glabrescens, Dielsia stenostachya, Dasypogon bromeliifolius* and *Boronia crenulata* var. *crenulata.*	7.64
Mr	Monoculture of young *Melaleuca rhaphiophylla* over water.	0.47

4.2.2. Floristic Community Types

The quadrat data was tested for similarity against each of the 509 Gibson *et al.* 1994 quadrats that were established as part of a regional study to describe the vegetation types present on the Swan Coastal Plain in 1994. Results from the statistical analysis and the site information, identified six Floristic Community Types (FCTs) as occurring in the Survey Area (Appendix B).

4.2.3. Threatened and Priority Ecological Communities

Vegetation association BaBm(a) has been determined to have affiliation with FCT SCP23a, AfEmBi has been determined to have affiliation with FCT 21a and BiKg and BaBm(b) have been determined to have affiliation with FCT 21c. These FCTs are listed as sub-communities of the BW TEC. The vegetation association Ec is an Ecotone of *Banksia ilicifolia* and *Banksia menziesii* over *Kunzea glabrescens, Dasypogon bromeliifolius* and *Phlebocarya ciliata*. This community is an ecotone between the drier BaBm association and the wetland. Even though the association is a mix of both dry land and wetland species, it has been included in the analysis due to the presence of Banksia species.

TECs and their associated buffers are regarded as Environmentally Sensitive Areas (ESAs).

4.2.4. Vegetation Condition

The condition of the vegetation associations BaBm (a&b), AfEmBi, BiKg and Ec varies greatly from Excellent to Good to Degraded (Table 4). There are areas considered high in diversity, however, there are pockets where the understory is low in both diversity and density and is weed infested.

Table 3: Vegetation Condition of Associations with Banksia Species

Condition	Area (ha)	Vegetation Association
Good - Degraded	0.56	BaBm (A), BiKg
Good	4.65	AfEmBi, BaBm (A), BaBm (B)
Very Good - Good	0.79	AfEmBi
Excellent - Very Good	2.94	AfEmBi, BiKg, Ec, BaBm (B)
Excellent	1.21	BaBm (A)

5. Discussion

5.1. Black Cockatoo Potential Breeding Habitat

Black Cockatoos breed in large hollow-bearing trees, generally within woodlands or forests (Johnstone *et al.* 2013). The size of the tree can be a useful indication of the hollow-bearing potential of the tree. Trees of suitable DBH are potentially important for maintaining breeding in the long-term, through maintaining the integrity of the habitat and allowing trees to provide future nest hollows. Maintaining the long-term supply of trees of a size to provide suitable nest hollows is particularly important in woodland stands that are known to support Black Cockatoo breeding (DSEWPaC 2012). Hollow formation in trees (in Eucalypt woodlands and forests) is a result of a number of processes including fungal attack, termites and fire and the propensity for hollow formation varies between the Eucalypt species (Whitford 2002).

During the Black Cockatoo habitat assessment 19 trees (Jarrah [11] and Flooded Gum [8]) were recorded in the Survey Area that have reached a size that are considered to be potential future hollow bearing trees, therefore potential breeding trees (>500 mm DBH [>300 mm for Wandoo]) according to the EPBC Act Black Cockatoo referral guidelines. No observable hollows were recorded in these trees in the Survey Area.

There were other Jarrah and Flooded Gum trees that are considered foraging habitat, however, they were under the threshold of 500 mm to be considered as potential breeding trees.

5.2. Black Cockatoo Foraging Habitat

Carnaby's Black Cockatoos feed on a variety of seeds, nuts and flowers from a range of native and exotic plants. Food plants include a number of Banksia species, Pine trees

(*Pinus* sp.), Marri, Jarrah and Allocasuarina, (Shah 2006; Johnstone & Storr 1998). The FRTBC feeds primarily on Marri and Jarrah fruit (Johnstone & Kirkby 1999; Cooper et al. 2002) which makes up 90% of the diet. Baudin's Black Cockatoo forages primarily in Eucalypt forest, where it feeds on Marri seeds, flowers, nectar and buds. They also feed on a wide range of seeds from other Eucalypt and Banksia species, and Pines (*Pinus* sp.) (Johnstone & Storr 1998).

The total area of Black Cockatoo foraging habitat present in the Survey Area is 14.73 ha. This foraging habitat consisted of Jarrah, Flooded Gum, *B. attenuata, B. menziesii, B. ilicifolia, A. fraseriana* and *X. preissii*. These species are known dietary items of all three Black Cockatoo species (Johnstone & Kirkby 2011).

5.3. BW TEC

The BW TEC is considered to occur in the Survey Area. A key diagnostic feature is a prominent tree layer of Banksia, with scattered Eucalypts and other tree species often present among the Banksia canopy. To determine if the BW TEC is present in the Survey Area, the results of the statistical analysis from the 2015 survey were compared to the list of sub-communities which were drawn from the FCT descriptions outlined in Gibson *et al.* (1994), Government of WA (2000) and Keighery *et al.* (2008).

The statistical analysis resulted in:

- BaBm(a) being most simular to SCP23a;
- AfEmBi being most simular to FCT 21a; and
- BiKg and BaBm(b) being most simular to FCT 21c.
- Vegetation association Ec has also been included due to the presence of Banksia species.

These FCTs have been listed as sub-communities under the EPBC Act listed BW TEC (DEE 2016). The vegetation associations BaBm(a), AfEmBi, BiKg, BaBm(b) and Ec are therefore considered to be the BW TEC. For vegetation remnants to be under full national protection the community has to meet key diagnostic characteristics. In regards to the presence of the TEC, the Approved Conservation Advice for the thresholds state that:

- Vegetation in Excellent Condition should have a minimum patch size of 0.5 ha;
- Vegetation in Very Good condition should be a minimum of 1 ha; and
- Vegetation in Good condition should be a minimum of 2 ha.

If a vegetation patch is considered Degraded or worse it is not considered favourable for national protection.

Based on this information, and the survey results, the vegetation in Good – Degraded condition is not suitable for National protection based on the size and condition thresholds. Vegetation mapped as Good, Good – Very Good, Excellent – Very Good and Excellent are considered suitable for National protection. Therefore, the vegetation considered to represent the BW TEC in the Survey Area equates to 9.59 ha (Figure 3).

6. References

360 Environmental (2015). Level 2 Flora and Vegetation Survey, Beenyup Road, Aigle Royal Developments.

Cooper, C. E., Withers, P. C., Mawson, P. R., Bradshaw, S. D., Prince, J., & Robertson, H. (2002). Metabolic ecology of cockatoos in the south-west of Western Australia. Australian Journal of Zoology 50, 67–76.

Department of Sustainability, Environment, Water, Populations and Communities (DSEWPaC) (2012). EPBC Act referral guidelines for three threatened black cockatoo species.

Gibson, N., Keighery, B., Keighery, G., Burbidge, A., & Lyons, M. (1994). A Floristic Survey of the Southern Swan Coastal Plain. Unpublished report for the Australian Heritage Commission. WA Department of Conservation and Land Management and the Western Australian Conservation Council of WA.

Government of Western Australia. (2000). Bush Forever: Volume 1: Policies, Principles and Processes. Perth: Department of Environmental Protection.

Johnstone, R. E. & Storr, G. M. (1998). *Handbook of Western Australian Birds*. Volume 1 - Non-Passerines (Emu to Dollarbird). Oxford University Press.

Johnstone, R. E., & Kirkby, T. (1999). Food of the forest red-tailed black cockatoo Calyptorhynchus banksii naso in south-west Western Australia. *Western Australian Naturalist* **22**, 167–177.

Johnstone, R. E, & Kirkby, T. (2011). Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*), Baudin's Black Cockatoo (*Calyptorhynchus baudinii*) and the Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) on the Swan Coastal Plain (Lancelin–Dunsborough), Western Australia. Studies on distribution, status, breeding, food, movements and historical changes. Perth: Department of Planning.

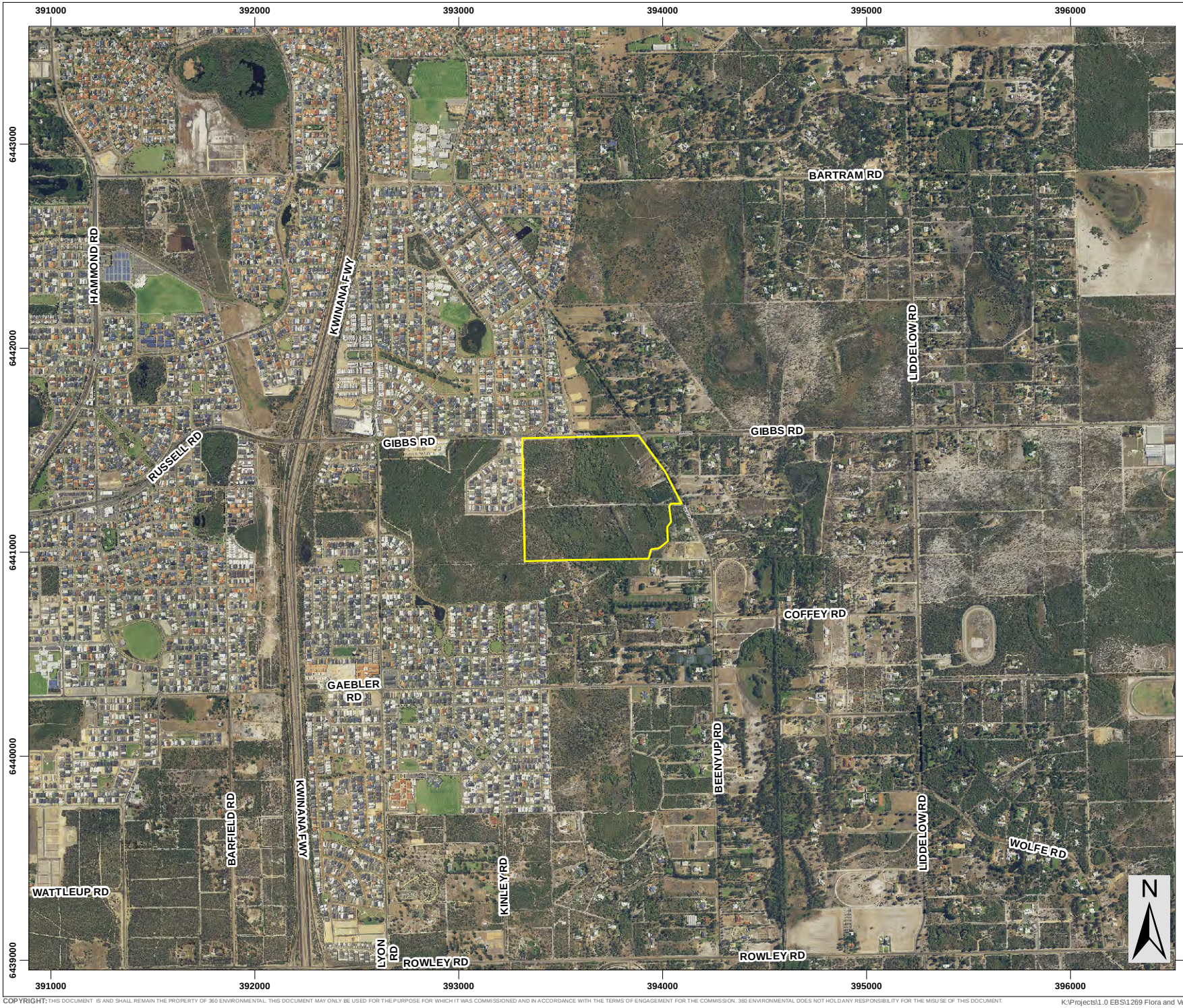
Johnstone, R. E., Kirkby, T., & Sarti, K. (2013). The breeding biology of the Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso* Gould in south-western Australia. I. Characteristics of nest trees and nest hollows. *Pacific Conservation Biology* **19**, 121-142.

Keighery, B.J., Keighery G.J., Webb A., Longman V.M., and Griffin E.A. (2008. A floristic survey of the Whicher Scarp. Department of Environment and Conservation, Perth.

Whitford, K.R. (2002. Hollows in Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*) trees I. Hollow sizes, tree attributes and ages. *Forest Ecology and management* 160, 201-214.

Shah, B. (2006). Conservation of Carnaby's Black Cockatoo on the Swan Coastal Plain, Western Australia. Perth: Birds Australia.

FIGURES



Legend

- Survey Area
- Roads

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Meters
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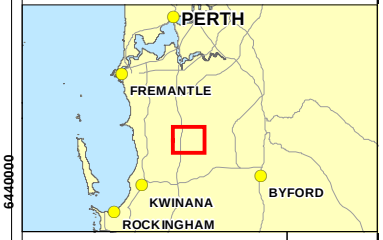
LOCALITY MAP



PROJECT ID	2123	DATE	13/12/2017

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
CS	NW	TS	0

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Beenyup Road, Banjup

Black Cockatoo & TEC Assessment

Figure 1 -
Survey Area

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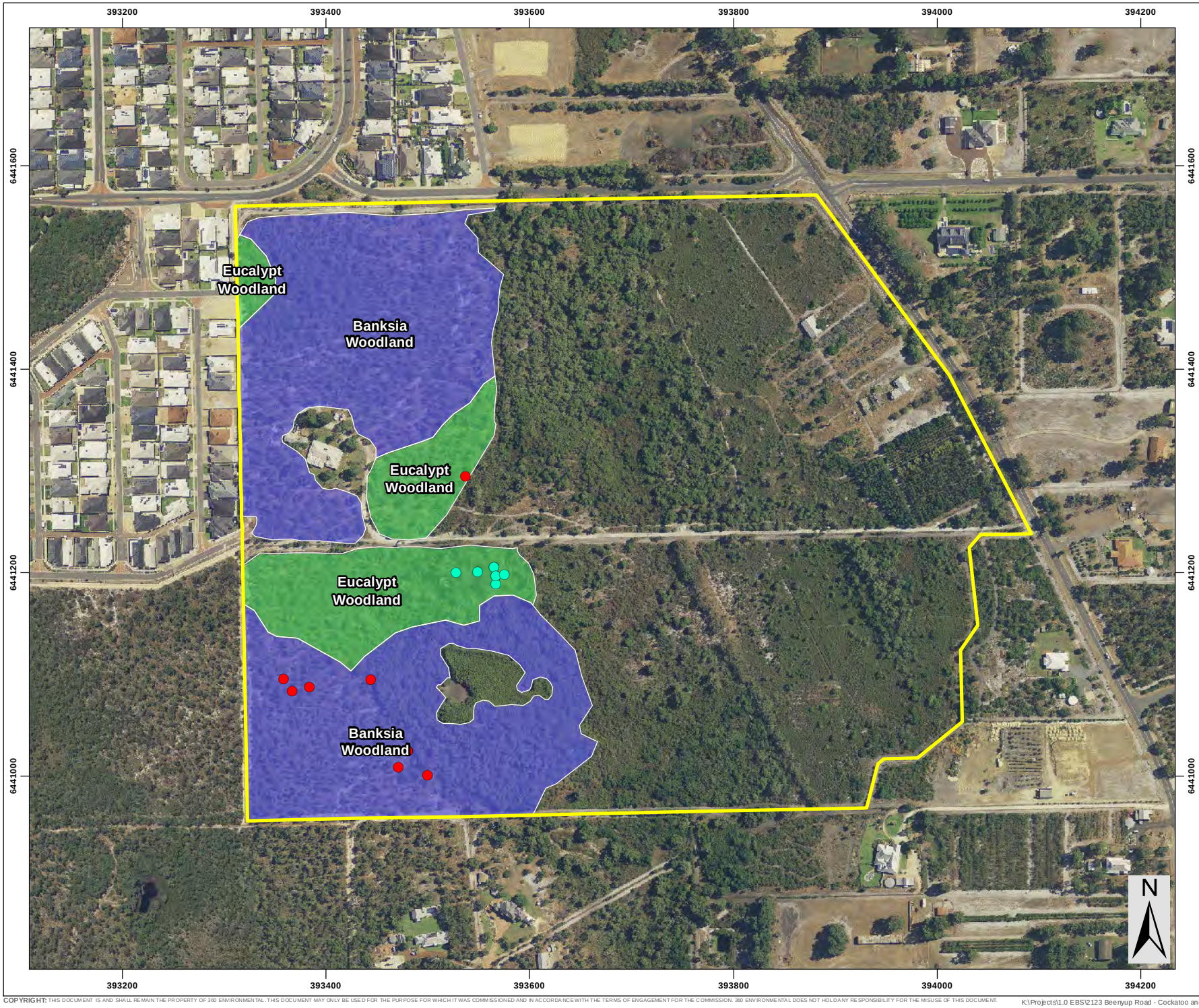

Legend

- Survey Area (41.4 ha)

Potential Breeding Trees

- Flooded Gum
- Jarrah

Fauna Habitat

- Banksia Woodland (11.26 ha)
- Eucalypt Woodland (3.47 ha)

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LOCALITY MAP

PROJECT ID	DATE
2123	21/02/2017

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
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Black Cockatoo Habitat Assessment

Figure 2 -
Black Cockatoo Habitat

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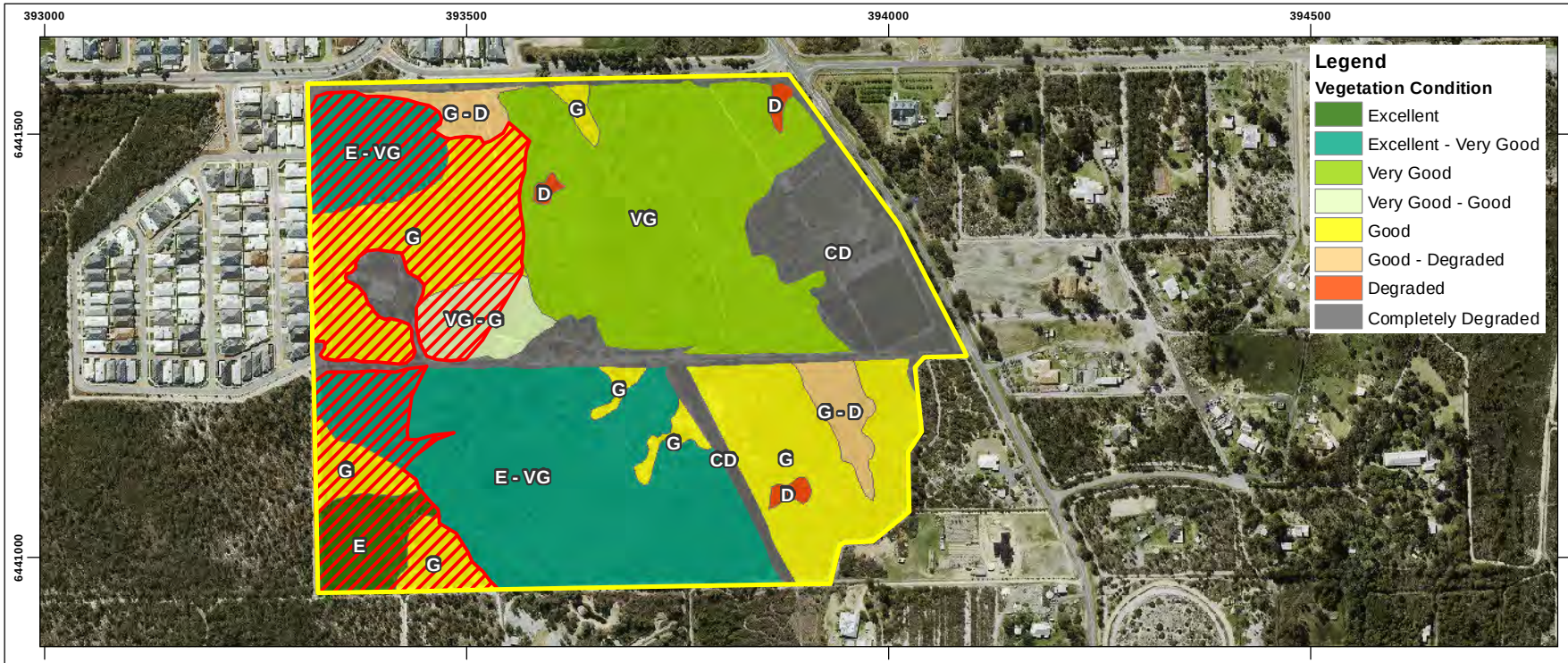

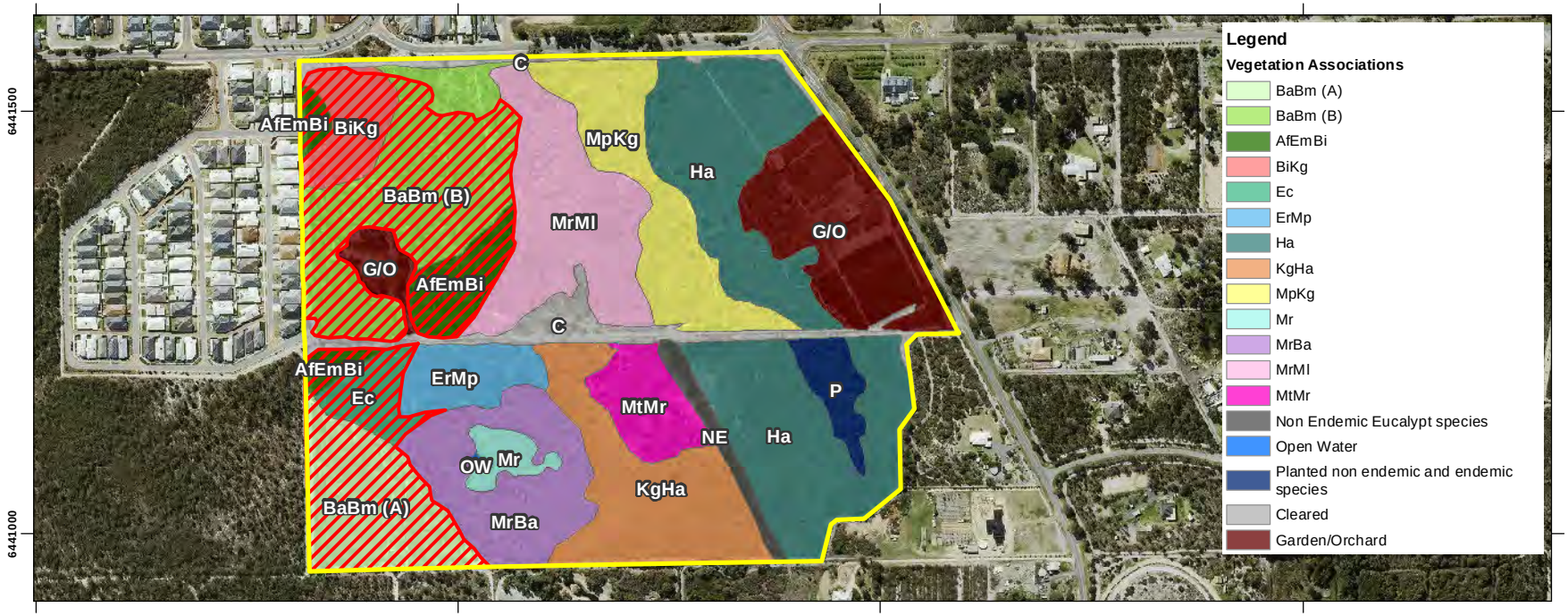

Legend

Survey Area

Banksia TEC

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- LOCALITY MAP SOURCED LANDGATE 2006
- CADASTRE SOURCED FROM LANDGATE 22 DEC 2015
- AERIAL PHOTOGRAPHY SOURCED LANDGATE SEPT 2015
(© Western Australian Land Information Authority 2015)

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LOCALITY MAP

PROJECT ID	DATE
2123	21/02/2017

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
MH	NW	RF	0

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Beenup Road, Banjup

Black Cockatoo Habitat and TEC Assessment

Figure 3

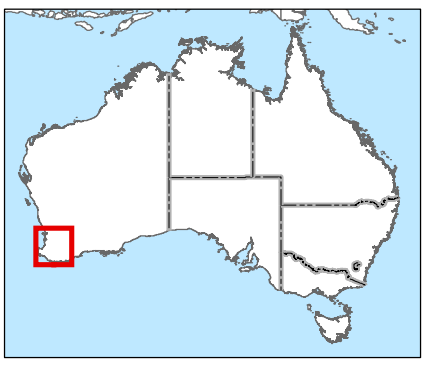
TEC Boundary Location

APPENDIX A

DEE Black Cockatoo Distribution Maps

Map 1: Modelled distribution of Baudin's black cockatoo (*Calyptorhynchus baudinii*)

INDICATIVE MAP ONLY: For the latest departmental information, please refer to the Protected Matters Search Tool at www.environment.gov.au/epbc/index.html



0 20 40 60 80 100 km

Australian Government

Department of Sustainability, Environment, Water, Population and Communities

Produced by: Environmental Resources Information Network (ERIN)

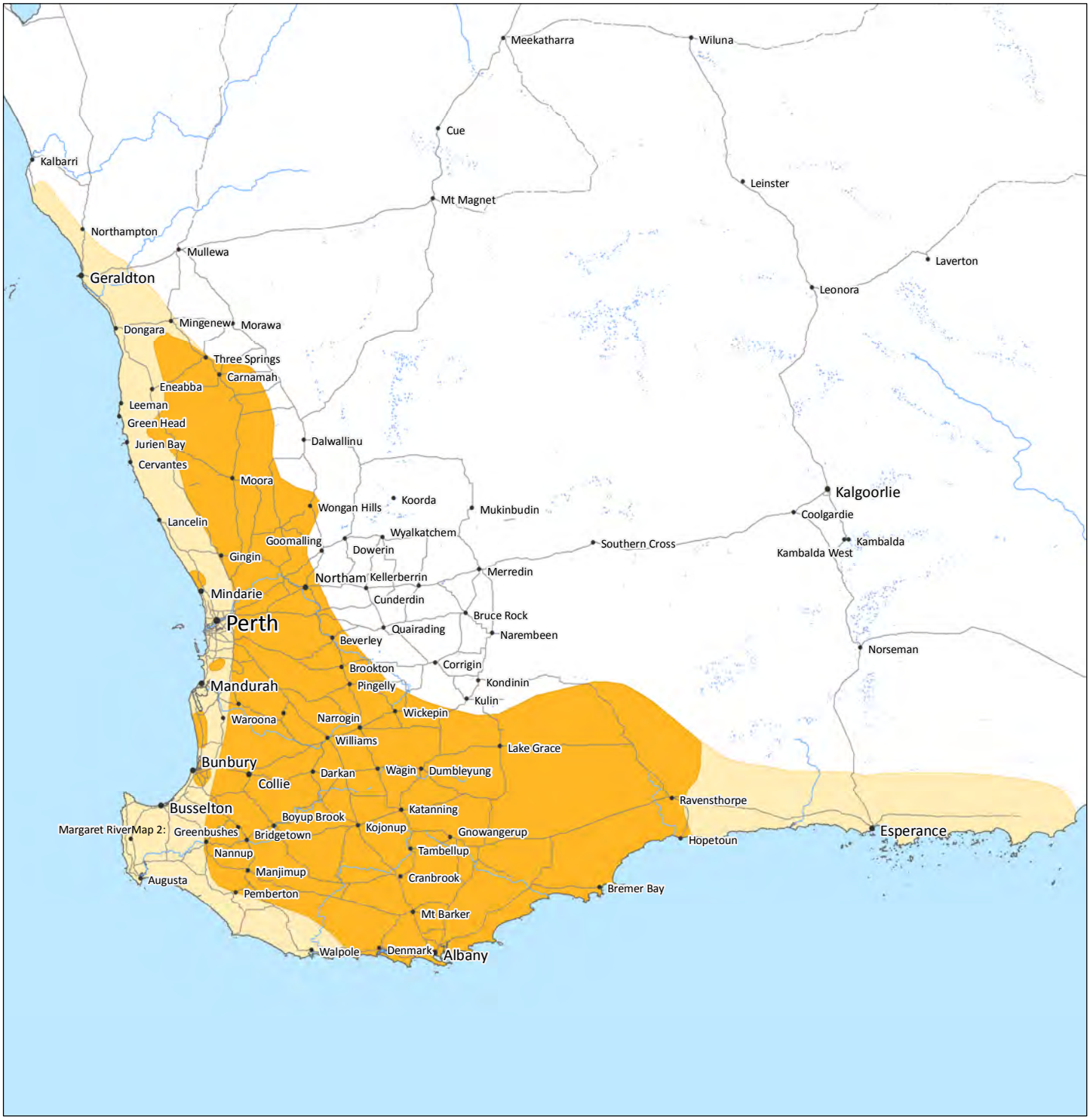
Contextual data sources:
DEWHA (2006), Collaborative Australian Protected Areas Database
Geoscience Australia (2006), Geodata Topo 250K Topographic Data

Legend

- Known Breeding Areas
- Predicted Breeding Range
- Main Wintering Area
- Species May Occur
- Cities & Towns
- Roads
- Major Rivers
- Lakes

Please Note: Known breeding areas represent locations known to be used by birds for breeding as at December 2009. As habitat has been lost in traditional breeding areas, birds have begun breeding at new locations.

Map 2: Modelled distribution of Carnaby's black cockatoo (*Calyptorhynchus latirostris*)



INDICATIVE MAP ONLY: For the latest departmental information, please refer to the Protected Matters Search Tool at www.environment.gov.au/epbc/index.html

0 50 100 150 200 250 km

Australian Government

Department of Sustainability, Environment, Water, Population and Communities

Produced by: Environmental Resources Information Network (ERIN)

Contextual data sources:
DEWHA (2006), Collaborative Australian Protected Areas Database
Geoscience Australia (2006), Geodata Topo 250K Topographic Data

Legend

- Breeding Range
- Non-breeding Range
- Cities & Towns
- Roads
- Major Rivers
- Lakes

Please Note: The breeding range represents the areas known to be used by birds for breeding as at December 2009. As habitat has been lost in traditional breeding areas, birds have begun breeding at new locations.

Map 3: Modelled distribution of forest red-tailed black cockatoo (*Calyptorhynchus banksii naso*)

INDICATIVE MAP ONLY: For the latest departmental information, please refer to the Protected Matters Search Tool at www.environment.gov.au/epbc/index.html

0 20 40 60 80 100 km

Australian Government

Department of Sustainability, Environment, Water, Population and Communities

Produced by: Environmental Resources Information Network (ERIN)

Contextual data sources:
DEWHA (2006), Collaborative Australian Protected Areas Database
Geoscience Australia (2006), Geodata Topo 250K Topographic Data

Legend

- Species May Occur
- Cities & Towns
- Roads
- Major Rivers
- Lakes

APPENDIX B

Floristic Community Types Analysis

Floristic Community Type Analysis

Vegetation Association	Gibson *et al.* Quadrat & FCT	Similarity Based on Statistical Analysis	Comments	Inferred Floristic Community Type
BJQ1 (BaBm[a])	CRES01 (FCT SCP 23a)	55.0	The top three results in the analysis were SCP23a. This result seems appropriate given the species present and the location of the community on the higher dunes of the Survey Area.	FCT SCP23a – Central *Banksia attenuata* – *B. menziesii* woodlands
	BANK-3 (FCT SCP 23a)	54.7		
	YULE-2 (FCT SCP 23a)	53.7		
BJQ2 (MrBa)	Chid06 (FCT SCP s17)	50	This quadrat was characterised by large mature *Melaleuca preissiana* over either sedges or exposed soil which had evidence of inundation.	FCT SCP13 – Deeper wetlands on heavy soils
	White04 (FCT SCP s17)	35.2		
	WN020 (FCT SCP s19)	30.7		
BJQ3 (MrBa)	HYMUS05 (FCT SCP 11)	28.5	The association had both *Melaleuca preissiana* and *M. rhaphiophylla* with an open understorey which showed signs of being inundated.	FCT SCP13 – Deeper wetlands on heavy soils
	HYMUS01 (FCT SCP 11)	25.8		
	CAVS06 (FCT SCP s07)	25.8		
BJQ4 (Mr)	MTB-5 (FCT SCP 17)	25	This quadrat was established in the core of the wetland and was still inundated with water to approximately 30 cm, consisting of only *Melaleuca preissiana*.	FCT SCP13 – Deeper wetlands on heavy soils
	CHID06 (FCT SCP 17)	22.2		
	WATER-2 (FCT SCP 13)	20		
BJQ5 (KgHa)	CHID06 (FCT SCP 17)	36.3	This association was characterised by high	FCT SCP5 – Mixed shrub

Vegetation Association	Gibson *et al.* Quadrat & FCT	Similarity Based on Statistical Analysis	Comments	Inferred Floristic Community Type
	PINJ02 (FCT SCP s03)	32.2	density wetland shrubs with scattered *Melaleuca preissiana* and *M. rhaphiophylla*. It is more analogous to SCP5 rather than SCP4. This is based on the low diversity of the dense shrub layer.	damplands
	GOSN05 (FCT SCP s03)	29.6		
BJQ6 (MtMr)	McLART-1 (FCT SCP 13)	35.7	This quadrat consisted of dense wetland shrubs and sedges with scattered *Melaleuca rhaphiophylla.*	**FCT SCP5** – Mixed shrub damplands
	ELLIS-1(FCT SCP 17)	29.6		
	CAPEL-9 (FCT SCP 12)	28.5		
BJQ7 (AfEmBi)	ELE33 (FCT SCP 4)	48.1	Regardless of the analysis results that indicate a higher similarity with SCP4, because of the presence of more dry land species and the dominance of *Allocasuarina fraseriana* and *Eucalyptus marginata* it is thought to be more similar with SCP21a.	**FCT SCP21a** – Central *Banksia attenuata* – *E. marginata* woodlands
	MODO-2 (FCT SCP 21c)	44.8		
	ELE04 (FCT SCP 21a)	42.1		
BJQ8 (Ha)	TWIN-1 (FCT SCP 6)	34.4	This association had been historically cleared and is now natural regrowth with very low diversity.	**FCT SCP5** – Mixed shrub damplands
	PINJ13 (FCT	33.3		

Vegetation Association	Gibson *et al.* Quadrat & FCT	Similarity Based on Statistical Analysis	Comments	Inferred Floristic Community Type
	SCP s17)		Due to the lack of upper- storey species, it is most analogous to SCP5.	
	AUSTB-4 (FCT SCP 5)	30		
BJQ9 (MrMl)	McLART-1 (FCT SCP 13)	31.25	Due to the dominance of *Melaleuca preissiana* and *M. rhaphiophylla* along with the typical understorey species it is thought that this association is more similar to SCP4. The area also did not appear to be subject to deep inundation in the winter months due to the species and ground litter present.	FCT SCP4 - *Melaleuca preissiana* damplands
	LESCH-6 (FCT SCP 17)	27.7		
	BEEL03 (FCT SCP 11)	27.5		
BJQ10 (BiKg)	LOW07 (FCT SCP 21c)	52.1	The analysis indicated that BJQ10 is most similar to SCP21c, given the species present, and the location of the association in the landscape SCP21c.	FCT SCP21c – Low Lying *Banksia attenuata* woodlands or shrublands
	MODO-2 (FCT SCP 21c)	48.3		
	GOSN13 (FCT SCP 23a)	46.6		
BJQ11 (MrMl)	WHITE08 (FCT SCP 21a)	33.3	Due to the dominance of *Melaleuca preissiana* and *M. rhaphiophylla* along with the typical understorey species	FCT SCP4 - *Melaleuca preissiana* damplands
	GOSN05 (FCT SCP s03)	28.5		

Vegetation Association	Gibson *et al.* Quadrat & FCT	Similarity Based on Statistical Analysis	Comments	Inferred Floristic Community Type
	McLART-1(FCT SCP 13)	28.5	it is thought that the association is more analogous to SCP4. The area also did not appear to be subject to deep inundation in the winter months.	
BJQ12 (BaBm[b])	FL-5 (FCT SCP 21c)	55	The analysis showed that BJQ10 is most similar to SCP21c. This is due to the species present and the location of the association in the landscape. .	**FCT SCP21c** – Low Lying *Banksia attenuata* woodlands or shrublands
	ELE02 (FCT SCP 21c)	49.3		
	HURST03 (FCT SCP 23a)	49.0		
BJQ13 (MpKg)	McLART-1 (FCT SCP 13)	36.3	Due to the dominance of *Melaleuca preissiana* along with the typical understorey species it is thought that the association is more similar to SCP4. The association is not part of the core wetland and did not appear to be subject to deep inundation in the winter months due to the species and ground litter present.	**FCT SCP4** - *Melaleuca preissiana* damplands
	WHITE08 (FCT SCP s17)	34.0		
	GOS05 (FCT SCP s03)	30.3		
BJQ14 (Ha)	PERTH10 (FCT SCP 4)	44.0	The location of this association had been historically disturbed and consequently has low diversity.	**FCT SCP5** – Mixed shrub damplands
	GUTHR-4 (FCT	36.6		

Vegetation Association	Gibson *et al.* Quadrat & FCT	Similarity Based on Statistical analysis	Comments	Inferred Floristic Community Type
	SCP 5)		Due to the lack of upper- storey species and in its present state it is most analogous with SCP5.	
	GOSN01 (FCT SCP 4)	34.9		
BJQ15 (BaBm[a])	HURST03 (FCT SCP 23a)	50.9	The top two results in the analysis were for SCP23a, this result seems appropriate given the species present and the location of the community on the higher dunes of the Survey Area.	FCT SCP23a – Central *Banksia attenuata* – *B. menziesii* woodlands
	CRESW01 (FCT SCP 23a)	49.4		
	CAVS11 (FCT SCP 21a)	49.4		