EPBC ACT REFERRAL 2017/8119

MUCHEA INDUSTRIAL PRECINCT

Title of Proposal - Muchea Industrial Precinct, Part of Lot 102 Great Northern Highway, Muchea, WA

Section 1 - Summary of your proposed action

Provide a summary of your proposed action, including any consultations undertaken.

1.1 Project Industry Type

Commercial Development

1.2 Provide a detailed description of the proposed action, including all proposed activities.

Sirona Capital Pty Ltd (the proponent) propose to develop a 127 ha portion of Lot 102 Great Northern Highway, Muchea (herein referred to as ‘the site’ or ‘the proposed action’) for industrial land uses. The site is located within the Shire of Chittering (SoC) local government area.

In conjunction with the SoC, the proponent has now progressed the necessary local and state planning approvals to enable industrial development within the site. The location of the site is shown in Figure 1 (note that all figures are provided in Attachment A). Whilst the majority of the site has been historically cleared to support former land uses, some vegetation remains within the site including scattered mature paddock trees and isolated stands of remnant vegetation.

To facilitate industrial development of the site, the following activities will be required:
• Bulk earthworks, including the importation of fill across the site to achieve suitable separation to maximum groundwater levels and the alteration of the current road network.
• Civil construction, including the construction of retaining walls, road networks, industrial lots and the installation of services, such as power, gas, water and sewerage.
• Landscape works, which will include the design and implementation of streetscape treatments and maintenance of these areas for two years.

The civil works required to support the proposed industrial development will necessitate the removal of some vegetation within the site. As a result, three Matter of National Environmental Significance (MNES) that are listed under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) have the potential to be impacted by the proposed action, specifically the Carnaby’s black cockatoo (CBC) (Calyptorhynchus latirostris), Forest red-tailed black cockatoo (FRTBC) (Calyptorhynchus banksii naso) and Banksia Woodland of the Swan Coastal Plain threatened ecological community (Banksia Woodland TEC).

1.3 What is the extent and location of your proposed action? Use the polygon tool on the map below to mark the location of your proposed action.

Area	Point	Latitude	Longitude
Part of Lot 102 Great Northern Highway, Muchea	1	-31.558729806034	115.9923313918
Part of Lot 102 Great Northern Highway, Muchea	2	-31.558437258835	115.99868286275
Part of Lot 102 Great Northern Highway, Muchea	3	-31.560521637608	116.0020302596
Part of Lot 102 Great Northern Highway, Muchea	4	-31.575842220292	116.00194442891
Part of Lot 102 Great Northern Highway, Muchea	5	-31.575257232335	115.99559295796
Part of Lot 102 Great Northern Highway, Muchea	6	-31.570430941624	115.99421966695
Part of Lot 102 Great Northern Highway, Muchea	7	-31.569004944285	115.99439132832
Part of Lot 102 Great Northern Highway, Muchea	8	-31.569004944285	115.99524963521
Part of Lot 102 Great Northern Highway, Muchea	9	-31.568712429314	115.99524963521
Part of Lot 102 Great Northern Highway, Muchea	10	-31.568712429314	115.99580753468
Part of Lot 102 Great Northern Highway, Muchea	11	-31.568163961272	115.99580753468
Part of Lot 102 Great Northern Highway, Muchea	12	-31.568310219732	115.9982537093
Part of Lot 102 Great Northern Highway, Muchea	13	-31.566408841857	115.99833953999
Part of Lot 102 Great Northern Highway, Muchea	14	-31.566408841857	115.99803913258
Part of Lot 102 Great Northern Highway,	15	-31.564214896135	115.99816787862

Area	Point	Latitude	Longitude
Muchea			
Part of Lot 102 Great Northern Highway, Muchea	16	-31.564141763722	115.99632251881
Part of Lot 102 Great Northern Highway, Muchea	17	-31.566079753289	115.99627960347
Part of Lot 102 Great Northern Highway, Muchea	18	-31.566116318742	115.99542129658
Part of Lot 102 Great Northern Highway, Muchea	19	-31.565640966725	115.99404800557
Part of Lot 102 Great Northern Highway, Muchea	20	-31.565896925805	115.99301803731
Part of Lot 102 Great Northern Highway, Muchea	21	-31.562825370483	115.99220264577
Part of Lot 102 Great Northern Highway, Muchea	22	-31.561252987542	115.99198806904
Part of Lot 102 Great Northern Highway, Muchea	23	-31.5601193927	115.99203098439
Part of Lot 102 Great Northern Highway, Muchea	24	-31.55865666932	115.99237430714
Part of Lot 102 Great Northern Highway, Muchea	25	-31.55865666932	115.9923313918
Part of Lot 102 Great Northern Highway, Muchea	26	-31.558729806034	115.9923313918

1.5 Provide a brief physical description of the property on which the proposed action will take place and the location of the proposed action (e.g. proximity to major towns, or for off-shore actions, shortest distance to mainland).

The proposed action is located within a portion of Lot 102 Great Northern Highway and incorporates an area of 127 hectares (ha), approximately 1.8 km north east of the Muchea

townsite. The site is zoned ‘Industrial development’ under the SoC Town Planning Scheme (TPS) No. 6, and incorporates the north-western extent of the Muchea Employment Node Structure Plan (MENSP) area. In accordance with the existing strategic planning framework, the site is proposed for industrial development, as set out in the MENSP.

Situated at the base of the Gingin Scarp, the site is bound by Great Northern Highway to the west, private rural landholdings to the north, Gulliente Road and various industrial facilities to the east and a transport depot incorporating a petrol station to the south.

1.6 What is the size of the proposed action area development footprint (or work area) including disturbance footprint and avoidance footprint (if relevant)?

Approximately 127 hectares

1.7 Is the proposed action a street address or lot?

Lot

1.7.2 Describe the lot number and title. The proposed action is a 127 ha portion of Lot 102 (Survey Plan 404620/809) Great Northern Highway,

1.8 Primary Jurisdiction.

Western Australia

1.9 Has the person proposing to take the action received any Australian Government grant funding to undertake this project?

No

1.10 Is the proposed action subject to local government planning approval?

Yes

1.10.1 Is there a local government area and council contact for the proposal?

Yes

1.10.1.0 Council contact officer details

1.10.1.1 Name of relevant council contact officer.

Peter Stuart

1.10.1.2 E-mail

emds@chittering.wa.gov.au

1.10.1.3 Telephone Number

08 9576 4600

1.11 Provide an estimated start and estimated end date for the proposed action.

Start date 03/2018

End date 03/2028

1.12 Provide details of the context, planning framework and State and/or Local government requirements.

The State Government has identified the south-east portion of the Muchea locality, including the site, as an industrial expansion area through the strategic land use planning framework, known as the Muchea Employment Node. The Muchea Employment Node comprises approximately 1,113 ha, and has been spatially identified for industrial development since the preparation of the North East Corridor Extension Strategy by the Western Australian Planning Commission (WAPC) in 2003.

In August 2011, the Department of Planning, Lands and Heritage (DPLH) and WAPC published the MENSP to guide and coordinate the envisaged industrial development of the Muchea Employment Node. The proposed action is located in the north-western extent of the MENSP and is proposed to be developed to support industrial land uses consistent with the structure plan.

In order to facilitate the proposed industrial development of the site, an amendment to the SoC TPS No. 6 was initiated to rezone the site from ‘Agricultural resource’ to ‘Industrial development’. The scheme amendment was approved by the SoC Council in October 2014, and gazetted and approved by the WAPC in 2015, resulting in the current ‘Industrial development’ zoning of the site under the SoC TPS No. 6.

Since the finalisation of the scheme amendment, the proponent progressed the preparation of the Muchea Industrial Precinct Local Structure Plan (LSP). The LSP was prepared for the entire 149 ha of Lot 102 Great Northern Highway, Muchea, while the site encompasses a 127 ha portion of this LSP area. The SoC assessed and considered the LSP before forwarding to the WAPC for approval. The WAPC approved the LSP on 13 October 2017.

The development of the site (i.e. the proposed action) will be implemented through subdivision applications, which are lodged with and approved by the WAPC. The first stage of subdivision which includes part of the proposed action has been lodged with the WAPC.

1.13 Describe any public consultation that has been, is being or will be undertaken, including with Indigenous stakeholders.

Given the strategic importance of the Muchea Employment Node at both a state and local government level, extensive public consultation has been undertaken to date as part of the planning process. Public consultation on the general industrial land use of the Muchea Employment Node (incorporating the site) has included:

- Introduction of the *North East Corridor Extension Strategy,* which involved a public comment period for the proposed location of the future industrial/employment node.

- The MENSP public consultation period prior to its adoption by the WAPC and SoC in August 2011

- A public comment period for SoC TPS no. 6 Amendment.

- The advertisement of the LSP and supporting documentation by the SoC to state government agencies and the general public, allowing the community to provide comment on the proposed LSP design.

In summary, a range of public consultation processes have been undertaken to date by the state government and the SoC. This has provided the public various opportunities to comment both generally on the industrial development of the MENSP and more directly on the proposed industrial development design within the site and the associated proposed action.

1.14 Describe any environmental impact assessments that have been or will be carried out under Commonwealth, State or Territory legislation including relevant impacts of the project.

As part of the scheme amendment process, the SoC referred the application to the Environmental Protection Authority (EPA) to determine whether environmental assessment under Part IV of the Environmental Protection Act 1986 was required. The EPA advised the SoC that the proposed scheme amendment did not require formal assessment, however provided informal advice regarding the environmental issues associated with the proposal (EPA reference 14-820992), specifically in regard to flora, vegetation and fauna considerations. These considerations have been integrated into the LSP design through the retention of remnant vegetation within the conservation and drainage reserves.

The LSP was also referred to regulatory authorities, including the EPA and the Department of Biodiversity and Attractions (DBCA), for comment. The EPA and DPCA provided informal advice regarding the environmental issues associated with the LSP, and these considerations have been integrated into the revised LSP design through the retention of remnant vegetation and wetland buffers within the conservation and drainage reserves to the satisfactory of the EPA and DBCA.

On this basis, the proposed industrial land use of the site has been considered and assessed by the EPA. The provision of the conservation and drainage reserves within the proposed LSP was the key mechanism in order to avoid and minimise potential environmental impacts associated with the development of the site, specifically in relation to the banksia woodland TEC and

associated black cockatoo habitat values. No other specific environmental issues were identified by the EPA through their assessment of the LSP as being applicable to the future development of the site.

1.15 Is this action part of a staged development (or a component of a larger project)?

Yes

1.15.1 Provide information about the larger action and details of any interdependency between the stages/components and the larger action.

The proposed action is considered to be part of a larger action as per the DoEE Policy statement – Stage Development-Split referrals: Section 74A of the EPBC Act.

The LSP comprises the entire 149 ha of Lot 102 Great Northern Highway, Muchea, which is proposed to be development for industrial purposes by the proponent. A 27 ha portion of Lot 102 Great Northern Highway has been excluded from the proposed action, as the development of this area is considered to have limited impact to MNES values, and therefore is unlikely to result in a material change to the consideration of MNES within this EPBC Act referral.

1.16 Is the proposed action related to other actions or proposals in the region?

No

Section 2 - Matters of National Environmental Significance

Describe the affected area and the likely impacts of the proposal, emphasising the relevant matters protected by the EPBC Act. Refer to relevant maps as appropriate. The interactive map tool can help determine whether matters of national environmental significance or other matters protected by the EPBC Act are likely to occur in your area of interest. Consideration of likely impacts should include both direct and indirect impacts.

Your assessment of likely impacts should consider whether a bioregional plan is relevant to your proposal. The following resources can assist you in your assessment of likely impacts:

• Profiles of relevant species/communities (where available), that will assist in the identification of whether there is likely to be a significant impact on them if the proposal proceeds;

• Significant Impact Guidelines 1.1 – Matters of National Environmental Significance;

• Significant Impact Guideline 1.2 – Actions on, or impacting upon, Commonwealth land and Actions by Commonwealth Agencies.

2.1 Is the proposed action likely to have ANY direct or indirect impact on the values of any World Heritage properties?

No

2.2 Is the proposed action likely to have ANY direct or indirect impact on the values of any National Heritage places?

No

2.3 Is the proposed action likely to have ANY direct or indirect impact on the ecological character of a Ramsar wetland?

No

2.4 Is the proposed action likely to have ANY direct or indirect impact on the members of any listed species or any threatened ecological community, or their habitat?

Yes

2.4.1 Impact table

Species	Impact
Carnaby's black cockatoo (CBC)	A level 1 fauna survey (Harewood 2013)

Species	Impact
(Calyptorhynchus latirostris)	(Attachment B) and an additional habitat tree site assessment by Emerge Associates (2017), was undertaken to gain a comprehensive understanding of the potential black cockatoo habitat values within the site. Overall, the historical disturbance of the site has significantly reduced the fauna habitat values. Notwithstanding this, the site does contain habitat suitable for CBC. In particular: • Approximately 376 potential habitat trees were recorded within the site, of which 314 are proposed to be removed, and 62 are proposed to be retained. Of these 376 trees identified, 49 were identified as Eucalyptus camaldulensis (River Red Gum), Eucalyptus todtiana (Coastal Blackbutt or Prickly Bark) or Eucalyptus grandis (Flooded Gum, Rose Gum), which are considered less likely to create suitable hollows for black cockatoos and are therefore considered lower value. • Approximately 12 of the 376 trees were identified as containing one or more hollows possibly suitable for a black cockatoo, although no past or active use was observed during the habitat assessments. Of the 12 potentially suitable trees, 10 will be removed as part of the proposed action and two will be retained. • Approximately 7.17 ha of potential foraging habitat associated with the banksia woodland community (BaBm) was recorded within the site, of which 0.57 ha (7.9%) is proposed to be removed and 6.60 ha (92.1%) is proposed to be retained. • No known roosting sites or nesting trees were identified within the site. As explained further in relation to the Significant impact guidelines 1.1 – Matters of National Environmental Significance in Section 5.2, the impacts to CBC as a result of the proposed action are not considered to be significant.
Forest red-tailed black cockatoo (FRBC) (Calyptorhynchus banksii naso)	As mentioned above, a number of surveys have been undertaken to gain a comprehensive understanding of the potential black cockatoo habitat values within the site. The site does contain habitat suitable for FRTBC. In particular: • Approximately 376 potential habitat trees were recorded within the site, of which

Species	Impact
	314 are proposed to be removed, and 62 are proposed to be retained. Of these 376 trees identified, 49 were identified as Eucalyptus camaldulensis (River Red Gum), Eucalyptus todtiana (Coastal Blackbutt or Prickly Bark) or Eucalyptus grandis (Flooded Gum, Rose Gum), which are considered less likely to create suitable hollows for black cockatoos and are therefore considered lower value. • Approximately 12 of the 376 trees were identified as containing one or more hollows possibly suitable for a black cockatoo, although no past or active use was observed during the habitat assessments. Of the 12 potentially suitable trees, 10 will be removed as part of the proposed action and two will be retained. • The only potential foraging habitat for FRTBC within the site is associated with the 376 scattered potential habitat trees. • no known roosting sites or nesting trees identified within the site. As explained further in relation to the Significant impact guidelines 1.1 – Matters of National Environmental Significance in Section 5.2, the impacts to CBC as a result of the proposed action are not considered to be significant.
Banksia Woodland of the Swan Coastal Plain threatened ecological community (Banksia Woodland TEC)	Plant community BaBm was determined to represent ‘floristic community type’ (FCT) 21c – Low-lying Banksia attenuata woodlands or shrublands’, which is associated with the ‘Banksia Woodlands of the Swan Coastal Plain’ TEC. FCT 21c is considered well reserved (i.e. occurs in two widely separated National Parks and/or Nature Reserves) and susceptible (i.e. community may be susceptible to modification and/or damage) (Gibson et al. 1994). FCT 21c is not a state listed TEC, however is a state listed Priority 3 ‘priority ecological community’ (PEC) and is associated with the state listed Priority 3 PEC ‘Banksia dominated woodlands of the Swan Coastal Plain IBRA region’. Approximately 8.04 ha of the site has been classified as representative of patch of the listed Banksia Woodland TEC, of which 7.17 ha is considered as ‘good’ condition, and associated with the BaBm plant community, and 0.87 ha is considered in

Species	Impact
	'completely degraded' condition, associated with tracks and an unused quarry (Emerge Associates 2017) (Attachment D). Given that only 7.17 ha of the patch is vegetated, the impacts associated with the development have been assessed based on the area of vegetation, excluding the completely degraded portion of the patch as shown in Figure 8. As a result, the proposed action will involve the clearing of approximately 0.57 ha (7.9%) of 'good' condition Banksia Woodland TEC vegetation and the retention of 6.60 ha (92.1%) of the 'good' condition Banksia Woodland TEC vegetation. The retained Banksia Woodland TEC vegetation will be managed during construction through the Flora, Vegetation, Wetland and Waterway Management Plan (FVWWMP) which is required to be prepared and approved as a part of subdivision. The retained Banksia Woodland vegetation will also be located within a conservation reserve, that will be handed over to the responsible authority to protect in perpetuity as part of the proposed action. Due to the small-scale clearing of good condition Banksia Woodland TEC (0.57 ha, 7.9% of the TEC within the site), and the retention of 92.1% (6.60 ha) of good condition Banksia Woodland TEC vegetation within a conservation reserve within the site, the impacts to Banksia Woodland TEC as a result of the proposed action is not significant and therefore not considered to require further consideration within this referral.

2.4.2 Do you consider this impact to be significant?

No

2.5 Is the proposed action likely to have ANY direct or indirect impact on the members of any listed migratory species, or their habitat?

No

2.6 Is the proposed action to be undertaken in a marine environment (outside Commonwealth marine areas)?

No

2.7 Is the proposed action to be taken on or near Commonwealth land?

No

2.8 Is the proposed action taking place in the Great Barrier Reef Marine Park?

No

2.9 Is the proposed action likely to have ANY direct or indirect impact on a water resource related to coal/gas/mining?

No

2.10 Is the proposed action a nuclear action?

No

2.11 Is the proposed action to be taken by the Commonwealth agency?

No

2.12 Is the proposed action to be undertaken in a Commonwealth Heritage Place Overseas?

No

2.13 Is the proposed action likely to have ANY direct or indirect impact on a water resource related to coal/gas/mining?

No

Section 3 - Description of the project area

Provide a description of the project area and the affected area, including information about the following features (where relevant to the project area and/or affected area, and to the extent not otherwise addressed in Section 2).

3.1 Describe the flora and fauna relevant to the project area.

A spring flora and vegetation survey incorporating the site was conducted by Plant Ecology on behalf of Emerge Associates in October 2012 (Emerge Associates 2013) (provided in **Attachment C**). A total of 72 native and 34 non-native (introduced and cultivated) species recorded within the site, representing 23 families and 77 genera. Overall, the floristic diversity of the site is significantly reduced from its original state as a result of historical land uses and associated vegetation clearing.

The spring survey included intensive targeted searches for priority and threatened flora species. No threatened or priority flora species were recorded or are considered are likely to occur.

Emerge undertook further surveys of the wetland vegetation within the site in 2016, to provide clarification in relation to plant community and vegetation condition mapping within the site. The results of this survey is summarised in a *Technical Memorandum - Update to flora and vegetation assessment focusing on wetland vegetation* (Emerge Associates 2017) (provided in **Attachment D**).

For the purposes of this report, the revised plant community and vegetation condition mapping has been used.

A Fauna Assessment was undertaken of the LSP area, including the site, by Greg Harewood in 2013 (Harewood 2013) (provided in **Attachment B**), and an additional site visit was conducted by an Ecologist from Emerge in October 2017, to review the status of the recorded potential habitat trees (i.e. hadn’t fallen over due to age and to identify any evidence of past or present use).

Overall, fauna habitat values at the subject site were compromised to varying degrees by the removal of a large percentage of the original native vegetation and the degradation of remnant patches for past rural land uses. As a consequence, the fauna diversity of the subject site is well below levels expected to be present in remnant patches of similar vegetation within the area. Much of the area lacks natural attributes, and therefore it is now only likely to be utilised by generally common and widespread fauna species with non-specific requirements which allow them to persist in disturbed/highly disturbed habitats.

A total of 28 native fauna species were observed (or positively identified through foraging

evidence, scats, tracks, skeletons or calls) within the site during the single day time survey (Harewood 2013). Evidence of four introduced species were also identified as being present. Evidence of two listed threatened black cockatoo species were observed during the fauna assessment including FRTBC and CBC. Whilst no direct observations of individuals of either species were recorded, foraging evidence of both species was observed within the site in the form of chewed marri and coastal blackbutt fruits (attributed to CBC and/or the FRTBC), in addition to chewed Banksia cones and pine cones (attributed to CBC only) (Harewood 2013).

No evidence of roosting activity was observed within the proposed action area, such as branch clippings, droppings or moulted feathers, which are normally associated with black cockatoo roost sites. This suggests that the site is unlikely to contain any permanent or established roosting areas which are frequently used by large flocks of cockatoos.

A total of 376 potential black cockatoo habitat trees (with a diameter at breast height greater than 500 mm) were recorded within the site(Harewood 2013)(Harewood 2013)(Harewood 2013)(Harewood 2013)(Harewood 2013). The majority of which are isolated and intermittently dispersed, representative of the 'Parkland cleared' plant community structure. In addition, approximately 49 of these trees were recorded as *Eucalyptus camaldulensis* (River Red Gum), *Eucalyptus todtiana* (Coastal Blackbutt or Prickly Bark) or *Eucalyptus grandis* (Flooded Gum, Rose Gum), which are considered less likely to create suitable hollows for black cockatoos and are therefore considered lower value.

Of the 376 potential black cockatoo habitat trees, the 2013 fauna assessment (Harewood 2013) identified 13 potential habitat trees as containing hollows of a suitable size to support black cockatoo nesting. In the subsequent site visit, undertaken by Emerge in 2017, one of these trees was observed to have fallen over, and as such any hollow were considered to be no longer present. Based on this, the site is considered to contain only 12 potential habitat trees that contain hollows of a suitable size to support black cockatoo nesting. No evidence (e.g. chew marks) of past or present use of any hollow by black cockatoos was seen in either survey. The location of all potential breeding habitat trees, as per the most recent survey, are shown in **Figure 5.**

3.2 Describe the hydrology relevant to the project area (including water flows).

3.2.1 Groundwater

Information on the regional groundwater obtained from the Department of Water (DoW) *Water Register* (DoW 2015) indicates the groundwater beneath the site is a multi-layered system comprised of the following:

- Perth Superficial Swan (unconfined) aquifer
- Perth Leederville Parmelia (confined) aquifer
- Perth Yarragadee North (confined) aquifer

The *Perth Groundwater Atlas* (DoW 2015) indicates that groundwater flows in a westerly direction towards Ellen Brook, with minimum groundwater levels (recorded in May 2003) ranging between 55 m AHD to 50 m AHD across the site.

Site specific groundwater monitoring was completed by Emerge Associates at six bores over a 15 month period, between October 2012 and December 2013. Groundwater levels were measured monthly and water quality samples taken every three months. Based on the results of this monitoring, average annual maximum groundwater levels are inferred to range from 62 m AHD in the east to 51 m AHD in the west, as shown in **Figure 2.**

3.2.2 Surface Water

The site is situated within the Ellen Brook catchment with Ellen Brook watercourse located approximately 650 m to the west of the site.

A review of available state agency data and various site inspections carried out by Emerge Associates identified the following three significant surface water features within the site:

- **Southern waterway**. A mildly meandering, natural channel that is not well defined and receives flows from a small upstream catchment through overland flows.

- **Central waterway**. A clearly defined, highly eroded natural channel with steep side slopes and minimal vegetation within the channel and adjacent banks. The waterway runs across the width of the site and receives flows from a large upstream catchment. These flows can be significant following large rainfall events.

- **Northern flow path**. An unclearly defined flow path which is identified by natural depressions in topography along the northern boundary of the site. Hydrological modelling based on surveyed topographical data was undertaken to confirm the route of this flow path.

All of the identified surface water features within the site experience westerly flows which drain toward Ellen Brook, crossing under Great Northern Highway via a number of culverts.

3.2.3 Wetlands

The site contains three wetlands, as confirmed by the *Geomorphic Wetlands of the Swan Coastal Plain* database:

- Palusplain - Ellen Brook floodplain (UFI 15732), Multiple Use

- Sumpland (UFI 9173), Resource Enhancement

- Sumpland (UFI 9174), Resource Enhancement

The Ellen Brook Floodplain Multiple Use Wetland (MUW) extends across the majority of the site and generally indicates minimal separation between surface levels and groundwater. The proposed action is not expected to impact upon the REWs within the site. Both REWs are

proposed for retention within reserves, incorporating buffers areas which will contribute to the protection, conservation and enhancement of wetland values.

Further details on identified wetlands within the site is provided in the *Flora and Vegetation Survey and Wetland Assessment* (Emerge Associates 2013) and the *Technical Memorandum – Update to flora and vegetation assessment focusing on wetland vegetation* (Emerge Associates 2017).

The EPBC Act protected matters search tool identified one wetland of national significance as occurring within 10 km of the site, the Chandala Swamp. This swamp is located approximately 7.5 km north west of the site. The proposed action is not expected to impact on the Chandala Swamp due to distance from the site (e.g. greater than 7.5 km) and the direction of groundwater at the site (e.g. direction to the south west, with Chandala Swamp located to the north west).

3.3 Describe the soil and vegetation characteristics relevant to the project area.

3.3.1 Soil

The western portion of the site is situated within the Yanga soil-landform formation, which is described as a poorly drained plain with grey, sandy benches and intervening swamps, with areas of bog iron ore and marl (Churchward and McArthur 1980). The eastern portion of the site is mapped as the Coonambidgee soil-landform formation, which comprises the gently sloping fringe to the Dandaragan Plateau with deep grey sands (Churchward and McArthur 1980).

The Geological Survey of Western Australia, as documented in *Perth Metropolitan Region 1:50,000 Environmental Geology Series Muchea Sheet 2034 I & part 2134 IV* (Gozzard 1982), indicates the site is comprised of:

- Mgs1 – Pebbly silt: strong brown, silt with common fine to occasionally coarse grained, sub-rounded laterite, quartz, heavily weathered granite pebbles, some fine to medium-grained quartz sand, of alluvial origin.

- 5 – Sand: very pale brown, medium to coarse-grained, sub-angular quartz and a trace of feldspar, moderately sorted, loose, of colluvial origin.

A site specific geotechnical investigation was undertaken in October 2015 (Infra Tech Group 2015), which confirmed the underlying soils to be generally consistent with the above regional geological mapping and comprise:

- Silty sand that covers the site, ranging from 0.2 m to more than 3.5 m in depth and is usually covered by a 200 mm layer of topsoil, brown-dark brown coloured, angular to sub-angular, well graded sand.

- Sandy clay that ranges from stiff to very stiff and generally sits below the sand layer, variable in depth.

- Granite bedrock with a variable depth across the site between 1.0 m and more than 3.5 m. The bedrock is made up of a medium weak rock layer, pale grey to brown in colour.

3.3.2 Vegetation

The revised spring flora and vegetation mapping (Emerge Associates 2017) identified eight plant communities within the site, including native remnants in addition to areas of revegetation and agricultural grazing, including:

- BaBm described as Open woodland of *Eucalyptus todtiana*, *Banksia attenuata* and *Banksia menziesii* over low open shrubland of *Eremaea pauciflora var. calyptra, Xanthorrhoea preissii* over open tussock grassland of **Ehrharta calycina* with *Dasypogon bromeliifolius* on grey sands. This community exists on the eastern boundary of the site and extends over 7.17 ha.

- MoAp described as Tall shrubland of *Melaleuca osullivanii* over sparse rushland of *Dielsia stenostachya* over forbland of *Angianthus preissianus, *Cotula coronopifolia* and **Hordeum hystrix* in damp grey/black sands. This community exists on the northern boundary of the site and extends over 0.019 ha.

- MoJp described as Tall open shrubland of *Melaleuca osullivanii* over open sedgeland of *Juncus pallidus* over closed forbland of **Cotula coronopifolia*, **Briza maxima* and **Lotus subbiflorus* in saturated black loams. This community exists on the western boundary of the site and extends over 0.542 ha.

- Mp described as Woodland of *Melaleuca preissiana* over mixed pasture grasses. This community exists in the centre of the site associated with the remnant vegetation and extends over 2.958 ha.

- MpJa described as Woodland of *Melaleuca preissiana* over sedgeland of **Juncus acutus subsp. acutus* over grassland of **Cynodon dactylon* in saturated black loams. This community exists in the centre of the site associated with the remnant vegetation and extends over 0.545 ha.

- MpJaJk described as Open woodland of *Melaleuca preissiana* over open sedgeland of *Juncus acutus* subsp. *acutus* and *Juncus pallidus* over grassland of **Cynodon dactylon* in saturated black loams with free water at the surface. This community exists in the centre of the site associated with the remnant vegetation and extends over 1.607 ha.

- Rehab described as revegetation areas of planted Eucalypt and Melaleuca species. This community exists in the centre of the site near the western boundary and extends over 3.987 ha.

- Pasture described as Cleared pastures with isolated paddock trees. The area of cleared pastures extends over the remainder of the site (110.364 ha).

The extent of the plant communities within the site is shown in **Figure 3.**

The majority of the vegetation within the site was assessed to be in completely degraded condition, with approximately 7.17 ha of vegetation associated with the BaBm plant community assessed as good condition. Portions of good to degraded, and degraded condition vegetation were also present on site in other areas. Vegetation condition mapping is shown in **Figure 4.**

Plant community BaBm was determined to represent floristic community type (FCT) 21c 'low lying *Banksia attenuata* woodlands or shrublands'. FCT 21c is associated with the 'Banksia Woodlands of the Swan Coastal Plain' threatened ecological community (TEC).

Plant community MoAp was determined to represent FCT 7 'herb rich saline shrublands in clay pans', which is associated with the 'Clay pans of the Swan Coastal Plain' TEC. The entire 0.019 ha of the MoAp 'Clay pans of the Swan Coastal Plain' TEC will be contained in a future conservation reserve and therefore will not be impacted by the proposed action.

3.4 Describe any outstanding natural features and/or any other important or unique values relevant to the project area.

There are no other unique values within the site.

3.5 Describe the status of native vegetation relevant to the project area.

In consideration of the results of the flora and vegetation surveys, tree survey, fauna survey and hydrological considerations, the following areas were identified as representing the most significant environmental values within the site:

- The remnant vegetation within southern half of the site (inclusive of the REW and Banksia Woodland TEC community)

- The remnant vegetation on the northern boundary of the site (associated with the MoAp TEC community)

- The creek line within the northern half of the site (inclusive of a number of potential black cockatoo habitat trees).

- The potential habitat trees scattered over the site.

On this basis, the LSP was strategically designed to avoid impacts to these areas as much as possible. This was primarily achieved through two designated conservation reserves and a

drainage reserve.

The overall management of significant vegetation and environmental values of the site will be managed through the Flora, Vegetation, Wetland and Waterway Management Plan (FVWWMP) prepared as a requirement of subdivision. The proposed reserves within the proposed action area include:

- A 20.47 ha conservation reserve including the retention of the REW, 6.60 ha of 'good' condition BaBm vegetation associated with the Banksia Woodland TEC and a potential habitat trees

- A 1.15 ha conservation reserve including the retention of the entire 0.019 ha MoAp 'Clay pans of the Swan Coastal Plain' TEC

- A 8.30 ha drainage reserve including the retention of the creekline and a number of potential habitat trees

In total, approximately 62 potential habitat trees will be retained within the drainage and conservation reserves. In addition, the ability for further retention of potential habitat trees within the site is also required to be assessed as part of each stage of subdivision, based on the alignment of roads, lot boundaries and required civil works, as well part of the development application process, once the use and design of each lot has been confirmed by the individual land owners. This will be managed through the preparation of a Key Cockatoo Habitat Tree Retention Plan (KCHTRP) required to be prepared for each stage of subdivision, and the preparation of a tree retention plan (or similar) as part of each Development Application for future lots.

3.6 Describe the gradient (or depth range if action is to be taken in a marine area) relevant to the project area.

The elevation of the site ranges from 70 m Australian Height Datum (AHD) in the east to 51 m AHD in the west (DoW 2008) resulting in a westward aspect, with a gentle grade of approximately 2.2%.

Based on this, minor bulk earthworks will be required to support the proposed land use.

3.7 Describe the current condition of the environment relevant to the project area.

The site is surrounded by various landholdings and industries, with the majority of land cleared of native vegetation. A poultry farm is located adjacent to the south-eastern boundary of the site, at the intersection of Gulliente Road and Muchea East Road. In addition, the West Australian Meat Industry Association (WAMIA) is situated directly adjacent to the eastern site boundary and covers an area of approximately 303 ha, which contains the Muchea Livestock Centre – an undercover sheep and cattle sale yard. WAMIA are actively seeking to develop the remainder of their lot for industrial land uses, in accordance with the MENSP.

Midland Brick own and lease land to the east of the site along Wandena Road, and operations in the local area are ongoing. Clay has been excavated from this part of Muchea for many years due to the uniqueness of the resource and proximity to the metropolitan area (WAPC 2011). This area is included within the extent of the MENSP, and an application to develop a number of historical clay pits for industrial land uses is currently being considered by the SoC.

3.8 Describe any Commonwealth Heritage Places or other places recognised as having heritage values relevant to the project area.

Not applicable. There are no Commonwealth or any other Heritage Places within the site.

3.9 Describe any Indigenous heritage values relevant to the project area.

The Aboriginal Heritage Inquiry System (AHIS) is maintained pursuant to Section 38 of the *Aboriginal Heritage Act 1972* by the DPLH (formerly Department of Aboriginal Affairs), containing information on Registered Aboriginal Heritages Sites and Other Heritage Places throughout Western Australia. A search of the AHIS online database (DPLH 2017) was undertaken. One Registered Aboriginal Heritage Site and one Other Heritage Place are mapped as occurring over the site, including:

- Gingin Brook Waggyl Site (ID 20008), Area: 108,061 ha, Type: historical, mythological
- Ellen Brook: Upper Swan (ID 3525), Ares: 20,819 ha, Type: mythological

Both identified sites are closed and therefore access to the location and content of each cannot be provided by the DAA without permission from Aboriginal informants. Notwithstanding, both heritage sites cover extensive areas generally associated with the Ellen Brook watercourse and upstream catchment areas.

Correspondence from the DAA in June 2016 confirmed that the actual location of both DAA 20008 and DAA 3525 are outside of the site.

3.10 Describe the tenure of the action area (e.g. freehold, leasehold) relevant to the project area.

The site comprises of part of Lot 102 (Survey Plan 404620/809) Great Northern Highway, Muchea and is owned in freehold by the proponent.

3.11 Describe any existing or any proposed uses relevant to the project area.

A review of existing and historical aerial imagery (Landgate 2015) indicate that historic land uses over the site have involved low intensity broad-acre agriculture. It is likely that prior to the implementation of these land uses the site was covered in remnant vegetation. Clearing to

support agricultural land uses occurred prior to 1977 and the current extent of remnant vegetation within the site has not been altered to any significant degree since this date.

A 0.5 ha area within the portion of Banksia woodland located in the eastern portion of the site appears to have been quarried from 1979 onwards. Quarrying activities are no longer active.

The *Ellen Brook Integrated Catchment Group* are understood to have undertaken a number of revegetation works within the site, including:

- Areas adjacent to Great Northern Highway along the southern waterway in the late 1990's.

- An area north of the central REW (UFI 9174) in 2003.

- An area adjacent to Great Northern Highway and the central waterway in 2004.

The flora and vegetation survey (Emerge Associates 2013) describes the revegetated areas as containing planted non-endemic Eucalypt and Melaleuca species. The extent of these areas is shown in **Figure 3.**

Section 4 - Measures to avoid or reduce impacts

Provide a description of measures that will be implemented to avoid, reduce, manage or offset any relevant impacts of the action. Include, if appropriate, any relevant reports or technical advice relating to the feasibility and effectiveness of the proposed measures.

Examples of relevant measures to avoid or reduce impacts may include the timing of works, avoidance of important habitat, specific design measures, or adoption of specific work practices.

4.1 Describe the measures you will undertake to avoid or reduce impact from your proposed action.

Avoidance of impacts

As described previously, the LSP has been specifically designed to maximise the avoidance of impacts to identified environmental values within site. The proposed action incorporates the retention of approximately 29.9 ha into future conservation and drainage reserves. This includes two conservation reserves and a drainage reserve which have been designed to maximise the retention of MNES (**Figure 1**). The future reserves include:

- Retention of 6.60 ha of banksia woodland TEC (which is also potential CBC foraging habitat) within a future conservation reserve (equal to 92.1% of the banksia woodland TEC within the site)

- Retention of 0.01 ha of clay pan TEC within a future conservation reserve (equal to 100% of the clay pan TEC within the site)

- Retention of 62 potential habitat trees within a future conservation and drainage reserve, inclusive of two trees that contain hollows suitable for black cockatoos.

The ability for further retention of potential habitat trees within the site is also required to be assessed as part of each stage of subdivision, based on the alignment of roads, lot boundaries and required civil works, as well part of the development application process, once the use and design of each lot has been confirmed by the individual land owners. This will be managed through the preparation of a KCHTRP at each stage of subdivision, and the preparation of a tree retention plan (or similar) prepared as part of each Development Application for future lots. As such, the tree retention statistics provided above are considered to represent a worst case scenario.

In addition, the conservation reserve will be handed over to a responsible authority such as the DBCA or SoC for conservation purposes as part of this proposed action. This will ensure further degradation of the vegetation is avoided and allow for improved long-term conservation management outcomes and opportunities for these areas. This will also ensure the protection of black cockatoo habitat and banksia woodland TEC in the local area in perpetuity.

Reduction of impacts

Measures to reduce and mitigate impacts to identified environmental values include:

- Street tree planting will incorporate flora species known to be used as a foraging resource by black cockatoo species.

- Installation of 20 artificial hollows within future conservation and drainage reserves to mitigate the loss of the 10 trees with hollows suitable for black cockatoo species. These hollows will also be monitored and maintained for a period of 5 years to ensure the effectiveness of the artificial hollow.

As part of future stages of development within the site, various management plans will be prepared and implemented to reduce environmental impacts and ensure the proposal is implemented as intended. These include:

- A KCHTRP to support each stage of subdivision and determine, based on refined civil earthwork requirements and detailed design, the retention of potential black cockatoo habitat trees within road reserves, along lot boundaries and reserve interfaces.

- A tree retention plan (or similar) as part of each Development Application to identify any potential habitat trees that can be retained based on the final location of buildings and services within each individual lot.

- A FVWWMP to support subdivisional works, to provide an interface management framework for developing areas adjacent to retained vegetation, waterways and wetlands of conservation significance. It is expected that the FVWWMP will discuss existing environmental values and the management of the existing environment, including the installation and management of artificial hollows, identification and incorporation of setback distances around significant wetlands and waterways and local reserves handover procedure and requirements. The FVWWMP will also address the construction management requirements to mitigate any impacts (i.e. erosion, unauthorized clearing) of civil construction on retained environmental values.

4.2 For matters protected by the EPBC Act that may be affected by the proposed action, describe the proposed environmental outcomes to be achieved.

The environmental outcomes to be achieved for applicable MNES as a result of the proposed action are summarised below. As discussed above, these are considered to represent a worst case scenario, and opportunities for further retention will be considered during detailed design.

CBC:

- approximately 314 potential habitat trees are proposed to be cleared (including 10 trees with hollows of a suitable size for black cockatoo nesting) and 62 trees will be retained (including two trees with hollows of a suitable size for black cockatoo nesting)

- approximately 0.57 ha of potential foraging habitat will be cleared and 6.60 ha will be retained associated with the BaBm plant community

- the installation of 20 additional artificial hollows, which will be monitored and managed by the proponent for a period of five years.

FRTBC:

- approximately 314 potential habitat trees are proposed to be cleared (including 10 trees with hollows of a suitable size for black cockatoo nesting) and 62 trees will be retained (including two trees with hollows of a suitable size for black cockatoo nesting)

- the installation of 20 additional artificial hollows, which will be monitored and managed by the proponent for a period of five years.

Banksia woodlands TEC:

- Approximately 0.57 ha good condition Banksia Woodland TEC will be cleared and 6.60 ha will be retained.

No clearing of the Clay pans of the SCP TEC will occur.

As mentioned previously, given the small-scale clearing (0.57 ha) associated with the Banksia Woodland TEC, and the large area (6.60 ha) that is being retained within the site, the proposed action is unlikely to have a significant impact on this MNES, and therefore the impact to this MNES is not discussed further in this referral.

In a regional context, the following environmental outcomes are achieved based on the regional habitat distribution for CBC and FRTBC.

- The net loss of 0.57 ha of CBC foraging habitat within the site equates to 7.9% of foraging habitat within the site, 0.39% (146 ha) within 1 km of the site, 0.01% (4,038 ha) within 6 km of the site and 0.003% (18,085 ha) within 12 km of the site, as shown in **Figure 6** (Glossop *et al.* 2011)**.**

- The net loss of CBC and FRTBC potential breeding habitat associated with the 314 scattered paddock trees equates to 21 ha of potential CBC and FRTBC breeding habitat within 1 km of the site, 1,827 ha within 6 km of the site, and 7,100 within 12 km of the site as shown in **Figure 7.** This is based on the mapping of regional plant communities known to contain Marri and/or Jarrah (Heddle et al. 1980) versus remaining vegetation extent (DAFWA 2016).

Given the above, the potential impact on the matters protected by the EPBC Act is not considered significant.

Section 5 – Conclusion on the likelihood of significant impacts

A checkbox tick identifies each of the matters of National Environmental Significance you identified in section 2 of this application as likely to be a significant impact.

Review the matters you have identified below. If a matter ticked below has been incorrectly identified you will need to return to Section 2 to edit.

5.1.1 World Heritage Properties

No

5.1.2 National Heritage Places

No

5.1.3 Wetlands of International Importance (declared Ramsar Wetlands)

No

5.1.4 Listed threatened species or any threatened ecological community

No

5.1.5 Listed migratory species

No

5.1.6 Commonwealth marine environment

No

5.1.7 Protection of the environment from actions involving Commonwealth land

No

5.1.8 Great Barrier Reef Marine Park

No

5.1.9 A water resource, in relation to coal/gas/mining

No

5.1.10 Protection of the environment from nuclear actions

No

5.1.11 Protection of the environment from Commonwealth actions

No

5.1.12 Commonwealth Heritage places overseas

No

5.2 If no significant matters are identified, provide the key reasons why you think the proposed action is not likely to have a significant impact on a matter protected under the EPBC Act and therefore not a controlled action.

The Department of Environment's *Significant Impact Guidelines 1.1* outline the criteria for what constitutes a significant impact on a MNES. An action is likely to have a significant impact on a MNES if it triggers any of the nine criteria outlined in the guidelines. The potential impacts of the proposed action have been assessed against these criteria for the CBC, FRTBC and the Banksia Woodlands TEC, as outlined below.

5.2.1Carnaby's black cockatoo:

It should be noted that a population of CBC can be split into two definitions:

- A 'population' is any seasonally migratory group of CBC that is present on the Swan Coastal Plain throughout different times of the year.

- A 'resident population' is any group of CBC that are known to be based in a defined spatial location and are unlikely to leave this area for any significant amount of time.

No resident populations have been identified within or in proximity to the site, therefore the definition of 'population' will be applied for the purpose of this referral, given the proposed action will not impact on any resident populations.

<u>Significant impact criteria for Carnaby's cockatoo in relation to the Proposed Action</u>

1. Lead to a long-term decrease in the size of a population

Likelihood: Unlikely

Comment:

In order to lead to a long term decrease in the size of a population, the proposed action would need to bring about a sustained reduction in birth rates and/or a sustained increased in mortality rates for the species.

A total of 376 potential black cockatoo habitat trees were identified within the site (Harewood 2013), as shown in **Figure 5,** only 12 of these trees were identified as containing hollows of a suitable size to potentially support black cockatoo nesting. The vast majority (364) of the potential habitat trees were not considered suitable for black cockatoos as they were observed to contain no hollows or the hollows were considered unsuitable for black cockatoos. In addition, of those 364 trees, 49 were recorded as *Eucalyptus camaldulensis* (River Red Gum), *Eucalyptus todtiana* (Coastal Blackbutt or Prickly Bark) or *Eucalyptus grandis* (Flooded Gum, Rose Gum), which are considered less likely tree species to create hollows suitable for black cockatoos and are therefore considered lower value.

The proposed action will result in the retention of 92.1% (6.6 ha) of the potential foraging habitat for CBC, the retention of 62 potential habitat trees including two potential habitat trees with hollows suitable for black cockatoos. The proposed action will also result in the clearing of 0.57 ha of CBC foraging habitat, as well as the loss of 314 potential habitat trees, including 10 potential habitat trees with hollows suitable for black cockatoos. No direct evidence of black cockatoos using any hollows was observed within the site during the two site assessments, and therefore, overall, the site does not contain any confirmed black cockatoo breeding habitat. Given that no historic and active nesting and breeding habitat trees are known to occur within the site, birth rates are deemed to be extremely low, if not zero within the site.

Availability of nearby foraging resources is also an important consideration for breeding habitat, with potential habitat trees in proximity to foraging vegetation preferred by CBC (Saunders 2014a). As is illustrated in **Figure 5,** the potential habitat trees proposed to be cleared within the site, occur in a highly disturbed landscape, and are typically scattered and isolated. Because of this, it is considered unlikely that these potential breeding trees would be considered ideal breeding habitat. In addition to this, the 62 potential habitat trees that have been targeted for retention, are considered to provide the higher breeding habitat value, given that they are close to water sources (wetlands and drainage lines) and form contiguous areas of habitat within the site and to habitat within adjacent Lots (**Figure 1**).

Furthermore, it is estimated that approximately 21 ha of potential breeding habitat occurs within 1 km of the site, 1,827 ha of occurs within 6 km of the site and 7,100 ha within 12 km of the site, as shown in **Figure 7**. These areas are known to contain extensive areas of intact remnant vegetation, including potential habitat trees and foraging resources, which is likely to be preferred by black cockatoos, compared to the highly disturbed habitat within the site.

The proposed action will also include the installation of 20 artificial hollows within future conservation and drainage reserves to mitigate the loss of the 10 trees with hollows of a suitable size for black cockatoo species. These hollows will be monitored and maintained for a period of five years to ensure their effectiveness. Based on the above, the proposed action is unlikely to disrupt existing breeding activity or preclude future potential breeding activity within the site that would result in a sustained reduction in CBC birth rates.

The proposed action is also unlikely to increase mortality rates through direct bird deaths (vehicle strikes, hunting etc.) as the site occurs in an already disturbed landscape in an area transitioning from rural and resource extraction to urban land uses, and CBC are a mobile species and are able to avoid dangers associated with industrial development.

The proposed action is also unlikely to increase mortality rates indirectly through a reduction of foraging resources given the retention of 6.60 ha of foraging habitat within the site and due to the large areas of potential foraging habitat in proximity to the site as per as shown in **Figure 6** (146 ha within 1 km, 4,038 ha within 6 km and 18,085 ha within 12 km of the site). In addition, the site already occurs in a disturbed landscape transitioning from rural pasture land to industrial, and therefore the areas proposed to be cleared contain minimal quality foraging habitat (i.e. individual scattered trees and fringing BaBm vegetation).

Lastly, the proposed action will also require the completion of a number of management plans as part of the planning process. This includes a KCHTRP to support each stage of subdivision, preparation of a tree retention plan (or similar) as part of each Development Application, and a FVWWMP to support subdivisional works. These documents will ensure additional protection of black cockatoo habitat where possible, and provide appropriate management of the future conservation and drainage reserves during development.

Given the above, the net loss of 0.57 ha of CBC foraging habitat and 314 potential habitat trees, is not expected to lead to a long-term decrease in the size of a population.

2. Reduce the area of occupancy of the species

Likelihood: Unlikely

Comment:

The vegetation proposed for removal within the site is considered highly disturbed due to the previously rural land use. The net loss of 0.57 ha of foraging habitat within the site represents approximately 7.9% of CBC foraging habitat within the site, 0.39% (146 ha) within 1 km of the site, 0.01% within 6 km of the site and 0.003% within 12 km of the site as shown in **Figure 6**. In addition to this, approximately 21 ha of potential breeding habitat occurs within 1 km of the site, 1,827 ha of occurs within 6 km of the site and 7,100 ha within 12 km of the site, as shown in **Figure 7.** These areas are known to contain extensive areas of intact remnant vegetation, which provides much higher quality habitat values for black cockatoos compared to the highly disturbed habitat within the site.

Given the above, the net loss of 0.57 ha of CBC foraging habitat and the loss of 314 scattered habitat trees is not expected to reduce the area of occupancy of the species. In addition, the loss of 10 potential habitat trees with suitable hollows will be mitigated by the installation of 20 artificial hollows within future conservation and drainage reserves, which will be monitored and maintained for a period of five years. Therefore, the proposed action is unlikely to reduce the area of occupancy of the species.

3. Fragment an existing population into two or more populations

Likelihood: Unlikely

Comment:

CBC are a highly mobile species and known to routinely cover large distances that do not require continuous habitat coverage. The proposed action only covers an area of 127 ha, which includes 7.17 ha of CBC foraging habitat, of which only 0.57 ha is proposed to be cleared as part of the proposed action. The site is also situated in proximity to a number of large areas of CBC habitat as discussed previously, and as shown in **Figure 6** and **Figure 7.**

Furthermore, the LSP has been specifically designed to accommodate the environmental values within the site, including the maintenance of any ecological linkages. As such, and as is illustrated in **Figure 1,** the conservation and drainages reserves have been positioned to retain areas with the highest environmental values, and to ensure that habitat corridors and linkages are maintained within the site and to adjacent lots. Conservation of this vegetation will avoid further degradation of these areas.

Based on the above information, the proposed action will not lead to an increase in existing gaps between known patches of habitat, nor fragment an existing population of CBC into two or more populations.

4. Adversely affect habitat critical to the survival of a species

Likelihood: Unlikely

Comment:

Habitat critical to survival for the CBC can be summarised as (DPaW 2013):

- The eucalypt woodlands that provide nest hollows used for breeding, together with nearby vegetation that provides feeding, roosting and watering habitat that supports successful breeding.

- Woodland sites known to have supported breeding in the past and which could be used in the future, provided adequate nearby food and/or water resources are available or are re-established;

- In the non-breeding season, the vegetation that provides food resources as well as the sites for nearby watering and night roosting that enable the cockatoos to effectively utilise the available food resources.

Approximately 12 trees were identified as containing hollows of a suitable size to potentially support black cockatoo nesting. However, no direct evidence of black cockatoos using any hollows was observed within the site during the two site assessments. In addition, there are also no available historic records of breeding or roosting occurring within the site.

A known breeding location for CBC occurs close to the north east of the site (< 6km) based on

the Department of Environment and Conservation (DEC, now named DBCA dataset (DEC 2011). No further information about this breeding site is available. Furthermore, known records of breeding activity are located approximately 13 km to the north in Chittering and approximately 15 km to the south east in Gidgegannup (Johnstone *et al.* 2011). Previous observations of black cockatoo roosting have been recorded in the general locality, with roosting activity previously observed at several locations near the Gnangara-moore River State Forest (Johnstone *et al.* 2011), as well as two confirmed CBC roosting sites within 12 km of the site during the Great Cocky Counts (Peck *et al.* 2017).

The proposed action will result in the clearing of 10 potential habitat trees with hollows suitable for black cockatoos. However, the proposed action will also include the retention of two potential habitat trees with hollows suitable for black cockatoos, and the installation of 20 artificial hollows within future conservation and drainage reserves. Recent trials have shown that CBC will breed readily in artificial hollows (Saunders 2014a, b; DPaW 2016) and this is considered to sufficiently mitigate any impacts associated with clearing these trees. These hollows will be monitored and managed by the proponent for a period of five years to ensure their effectiveness.

Foraging evidence was also identified within the site, therefore the site does contain 'vegetation that provides a food source' in accordance with the descriptions above. However, the proposed action will result in the retention of 92.1% of potential foraging habitat within the site for conservation, with only 7.9% of the intact foraging habitat within the site proposed to be cleared.

Given the above, the net loss of 0.57 ha of CBC foraging habitat and 10 potential habitat trees with hollows suitable for black cockatoos is not expected to adversely affect habitat critical to the survival of this species.

5. **Disrupt the breeding cycle of a population**

Likelihood: Unlikely

Comment:

The proposed action will result in the removal of 314 potential habitat trees, of which 10 contain hollows of a suitable size for CBC nesting. None of these hollows were identified as having past or present use by black cockatoos during the two site specific surveys of the site.

As described previously, availability of nearby foraging resources is an important consideration for breeding habitat, with potential habitat trees in proximity to foraging vegetation preferred by CBC (Saunders et al. 2014). The potential habitat trees proposed to be cleared within the site, occur in a highly disturbed landscape, and are typically scattered and isolated. Because of this, it is considered unlikely that these potential breeding trees would be considered ideal breeding habitat for CBC. In addition to this, the 62 potential habitat trees that were targeted for

retention, are considered to provide a higher habitat value, given that they are close to water sources (wetlands and drainage lines) and form contiguous areas of habitat within the site and to habitat within adjacent Lots (**Figure 1**).

Furthermore, it is estimated that approximately 21 ha of potential breeding habitat occurs within 1 km of the site, 1,827 ha of occurs within 6 km of the site and 7,100 ha within 12 km of the site, as shown in **Figure 7**. These areas are known to contain extensive areas of intact remnant vegetation, including potential habitat trees and foraging resources, which is likely to provide much higher quality breeding habitat, compared to the highly disturbed habitat within the site.

A known breeding location for CBC occurs close to the north east of the site (< 6km) based on the DEC dataset (now named DBCA (DEC 2011). No further information about this breeding site is available. Furthermore, known records of breeding activity are located approximately 13 km to the north in Chittering and approximately 15 km to the south east in Gidgegannup (Johnstone *et al.* 2011). Illustrating the use of adjacent areas for breeding, rather than the use of this site.

Given the availability of potential breeding habitat within close proximity to the site, as well as the retention of 62 potential habitat trees (including two that contain potentially suitable hollows) and the provision of 20 artificial hollows within future conservation and drainage reserves, the clearing of 314 potential habitat trees is unlikely to disrupt the breeding cycle of a population of CBC.

6. Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

Likelihood: Unlikely

Comment:

Decline in this sense has been interpreted to mean a decline in the distribution and abundance of CBCs. The proposed action involves the clearing of 0.57 ha of CBC foraging habitat, however 6.60 ha (92.1%) is proposed to be retained within the site. Given the small extent of net foraging habitat loss within the site, as well as the large areas of CBC foraging habitat in close proximity to the site (18,085 ha within a 12 km radius), as shown in **Figure 6,** the proposed action is unlikely to modify, destroy, remove, isolate or decrease the availability or quality of foraging habitat to the extent that the species is likely to decline.

The proposed action also involves the clearing of 314 potential habitat trees. However, given the retention of 62 potential habitat trees, the provision of 20 artificial hollows within future conservation and drainage reserves, and given the large areas of potential breeding habitat that occurs in close proximity to the site (**Figure 7**), the clearing of 314 potential habitat trees, is unlikely to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the

extent that the species is likely to decline.

7. Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat

Likelihood: Unlikely

Comment:

The key consideration for this criteria would be the introduction of species that are known to compete with black cockatoos for nesting hollows. These species include the native and introduced corellas (Cacatua species), galahs (Cacatua roseicapilla), Australian shelducks (Tadorna tadornoides), Australian wood ducks (Chenonetta jubata) and feral European honey bees (Apis mellifera).

The proposed action is located in an area that is already highly modified with a variety of historical and existing land uses. In addition, a number of these species have already been recorded within the area as confirmed by the NatureMap search results undertaken as part of the fauna assessment (Harewood 2013). The proposed action is therefore unlikely to either introduce or further establish any of these species within the site or in immediate surrounding areas.

8. Introduce disease that may cause the species to decline

Likelihood: Unlikely

Comment:

CBCs are potentially susceptible to diseases such as beak and feather disease virus (BFDV), avian polyomavirus (APV) and chlamydophilosis. Phytophthora cinnamomi (dieback), other soil-borne, foliar and canker pathogens, and insects can affect the health of CBC habitat.

The proposed action is very unlikely to be responsible for the introduction of these diseases or increase the susceptibility of birds to these, as the site is already highly modified with a variety of historical land uses. Any soil brought into the site to facilitate development and/or landscaping will be certified dieback free and therefore will not introduce dieback into the site. In addition, best practice construction management will ensure the implementation of measures to avoid the introduction of soil borne pathogens that could impact surrounding habitat.

Based on the above, the proposed action is unlikely to introduce disease/s that may cause the CBC species to decline.

9. Interfere with the recovery of the species.

Likelihood: Unlikely

Comment:

The recovery objective for CBCs is "*to stop further decline in the distribution and abundance of Carnaby's cockatoos by protecting the birds throughout their life stages and enhancing habitat critical for survival throughout their breeding and non-breeding range, ensuring that the reproductive capacity of the species remains stable or increases*" (DPaW 2013).

Given that no known breeding trees are located within the site, and given that there is substantial habitat retained within the site (6.6 ha of foraging habitat and 62 potential breeding trees), it is considered unlikely that the net loss of 0.57 ha of CBC foraging habitat and the clearing of 314 potential habitat trees will interfere with the recovery of the species.

Furthermore, as explained previously substantial areas of habitat occurs in close proximity to the site as shown in **Figure 6** and **Figure 7.** These areas are known to contain extensive areas of intact remnant vegetation, including potential habitat trees, which provides much higher quality habitat values for black cockatoos compared to the highly disturbed habitat within the site.

Based on the above, it is considered unlikely that the net loss of 0.57 ha of foraging habitat and 314 potential habitat trees will interfere with the recovery of the species.

5.2.2 Forest red-tailed black cockatoo

1. lead to a long-term decrease in the size of an important population of a species

Likelihood: Unlikely

Comment:

In order to lead to a long term, decrease in the size of a population, the proposed action would need to bring about a sustained reduction in birth rates and/or a sustained increased in mortality rates for the species.

As discussed previously, a total of 376 potential black cockatoo habitat trees were identified within the site, as shown in **Figure 5,** only 12 of these trees were identified as containing hollows of a suitable size to potentially support black cockatoo nesting. Of those 364 remaining trees, 49 were recorded as *Eucalyptus camaldulensis* (River Red Gum), *Eucalyptus todtiana* (Coastal Blackbutt or Prickly Bark) or *Eucalyptus grandis* (Flooded Gum, Rose Gum), which are considered less likely tree species to create hollows suitable for black cockatoos and are therefore considered lower value.

The proposed action will result in the retention of 62 potential habitat trees, including two potential habitat trees with hollows suitable for black cockatoos, and the loss of 314 potential habitat trees, including 10 potential habitat trees with hollows suitable for black cockatoos. No direct evidence of black cockatoos using any hollows was observed within the site during the two site assessments, and therefore, overall, the site does not contain any confirmed black cockatoo breeding habitat. Given that no historic and active nesting and breeding habitat trees are known to occur within the site, birth rates are deemed to be extremely low, if not zero within the site.

FRTBC nests are typically clustered in the landscape, where nests are clumped together in remnant patches of vegetation (Johnstone *et al.* 2013). As is illustrated in **Figure 5,** the potential habitat trees proposed to be cleared within the site, occur in a highly disturbed landscape, and are typically scattered and isolated. Because of this, it is considered unlikely that these potential breeding trees would be considered ideal breeding habitat for FRTBC. It is estimated that approximately 21 ha of potential breeding habitat occurs within 1 km of the site, 1,827 ha of occurs within 6 km of the site and 7,100 ha within 12 km of the site, as shown in **Figure 7**. These areas are known to contain extensive areas of intact remnant vegetation, including potential habitat trees and foraging resources, which is likely to be preferred by black cockatoos, compared to the highly disturbed habitat within the site. As such, FRTBCs are unlikely to be dependent on vegetation within the site.

The proposed action will also include the installation of 20 artificial hollows within future conservation and drainage reserves to mitigate the loss of the 10 trees with hollows of a suitable size for black cockatoo species. These hollows will be monitored and maintained for a period of five years to ensure their effectiveness. Based on the above, the proposed action is unlikely to disrupt existing breeding activity or preclude future potential breeding activity within the site that would result in a sustained reduction in FRTBC birth rates.

In addition, the proposed action is unlikely to increase mortality rates through direct bird deaths (vehicle strikes, hunting etc.) as the site occurs in an already disturbed landscape in an area transitioning from rural and resource extraction to urban land uses, and FRTBCs as a mobile species are able to avoid dangers associated with development.

The proposed action is also unlikely to increase mortality rates indirectly through a reduction of foraging resources, given that the site only contains scattered habitat trees considered to be potential foraging habitat for FRTBC.

Lastly, the proposed action will also require the completion of a number of management plans as part of the planning process. This includes a KCHTRP to support each stage of subdivision,

preparation of a tree retention plan (or similar) as part of each Development Application, and a FVWWMP to support subdivisional works. These documents will ensure additional protection of black cockatoo habitat where possible, and provide appropriate management of the future conservation and drainage reserves during development.

Given the above, the net loss of 314 potential habitat trees, is not expected to lead to a long-term decrease in the size of a population.

2. reduce the area of occupancy of an important population

Likelihood: Unlikely

Comment:

The vegetation proposed for removal within the site is considered highly disturbed due to the previously rural land use, and contains only scattered mainly isolated trees that are considered FRTBC habitat. The loss of approximately 314 scattered paddock trees is not considered significant given the extent of potential breeding habitat in the local area (appoximately 21 ha of within 1 km of the site, 1,827 ha of occurs within 6 km of the site and 7,100 ha within 12 km of the site, as shown in **Figure 7).** These areas are known to contain extensive areas of intact remnant vegetation, which provides much higher quality habitat values for black cockatoos compared to the highly disturbed habitat within the site.

Given the above, the loss of 314 scattered habitat trees is not expected to reduce the area of occupancy of the species. In addition, the loss of 10 potential habitat trees with suitable hollows will be mitigated by the installation of 20 artificial hollows within future conservation and drainage reserves, which will be monitored and maintained for a period of five years. Therefore, the proposed action is unlikely to reduce the area of occupancy of the species.

3. fragment an existing important population into two or more populations

Likelihood: Unlikely

Comment:

FRTBC are a highly mobile species and known to routinely cover large distances that does not require continuous habitat coverage. The proposed action covers an area of 127 ha, of which only 376 scattered paddock trees represent FRTBC foraging habitat within the site. The proposed action will include the retention of 62 of these potential habitat trees, and the site is also situated in proximity to a number of large areas of FRTBC habitat, as shown in **Figure 7.**

Furthermore, the LSP has been specifically designed to accommodate the environmental values within the site, including the maintenance of any ecological linkages. As such, and as is illustrated in **Figure 1,** the conservation and drainages reserves have been positioned to retain areas with the highest environmental values, and to ensure that habitat corridors and linkages are maintained within the site and to adjacent lots and further degradation of the vegetation is avoided.

Based on the above information, the proposed action will not lead to an increase in existing gaps between known patches of habitat, nor fragment an existing population of FRTBC into two or more populations.

4. adversely affect habitat critical to the survival of a species

Likelihood: Unlikely

Comment:

Habitat critical to survival for the FRTBC can be summarised as (DEC 2007):

- areas currently occupied by the cockatoos;
- areas not currently occupied by the cockatoos due to recent fire but capable of supporting cockatoo populations when sufficiently recovered;
- areas of natural vegetation in which the cockatoos nest, feed and roost;
- areas of natural vegetation through which the cockatoos can move from one occupied area to another; and
- areas of suitable vegetation within recorded range in which undiscovered cockatoo populations may exist.

As detailed above, approximately 12 trees were identified as containing hollows of a suitable size to potentially support black cockatoo nesting. However, no direct evidence of black cockatoos using any hollows was observed within the site during the two site assessments. In addition, there are also no available historic records of breeding occurring within the site.

In addition, no evidence of roosting activity was observed within the site, such as branch clippings, droppings or moulted feathers, which are normally associated with black cockatoo roost sites. This suggests that the site is unlikely to contain any permanent or established roosting areas which are frequently used by large flocks of cockatoos, which represents the most important roosting habitat for cockatoos. Previous observations of black cockatoo roosting have been recorded in the general locality, with roosting activity previously observed at several locations near the Gnangara-moore River State Forest (Johnstone *et al.* 2011). The findings of the Great Cocky Count (Peck *et al.* 2016) identified three confirmed FRTBC roosting sites within 12 km of the site (**Figure 7**).

The proposed action will result in the clearing of 314 potential habitat trees including 10 trees with hollows suitable for black cockatoos. However, the proposed action will also include the retention of 62 potential habitat trees, including two trees with hollows suitable for black cockatoos, as well as the installation of 20 artificial hollows within future conservation and drainage reserves. These hollows will be monitored and managed by the proponent for a period of five years to ensure their effectiveness.

Given the above, the net loss of 314 potential habitat trees is not expected to adversely affect habitat critical to the survival of this species.

5. disrupt the breeding cycle of an important population

Likelihood: Unlikely

Comment:

The proposed action will result in the removal of 314 potential habitat trees, of which 10 contain hollows of a suitable size for CBC nesting. None of these hollows were identified as having past or present use by black cockatoos during the two site specific surveys of the site.

As mentioned previously, FRTBC nests are typically clustered in the landscape, where nests are clumped together in remnant patches of vegetation (Johnstone et al. 2013). As is illustrated in **Figure 5,** the potential habitat trees proposed to be cleared within the site, occur in a highly disturbed landscape, and are typically scattered and isolated. Because of this, it is considered unlikely that these potential breeding trees would be considered ideal breeding habitat for FRTBC. In addition, it is estimated that approximately 21 ha of potential breeding habitat occurs within 1 km of the site, 1,827 ha of occurs within 6 km of the site and 7,100 ha within 12 km of the site, as shown in **Figure 7**. These areas are known to contain extensive areas of intact remnant vegetation, including potential habitat trees and foraging resources, which is likely to be preferred by black cockatoos, compared to the highly disturbed habitat within the site. As such, FRTBCs are unlikely to be dependent on the vegetation within the site.

Furthermore, the LSP has been specifically designed to accommodate the environmental values within the site. As such, the conservation and drainages reserves have been positioned to retain areas with the highest environmental values, which includes clusters of vegetation in good condition that contain potential habitat trees.

Given that no breeding is known to occur within the site, and given the extensive availability of potential breeding habitat within close proximity to the site, as well as the retention of 62 potential habitat trees (including two that contain potentially suitable hollows) and the provision of 20 artificial hollows within future conservation and drainage reserves, the clearing of 314 potential habitat trees is unlikely to disrupt the breeding cycle of a population of FRTBC.

6. modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

Likelihood: Unlikely

Comment:

Decline in this sense has been interpreted to mean a decline in the distribution and abundance of FRTBCs. The proposed action involves the clearing of approximately 314 potential habitat trees and the retention of 62 within the site. Given the small extent of net habitat loss within the site in contrast to large areas of FRBC habitat in close proximity to the site (7,100 ha within a

12 km radius), as shown in **Figure 7**, the proposed action is unlikely to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline. In addition, the provision of 20 artificial hollows within future conservation and drainage reserves, will assist to mitigate the loss of the 10 potential habitat trees which contain hollows potentially suitable for black cockatoos.

7. result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

Likelihood: Unlikely

Comment:

Similar to CBC, the key consideration for this criteria would be the introduction of species that are known to compete with black cockatoos for nesting hollows.

As mentioned previously, the proposed action is located in an area that is already highly modified with a variety of historical and existing land uses. In addition, a number of species which will compete with FRTBC have already been recorded within the area as confirmed by the *NatureMap* search results undertaken as part of the fauna assessment (Harewood 2013). The proposed action is therefore unlikely to either introduce or further establish any of these species within the site or in immediate surrounding areas.

8. introduce disease that may cause the species to decline

Likelihood: Unlikely

Comment:

Similar to CBC, FRTBCs are potentially susceptible to diseases such as beak and feather disease virus (BFDV), avian polyomavirus (APV) and chlamydophilosis. *Phytophthora cinnamomi* (dieback), other soil-borne, foliar and canker pathogens, and insects can affect the health of FRTBC habitat.

The proposed action is very unlikely to be responsible for the introduction of these diseases or increase the susceptibility of birds to these, as the site is already highly modified with a variety of historical land uses. Nevertheless, any soil brought into the site to facilitate development and/or landscaping will be certified dieback free and therefore will not introduce dieback into the site. In addition, best practice construction management will ensure the implementation of measures to avoid the introduction of soil borne pathogens that could impact surrounding habitat.

Based on the above, the proposed action is unlikely to introduce disease/s that may cause the FRTBC to decline.

9. interfere substantially with the recovery of the species.

Likelihood: Unlikely

Comment:

The recovery objective for FRTBC is "*to stop further decline in the breeding populations of the Forest Red-tailed Black Cockatoo and to ensure their persistence throughout their current range in the south-west of Western Australia for the duration of this plan*" (DEC 2007).

Given that no known breeding trees are located within the site, and given that there is habitat retained within the site (62 potential breeding trees) as well as 20 artificial hollows proposed to be installed, it is considered unlikely that the net loss of 314 ha of potential habitat trees will interfere with the recovery of the species.

Furthermore, as explained previously substantial areas of habitat occurs in close proximity to the site as shown in **Figure 7.** These areas are known to contain extensive areas of intact remnant vegetation, including potential habitat trees, which provides much higher quality habitat values for black cockatoos compared to the highly disturbed habitat within the site.

Based on the above, it is considered unlikely that the net loss of 314 potential habitat trees will interfere with the recovery of the species.

Section 6 – Environmental record of the person proposing to take the action

Provide details of any proceedings under Commonwealth, State or Territory law against the person proposing to take the action that pertain to the protection of the environment or the conservation and sustainable use of natural resources.

6.1 Does the person taking the action have a satisfactory record of responsible environmental management? Please explain in further detail.

Sirona Capital Pty Ltd is an Australian specialist alternative funds manager with a focus on urban renewal, private real estate (including industrial development) and agriculture. Sirona have extensive experience in residential, commercial and industrial land development. In undertaking its project, Sirona has an acceptable record of responsible environmental management.

6.2 Provide details of any past or present proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources against either (a) the person proposing to take the action or, (b) if a permit has been applied for in relation to the action – the person making the application.

Not applicable.

6.3 If it is a corporation undertaking the action will the action be taken in accordance with the corporation's environmental policy and framework?

Yes

6.3.1 If the person taking the action is a corporation, please provide details of the corporation's environmental policy and planning framework.

Sirona Capital Pty Ltd does not have a corporate environmental policy; however, it is committed to responsible environmental management.

6.4 Has the person taking the action previously referred an action under the EPBC Act, or been responsible for undertaking an action referred under the EPBC Act?

No

Section 7 – Information sources

You are required to provide the references used in preparing the referral including the reliability of the source.

7.1 List references used in preparing the referral (please provide the reference source reliability and any uncertainties of source).

Reference Source	Reliability	Uncertainties
Churchward, H. M. and McArthur, W. M. 1980, 'Landforms and Soils of the Darling System, Western Australia', in Department of Conservation and Environment (ed.), Atlas of Natural Resources Darling System Western Australia, Department of Conservation and Environment, Perth.	Reliable	No uncertainties known
Department of Agriculture and Food (DAFWA) 2016, Current Extent of Native Vegetation - Western Australia (October 2016), Spatial dataset published by DAFWA, Perth.	Reliable	No uncertainties known
Department of Environment and Conservation (DEC) 2007, Forest Black Cockatoo (Baudin's Cockatoo - Calyptorhynchus baudinii) and Forest Red-tailed Black Cockatoo (Calyptorhynchus banksii naso) Recovery Plan, DEC, Perth.	Reliable	No uncertainties known
Department of Water (DoW) 2008, LiDAR Elevation Dataset, Swan Coastal Plain, Department of Water, Perth.	Reliable	No uncertainties known
Department of Parks and Wildlife (DPaW) 2013, Carnaby's cockatoo (Calyptorhynchus latirostris) Recovery Plan, Department of	Reliable	No uncertainties known

Reference Source	Reliability	Uncertainties
Parks and Wildlife, Perth, Western Australia.		
Department of Parks and Wildlife (DPaW) 2016, Nesting hollows installed for Carnaby's, Parks and Wildlife News, May 2016.	Reliable	No uncertainties known
Emerge Associates 2013, Flora and Vegetation Report: Pt Lot M1313 Great Northern Highway, Muchea, unpublished report prepared by Emerge Associates, Subiaco.	Reliable	No uncertainties known
Emerge Associates 2017, Technical Memorandum: Update to flora and vegetation assessment focussing on wetland vegetation, Unpublished memorandum for Sirona Capital.	Reliable	No uncertainties known
Gibson, N., Keighery, B., Keighery, G., Burbidge, A. and Lyons, M. 1994, A Floristic survey of the southern Swan Coastal Plain, Department of Conservation and Land Management and the Conservation Council of Western Australia, Perth.	Reliable	No uncertainties known
Glossop, B., Clarke, K., Mitchell, D. and Barrett, G. 2011, Methods for mapping Carnaby’s cockatoo habitat, Department of Environment and Conservation, Perth.	Reliable	No uncertainties known
Gozzard, J. R. 1982, Muchea, Sheet 2034 I and Part 2134 IV, Geological Survey of Western Australia, Perth.	Reliable	No uncertainties known
Harewood, G. 2013, Fauna Assessment - Lot 1313 (pt) Great Northern Highway Muchea, unpublished report prepared by Greg Harewood, Bunbury.	Reliable	No uncertainties known
Heddle, E. M., Loneragan, O.	Reliable	No uncertainties known

Reference Source	Reliability	Uncertainties
W. and Havel, J. J. 1980, 'Vegetation Complexes of the Darling System Western Australia', in Department of Conservation and Environment (ed.), Atlas of Natural Resources Darling System Western Australia, Department of Conservation and Environment, Perth.		
Infra Tech Group 2015, Lot 102, Great Northern Highway, Muchea Geotechnical Investigation, Perth.	Reliable	No uncertainties known
Johnstone, R. E., Johnstone, C. and Kirkby, T. 2011, Black Cockatoos on the Swan Coastal Plain: Carnaby's Cockatoo (Calyptorhynchus latirostris), Baudin's 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., Report for the Department of Planning, Western Australia.	Reliable	No uncertainties known
Johnstone, R. E., Kirkby, T. and 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(2): 121-142.	Reliable	No uncertainties known
Peck, A., Barret, G. and Williams, M. 2017, The 2017 Great Cocky Count: a community-based survey for	Reliable	No uncertainties known

Reference Source	Reliability	Uncertainties
Carnaby's Black-Cockatoo (Calyptorhynchus latirostris), Baudin's Black-Cockatoo (Calyptorhynchus baudinii) and Forest Red-tailed Black-Cockatoo (Calyptorhynchus banksii naso). BirdLife Australia, Floreat, Western Australia.		
Peck, A., Barrett, G. and Williams, M. 2016, The 2016 Great Cocky Count: a community?based survey for Carnaby's Black?Cockatoo (Calyptorhynchus latirostris) and Forest Red?tailed Black?Cockatoo (Calyptorhynchus banksii naso), BirdLife Australia, Floreat, Western Australia.	Reliable	No uncertainties known
Saunders, D. A., Mawson, P.R., Dawson, R. 2014a, One fledgling or two in the endangered Carnaby's Cockatoo (Calyptorhynchus latirostris): a strategy for survival or legacy from a bygone era?, Conservation Physiology, 2(1): cou001.	Reliable	No uncertainties known
Saunders, D. A., Mawson, P.R., Dawson, R. 2014b, Use of tree hollows by Carnaby's Cockatoo and the fate of large hollow-bearing trees at Coomallo Creek, Western Australia 1969-2013., Biological Conservation, 177: 185-193.	Reliable	No uncertainties known
Western Australian Planning Commission (WAPC) 2011, Muchea Employment Node Structure Plan: Final Report, Western Australian Planning Commission, Perth.	Reliable	No uncertainties known

Section 8 – Proposed alternatives

You are required to complete this section if you have any feasible alternatives to taking the proposed action (including not taking the action) that were considered but not proposed.

8.0 Provide a description of the feasible alternative?

Not applicable.

8.1 Select the relevant alternatives related to your proposed action.

8.27 Do you have another alternative?

No

Section 9 – Contacts, signatures and declarations

Where applicable, you must provide the contact details of each of the following entities: Person Proposing the Action; Proposed Designated Proponent and; Person Preparing the Referral. You will also be required to provide signed declarations from each of the identified entities.

9.0 Is the person proposing to take the action an Organisation or an Individual?

Organisation

9.2 Organisation

9.2.1 Job Title

Managing Director

9.2.2 First Name

Kevin

9.2.3 Last Name

Flynn

9.2.4 E-mail

kflynn@sirona.capital.com

9.2.5 Postal Address

PO Box 1944
West Perth WA 6872
Australia

9.2.6 ABN/ACN

ACN

149096284 - SIRONA CAPITAL MANAGEMENT PTY LTD

9.2.7 Organisation Telephone

08 9212 1200

9.2.8 Organisation E-mail

info@sironacapital.com

9.2.9 I qualify for exemption from fees under section 520(4C)(e)(v) of the EPBC Act because I am:

Not applicable

Small Business Declaration

I have read the Department of the Environment and Energy's guidance in the online form concerning the definition of a small a business entity and confirm that I qualify for a small business exemption.

Signature:..... Date: .....

9.2.9.2 I would like to apply for a waiver of full or partial fees under Schedule 1, 5.21A of the EPBC Regulations

No

9.2.9.3 Under sub regulation 5.21A(5), you must include information about the applicant (if not you) the grounds on which the waiver is sought and the reasons why it should be made

Person proposing the action - Declaration

I, Kelvin Flynn, declare that to the best of my knowledge the information I have given on, or attached to the EPBC Act Referral is complete, current and correct. I understand that giving false or misleading information is a serious offence. I declare that I am not taking the action on behalf of or for the benefit of any other person or entity.

Signature:..... Date: 18.12.17

I, Kelvin Flynn, the person proposing the action, consent to the designation of Kelvin Flynn as the proponent of the purposes of the action describe in this EPBC Act Referral.

Signature:..... Date: 18.12.17

9.3 Is the Proposed Designated Proponent an Organisation or Individual?

Organisation

9.5 Organisation

9.5.1 Job Title

Managing Director

9.5.2 First Name

Kevin

9.5.3 Last Name

Flynn

9.5.4 E-mail

kflynn@sirona.capital.com

9.5.5 Postal Address

PO Box 1944,
West Perth WA 6872
Australia

9.5.6 ABN/ACN

ACN

149096284 - SIRONA CAPITAL MANAGEMENT PTY LTD

9.5.7 Organisation Telephone

08 9212 1200

9.5.8 Organisation E-mail

info@sironacapital.com

Proposed designated proponent - Declaration

I, Kelvin Flynn, the proposed designated proponent, consent to the designation of myself as the proponent for the purposes of the action described in this EPBC Act Referral.

Signature: ..... Date: 20 - 12 - 2017

9.6 Is the Referring Party an Organisation or Individual?

Organisation

9.8 Organisation

9.8.1 Job Title

Senior Environmental Consultant

9.8.2 First Name

Anna

9.8.3 Last Name

Welker

9.8.4 E-mail

Anna.welker@emergeassociates.com.au

9.8.5 Postal Address

Suite 4, 26 Railway Road
Subiaco WA 6008
Australia

9.8.6 ABN/ACN

ABN

57144772510 - Emerge Environmental Services Pty Ltd

9.8.7 Organisation Telephone

08 9380 4988

9.8.8 Organisation E-mail

admin@emergeassociates.com.au

Referring Party - Declaration

I, Anna Welker, I declare that to the best of my knowledge the information I have given on, or attached to this EPBC Act Referral is complete, current and correct. I understand that giving false or misleading information is a serious offence.

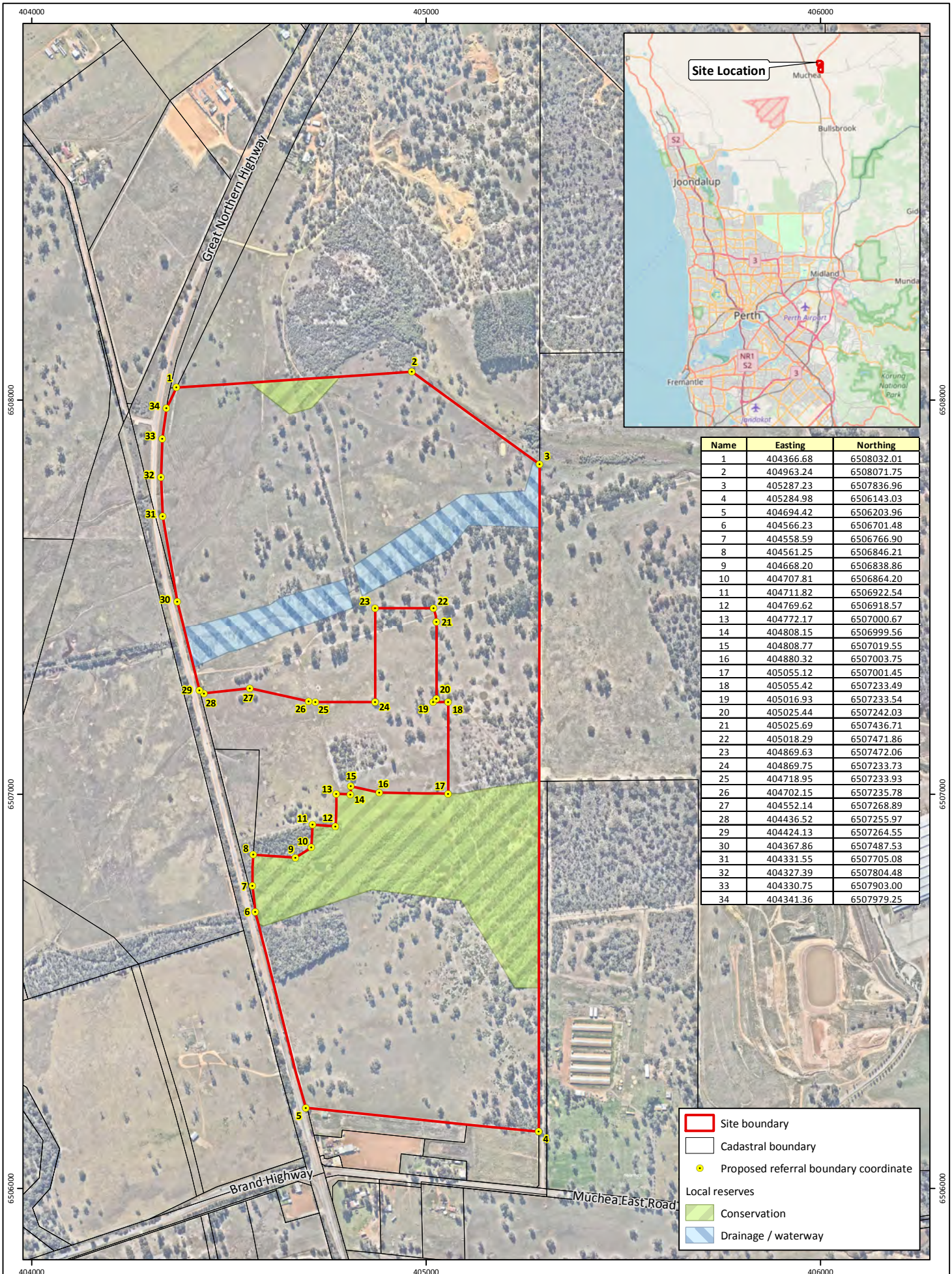
Signature: ..... Date: 18/12/17

Appendix A - Attachments

The following attachments have been supplied with this EPBC Act Referral:

1. combined_figures_reduced.pdf
2. ep12-05201-011_flora_and_vegetation_survey_2013_emerge_associates.pdf
3. ep15-03701-030a_vegetation_summary_2017_emerge.pdf
4. fauna_assessment_report_2013_harewood.pdf

ATTACHMENT 1: REFERRAL FIGURES



Name	Easting	Northing
1	404366.68	6508032.01
2	404963.24	6508071.75
3	405287.23	6507836.96
4	405284.98	6506143.03
5	404694.42	6506203.96
6	404566.23	6506701.48
7	404558.59	6506766.90
8	404561.25	6506846.21
9	404668.20	6506838.86
10	404707.81	6506864.20
11	404711.82	6506922.54
12	404769.62	6506918.57
13	404772.17	6507000.67
14	404808.15	6506999.56
15	404808.77	6507019.55
16	404880.32	6507003.75
17	405055.12	6507001.45
18	405055.42	6507233.49
19	405016.93	6507233.54
20	405025.44	6507242.03
21	405025.69	6507436.71
22	405018.29	6507471.86
23	404869.63	6507472.06
24	404869.75	6507233.73
25	404718.95	6507233.93
26	404702.15	6507235.78
27	404552.14	6507268.89
28	404436.52	6507255.97
29	404424.13	6507264.55
30	404367.86	6507487.53
31	404331.55	6507705.08
32	404327.39	6507804.48
33	404330.75	6507903.00
34	404341.36	6507979.25

Figure 1: Location Plan

Project: EPBC Act Referral
Muchea Industrial Precinct Subdivision Support
Client: Sirona Capital Pty Ltd

Plan Number:
EP17-089(02)--F14
Drawn: KNM
Date: 06/11/2017
Checked: JHL
Approved: ACW
Date: 15/11/2017

N

0 100 200 300
Metres
Scale: 1:12,500@A4
GDA 1994 MGA Zone 50

emerge ASSOCIATES

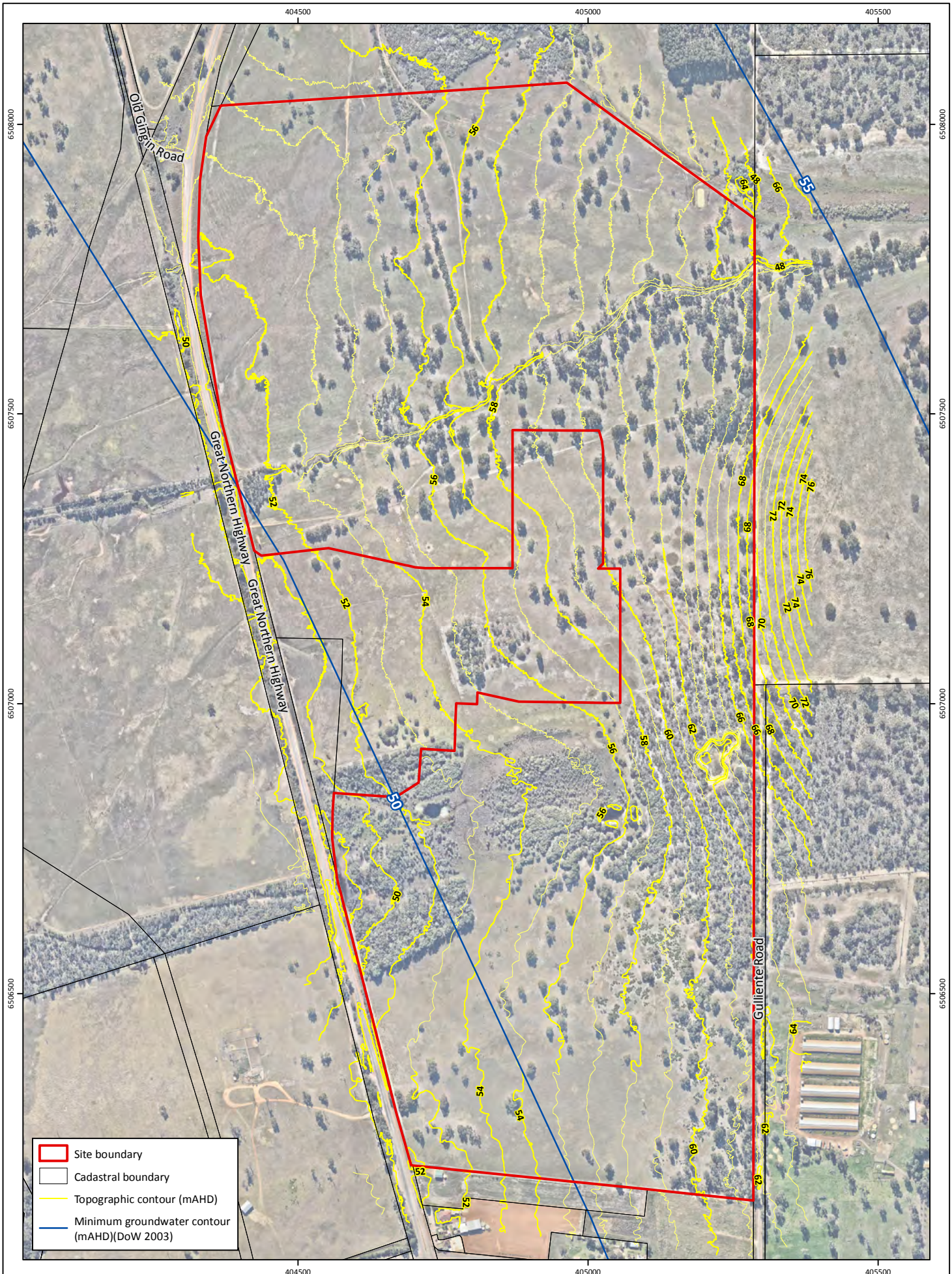


Figure 2: Topography and Groundwater Levels

Project: EPBC Act Referral
Muchea Industrial Precinct Subdivision Support
Client: Sirona Capital Pty Ltd

Plan Number:
EP17-089(02)--F15

Drawn:	KNM
Date:	06/11/2017
Checked:	JHL
Approved:	ACW
Date:	15/11/2017

N

0 100 200
Metres

Scale: 1:8,500@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

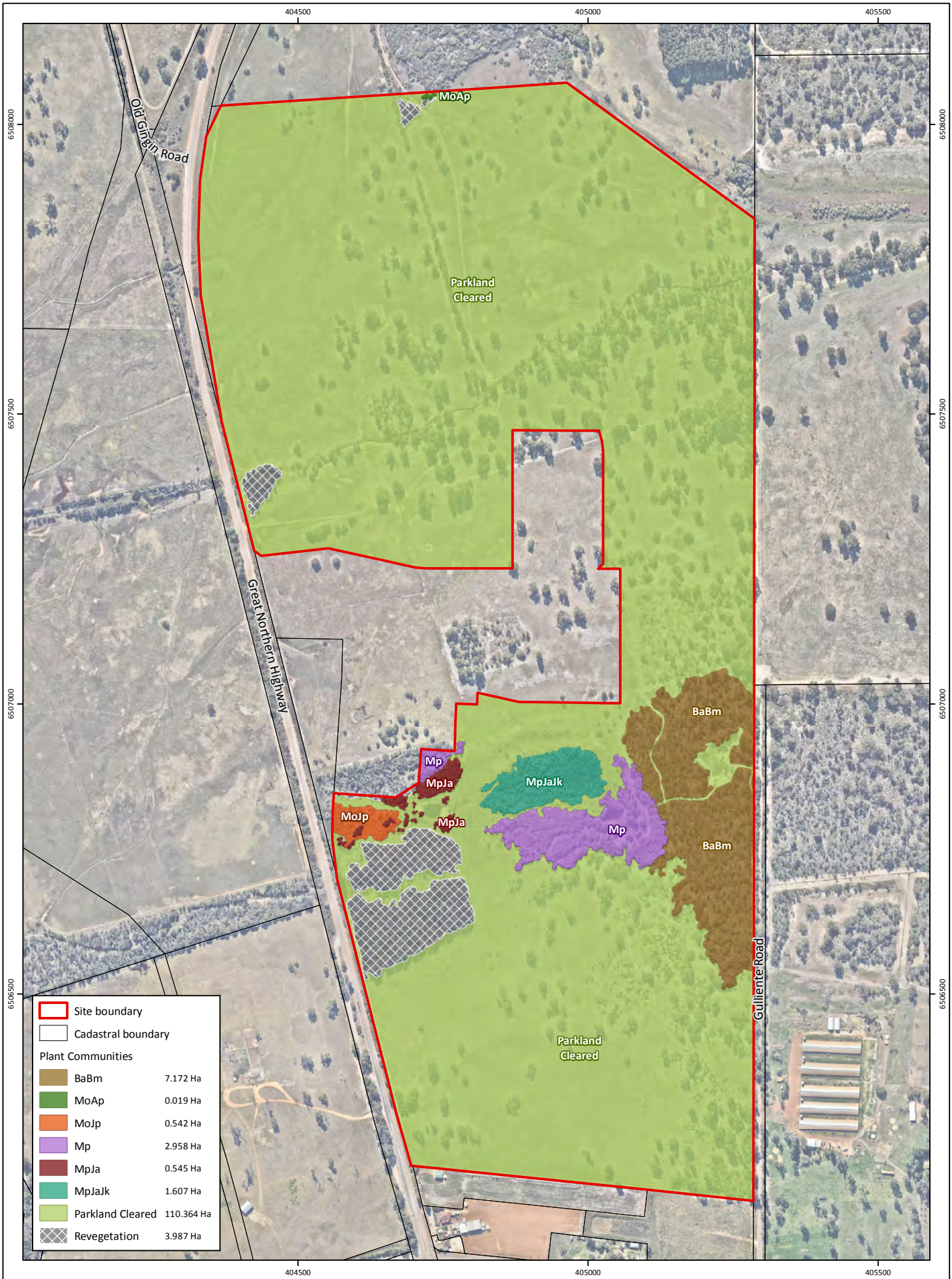


Figure 3: Plant Communities

Project: EPBC Act Referral
Muchea Industrial Precinct Subdivision Support
Client: Sirona Capital Pty Ltd

Plan Number: EP17-089(02)--F16
Drawn: KNM
Date: 18/10/2017
Checked: JHL
Approved: ACW
Date: 15/11/2017

N

0 100 200
Metres
Scale: 1:8,500@A4
GDA 1994 MGA Zone 50

emerge ASSOCIATES

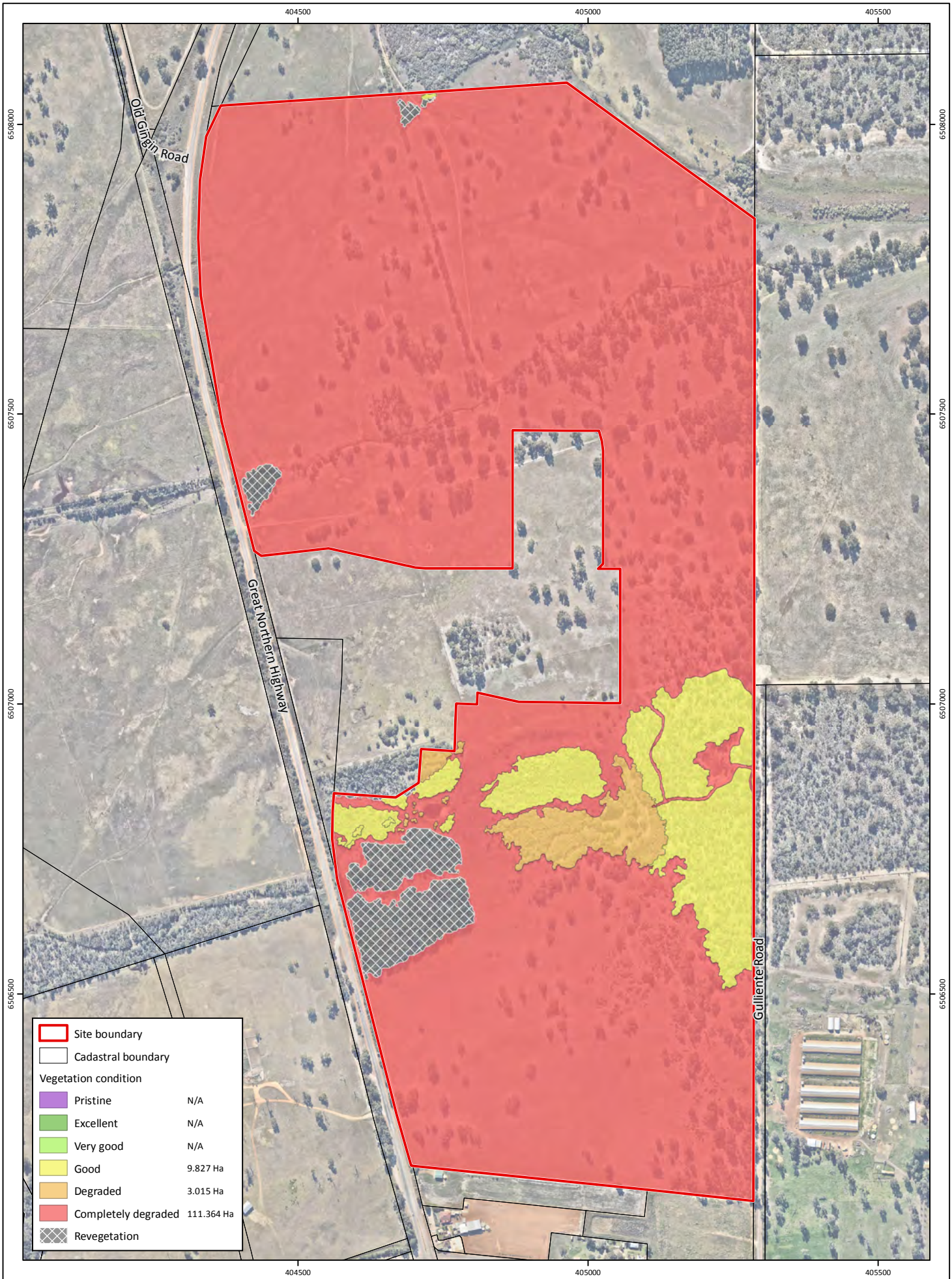


Figure 4: Vegetation Condition

Project: EPBC Act Referral
Muchea Industrial Precinct Subdivision Support
Client: Sirona Capital Pty Ltd

Plan Number:
EP17-089(02)--F17

Drawn:	KNM
Date:	06/11/2017
Checked:	JHL
Approved:	ACW
Date:	15/11/2017

N

0 100 200
Metres

Scale: 1:8,500@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

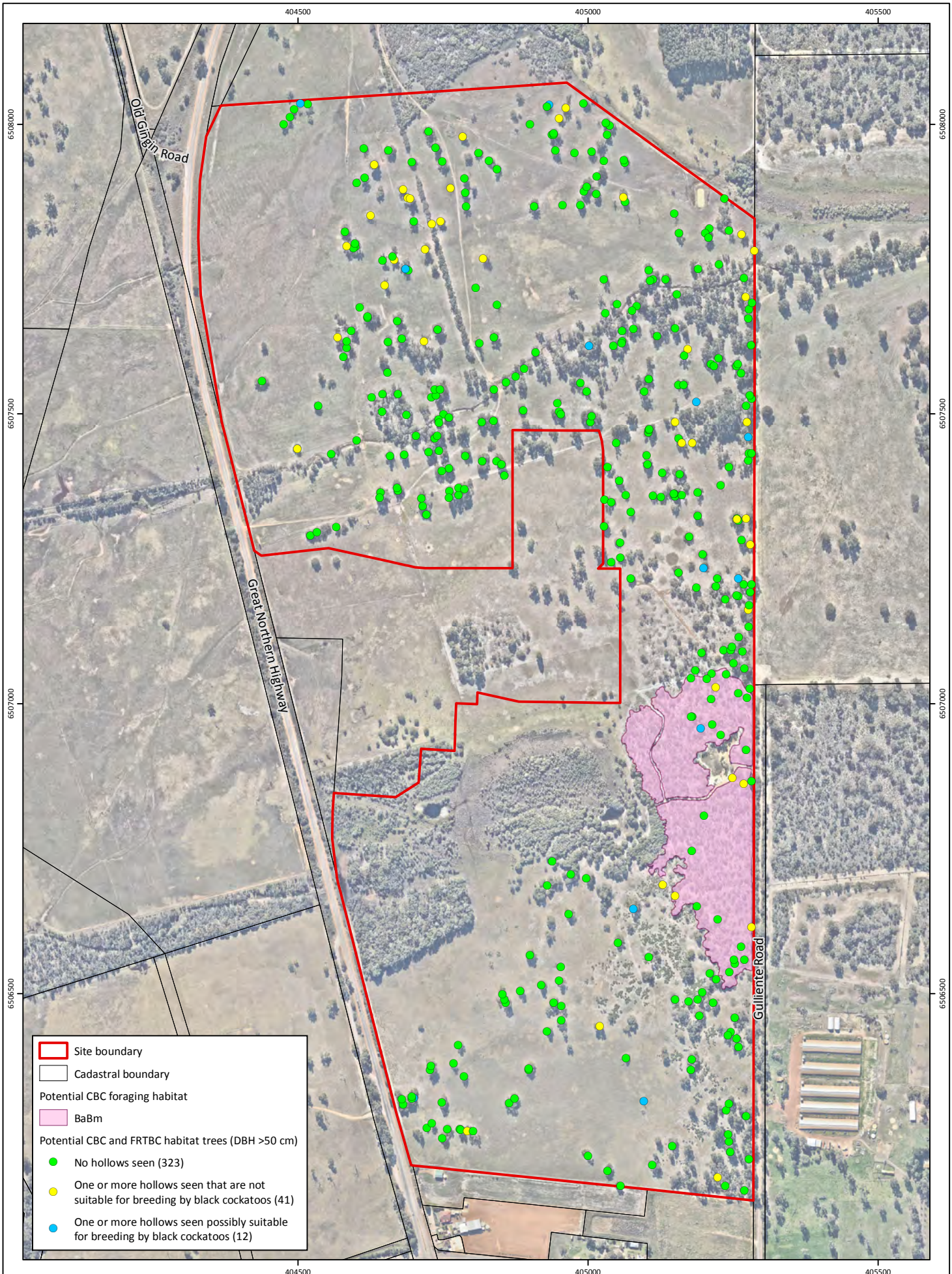


Figure 5: **Potential Black Cockatoo Habitat Trees and Foraging Habitat**

Project: EPBC Act Referral
Muchea Industrial Precinct Subdivision Support
Client: Sirona Capital Pty Ltd

Plan Number: EP17-089(02)--F18

Drawn:	KNM
Date:	06/11/2017
Checked:	JHL
Approved:	ACW
Date:	15/11/2017

N

0 100 200
Metres
Scale: 1:8,500@A4
GDA 1994 MGA Zone 50

emerge ASSOCIATES

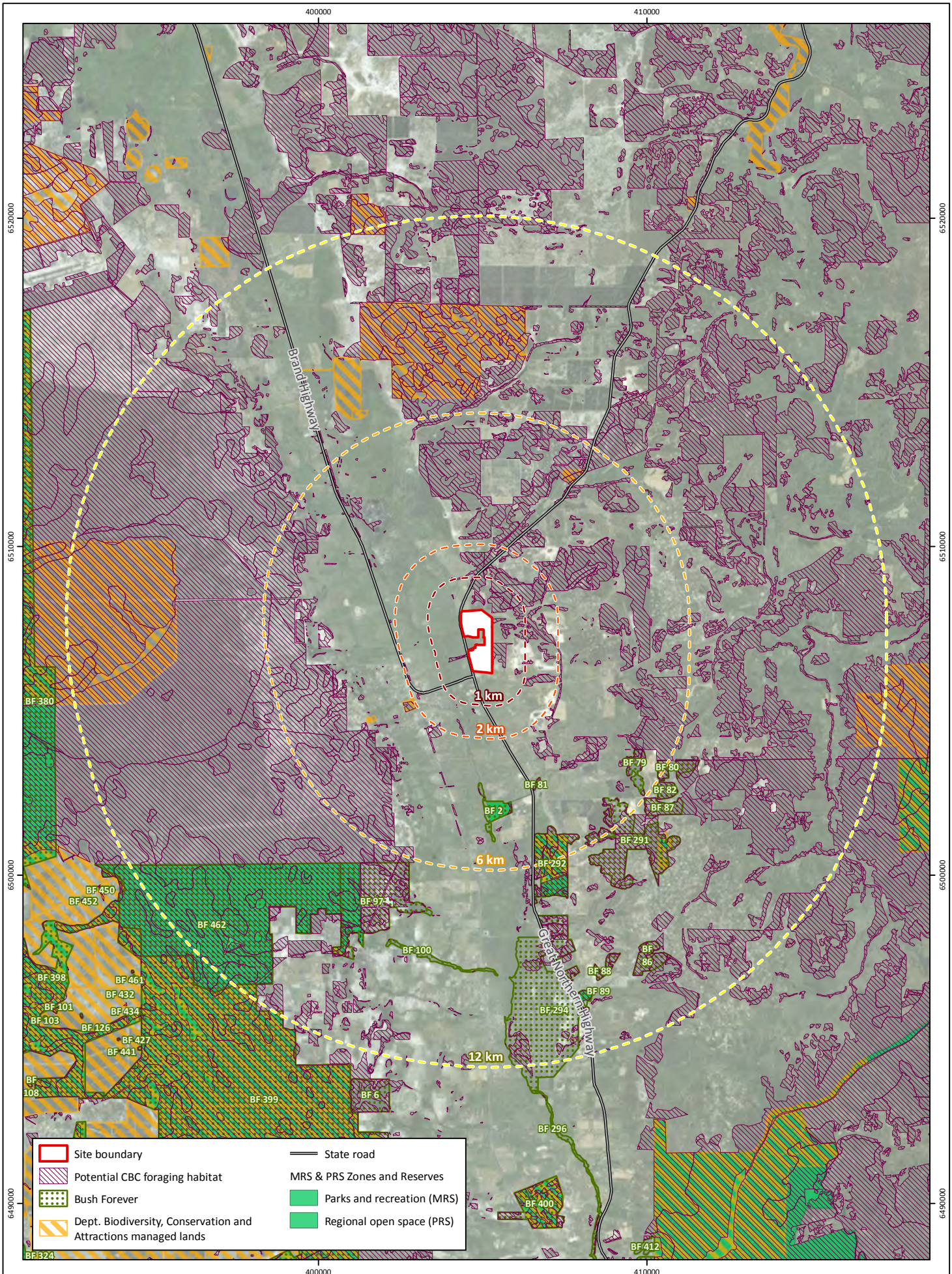


Figure 6: **Potential Carnaby's Black Cockatoo Foraging Habitat - Regional Distribution**

Project: EPBC Act Referral
Muchea Industrial Precinct Subdivision Support

Client: Sirona Capital Pty Ltd

Plan Number: EP17-089(02)--F19

Drawn:	KNM
Date:	08/11/2017
Checked:	JHL
Approved:	ACW
Date:	15/11/2017

N

0 1 2 3
Kilometres

Scale: 1:150,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

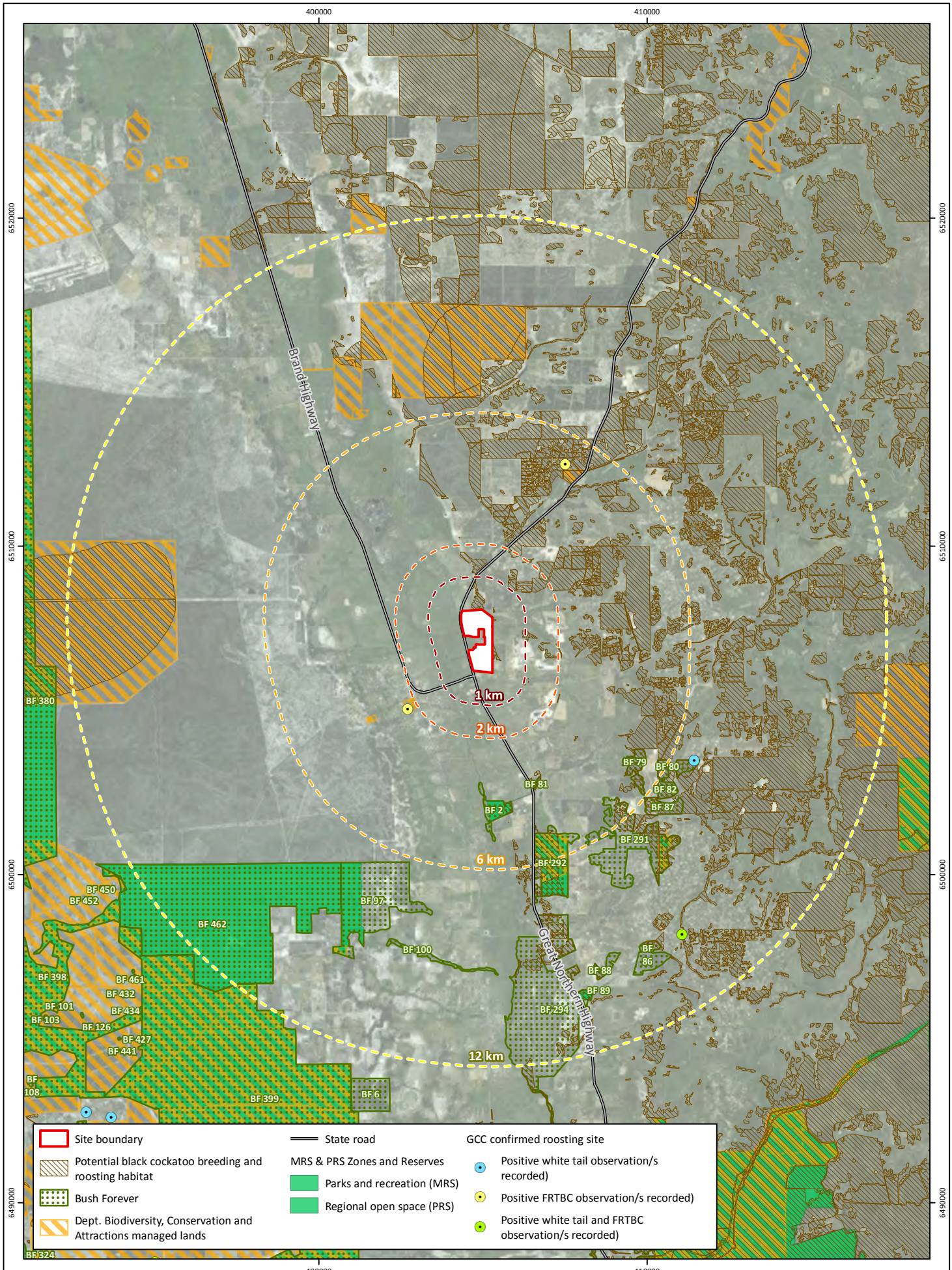


Figure 7: **Potential Black Cockatoo Breeding and Roosting habitat – Regional Distribution**

Project: EPBC Act Referral
Muchea Industrial Precinct Subdivision Support

Client: Sirona Capital Pty Ltd

Plan Number: EP17-089(02)--F20

Drawn:	KNM
Date:	08/11/2017
Checked:	JHL
Approved:	ACW
Date:	15/11/2017

N

0 1 2 3
Kilometres

Scale: 1:150,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

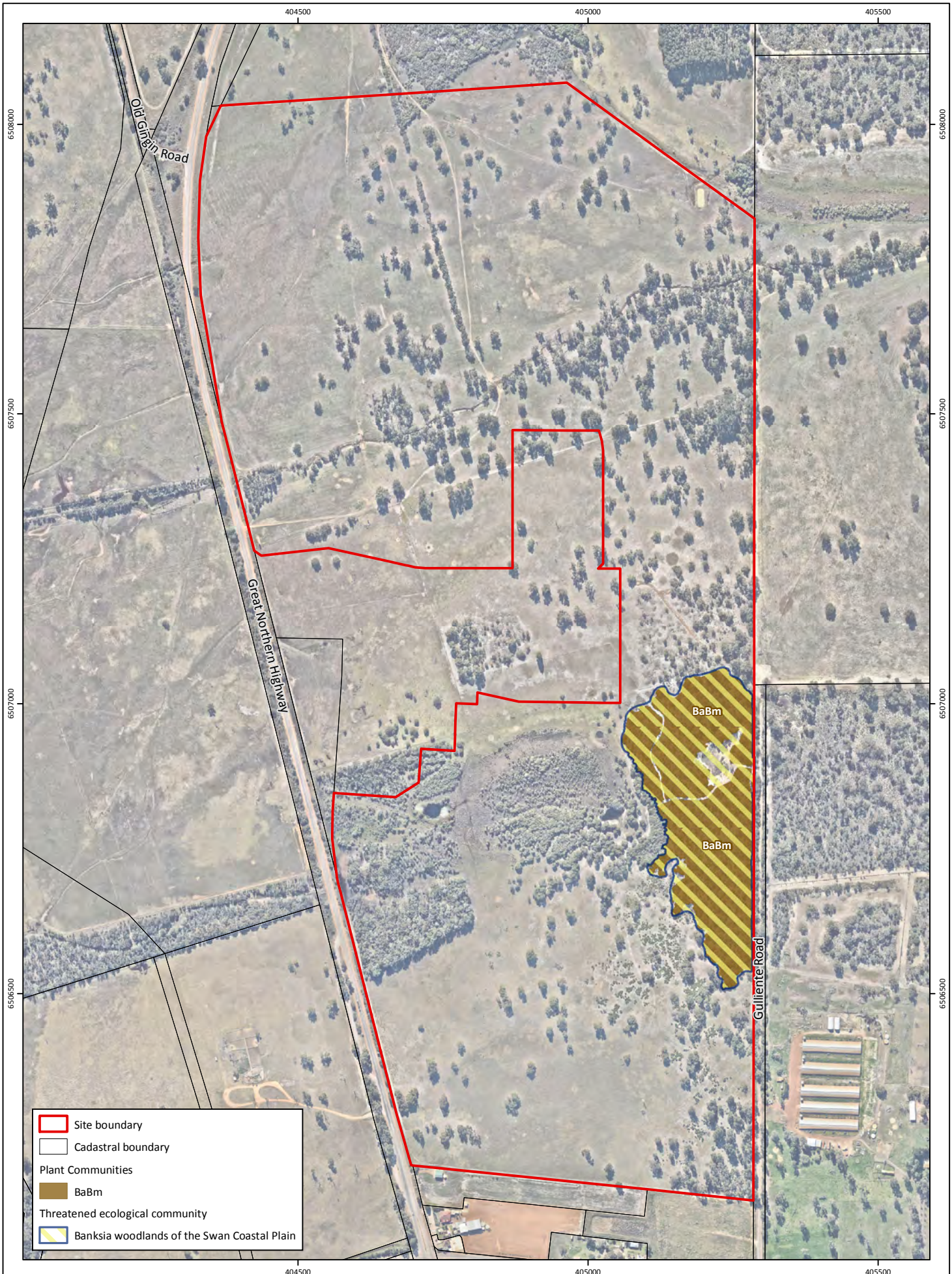


Figure 8: **Banksia Woodland Threatened Ecological Community**

Project: EPBC Act Referral
Muchea Industrial Precinct Subdivision Support
Client: Sirona Capital Pty Ltd

Plan Number: EP17-089(02)--F25
Drawn: KNM
Date: 15/11/2017
Checked: JHL
Approved: ACW
Date: 15/11/2017

N

0 100 200
Metres
Scale: 1:8,500@A4
GDA 1994 MGA Zone 50

emerge ASSOCIATES

ATTACHMENT 2: FLORA AND VEGETATION SURVEY

emerge ASSOCIATES
Integrated Science & Design

FLORA AND VEGETATION SURVEY AND WETLAND ASSESSMENT

PT LOT M1313 GREAT NORTHERN HIGHWAY MUCHEA

Project Number EP12-052

Prepared for Westbridge Property Group Pty Ltd
January 2013

Document Control

DOC NAME	FLORA AND VEGETATION SURVEY AND WETLAND ASSESSMENT				
DOC NO.	EP12-052(01)--011				
REVISION	DATE	AUTHOR		REVIEWER	
1	January 2013	Shane Chalwell	SC	Chrystal King	CK
A					
B					
C					
D					

Executive Summary

The flora and vegetation survey and wetland assessment of the Pt Lot M1313, Great Northern Highway, Muchea (the site), in the Shire of Chittering was undertaken by Dr Shane Chalwell from Plantecology Consulting on behalf of Emerge Associates. The site is located on the eastern side of Great Northern Highway just north of the intersection with Brand Highway. This area has been identified as part of the Muchea employment node, which is an area set aside for commercial and industrial uses such as transport, livestock, wholesaling, fabrication and warehousing (Western Australian Planning Commission 2011). The purpose of the survey was to provide a detailed assessment of botanical values within the site, which could then inform the development process regarding future land uses.

The field survey was conducted by a botanist from Plantecology Consulting over three days on the 15th, 16th and 25th October 2012, using a standard phytosociological approach in accordance with EPA Guidance Statement No. 51. A detailed survey of the native vegetation was undertaken at 7 sampling points, as well as 7 points in other vegetation communities.

A total of 72 native and 34 non-native (introduced and cultivated) taxa were recorded within the site, representing 23 families and 77 genera. No Threatened Flora pursuant to the *Wildlife Conservation Act* 1950 nor the *Environmental Protection and Biodiversity Conservation Act* (EPBC Act) 1999 were recorded during the survey. Also, no Priority Flora listed by the Department of Environment and Conservation (DEC) were recorded during the survey.

The survey identified eight vegetation communities within the site, including native remnants and areas of rehabilitation and agricultural grazing. The eight vegetation communities are:

- BaBm: Open woodland of *Eucalyptus todtiana*, *Banksia attenuata* and *Banksia menziesii* over low open shrubland of *Eremaea pauciflora* var. *calyptra, Xanthorrhoea preissii* over open tussock grassland of **Ehrharta calycina* with *Dasypogon bromeliifolius* on grey sands.
- MpJp**:** Open woodland of *Melaleuca preissiana* over open sedgeland of *Juncus pallidus* over grassland of **Cynodon dactylon* in saturated black loams with free-standing water at the surface.
- MoJp: Tall open shrubland of *Melaleuca osullivanii* over open sedgeland of *Juncus pallidus* over closed forbland of **Cotula coronopifolia*, **Briza maxima* and **Lotus subbiflorus* in saturated black loams.
- Rehab: Revegetated areas of mixed native and introduced Eucalypt and Melaleuca species.
- MpJa: Woodland of *Melaleuca preissiana* over sedgeland of **Juncus acutus subsp. acutus* over grassland of **Cynodon dactylon* in saturated black loams.
- MpPg: Woodland of *Melaleuca preissiana* over mixed pasture grasses.
- Pasture: Cleared pastures with isolated paddock trees.
- MoCp: Tall shrubland of *Melaleuca osullivanii* over sparse rushland of *Dielsia stenostachya* over forbland of **Cotula coronopifolia*, *Angianthus preissianus* and **Hordeum hystrix* in damp grey/black sands.

The results of the cluster analysis determined that Community BaBm to be Floristic Community Type (FCT) 21c – Low–lying *Banksia attenuata* woodlands or shrublands. Communities MpJp and MpJa were determined to be FCT 11 – Wet forests and woodlands, and Community MoJp was determined to be FCT 7 – Herb rich saline shrublands in clay. These FCT's are not threatened Ecological Communities either at a state or federal level. But FCT 21c represents a PEC, listed as a Priority 3 community under DEC policy.

The majority of the site is in a “Completely Degraded” condition and retains little of its original botanical value. All stands of native vegetation have been impacted by past and current uses such as cattle grazing and have been heavily infested by grassy weed species.

There are two Resource Enhancement Wetlands (REWs) within the site, the objectives for which are the restoration of ecological values and functions. Both wetlands, however, are under threat from continuing grazing impacts and salinity. The presence of **Juncus acutus* subsp. *acutus* in high densities suggests saline conditions in part of one wetland.

The remnant native vegetation of Pt Lot M1313 Great Northern Highway, Muchea does not hold high intrinsic botanical values such as the presence of conservation-coded flora or communities. The values of the site relate to its regional context as part of a local ecological linkage, the potential presence of Priority Ecological Communities (PECs), the restricted extent of the Yanga Vegetation Complex and wetlands that perform important ecological functions. However, without protection and active intervention, the ecological values of the vegetation will likely continue to decline.

Given the ecological values of the site, it is suggested that:

- Development of the site includes plans or policies to improve the vegetation condition of the remnant vegetation.

Furthermore, it is recommended that:

- Any development of the site includes appropriate buffers or barriers to minimise adverse impacts to the native vegetation and wetlands within the site.

Table of Contents

List of Tables

Figures

Appendices

1 Introduction

The flora and vegetation survey of the Pt Lot M1313, Great Northern Highway, Muchea (the site) (**Figure 1**), in the Shire of Chittering was undertaken by Dr Shane Chalwell from Plantecology Consulting on behalf of Emerge Associates. The site is located on the eastern side of Great Northern Highway just north of the intersection with Brand Highway. This area has been identified as part of the Muchea employment node, which is an area set aside for commercial and industrial uses such as transport, livestock, wholesaling, fabrication and warehousing (Western Australian Planning Commission 2011). Such activities would represent a change of land use to the current agricultural usage and would potentially introduce new impacts on the natural attributes of the site. Therefore, an assessment of the site's key environmental values is required to mitigate any potential negative impacts of industrial development. This vegetation survey and assessment of the site's botanical values forms part of those environmental studies.

1.1 Purpose of the report

The purpose of the survey was to provide a detailed assessment of botanical values within the site, which could then inform the development process regarding future usage.

The objectives of the survey were to:

- Undertake a detailed spring flora and vegetation survey in accordance with the Environmental Protection Authority's (EPA) Guidance Statement No. 51 – *Terrestrial flora and vegetation surveys for environmental impact assessment in Western Australia* (2004)
- Undertake a desktop review by examining other local flora and vegetation reports and undertaking an on-line search of government databases
- Identify the plant associations present and assign them to the Swan Coastal Plain Floristic Community Type classification (Gibson *et al*., 1994)
- Identify the presence of any Threatened Ecological Communities (TECs) and Priority Ecological Communities (PECs)
- Undertake a systematic search for all vascular flora taxa present
- Record the locations and numbers present of any Threatened Flora and Priority Flora.

1.2 Existing Environment

The site is currently used for livestock grazing and some extractive activities, and has been mostly cleared of its original vegetation. An area of remnant banksia woodland occurs adjacent to the eastern boundary of the site on a shallow rise. Part of this remnant has been cleared and sand and/or gravel have been extracted. The remainder of the site is mainly flat except where dissected by minor drainage channels. The paddock areas are mainly parkland cleared with isolated individuals of *Corymbia calophylla* and *Banksia* spp., with trees of *Melaleuca preissiana* occurring within and adjacent to wetland areas.

There are two areas that contain wetland vegetation. The most southerly of the wetland areas contains free-standing water at the surface and drains to the west. This wetland is currently accessed by cattle as a water source. The other wetland area has no free-draining water.

1.3 Climate

The Muchea area experiences a dry Mediterranean climate of hot dry summers and cool wet winters. Long-term climatic averages indicate the site is located in an area of moderate to high rainfall, receiving 682.7 mm on average annually (data for Pearce RAAF, the nearest currently reporting station) (Bureau of Meteorology 2012) with the majority of rainfall received between June and August. The area experiences rainfall on an average of 57 days per year. Mean maximum temperatures range from 17.8 ^{o}C in July to 33.5 ^{o}C in January. Mean minimum temperatures range from 8.1 ^{o}C in August to 17.5 ^{o}C in February.

1.4 Soils

The Atlas of Australian Soils maps the soils for the site as Map Unit Sp2, which is a gently sloping bench or terrace also known as the Ridge Hill Shelf. The soils of this unit consist of “hard acidic yellow soils (Dy2.61), containing ironstone gravels. Associated are brown sands (Uc4.2) often containing ironstone gravels at depth and forming a western fringe to the bench; and some (Dy3.4) soils on dissected areas” (Natural Resource Information Centre 1991).

1.5 Vegetation Complexes

Two vegetation complexes have been mapped as occurring on the site: the Coonambidgee Vegetation Complex and the Yanga Vegetation Complex. The Coonambidgee Vegetation Complex occurs on the shallow slopes in the eastern part of the site and consists of low open forests and low open woodlands of *Eucalyptus todtiana-Banksia attenuata-Banksia menziesii-Banksia ilicifolia* with localised admixtures of *Banksia prionotes*, and open woodlands of *Corymbia calophylla*- Banksia species (Heddle *et al*. 1980). The Yanga Vegetation Complex is predominantly a closed scrub of Melaleuca species and low open forest of *Casuarina obesa* on the flats subject to inundation. On drier sites, the vegetation is more similar to the Coonambidgee and Bassendean Vegetation Complexes (Heddle *et al*. 1980).

EPA Position Statement No.9 identifies vegetation complexes with less than 30% of their original (pre-1750) extent remaining on the Swan Coastal Plain to be critical assets. Any clearing of a critical asset would generally be at variance to clearing principles contained within Schedule 5 of the *Environmental Protection Act* 1986. Approximately 45% of the Coonambidgee Vegetation Complex is still extant, but only 9% is in secure reserves (EPA 2006). Whilst the Coonambidgee Vegetation Complex would not be considered a Critical Asset, it is not well reserved. The Yanga Vegetation Complex, however, would be considered a Critical Asset as only 18% of its original extent remains and only about 1% is in secure reserves (EPA 2006).

1.6 Wetlands

Hill *et al*. (1996) has mapped all wetlands of the Swan Coastal Plain using the classification system of Semeniuk (1987). This classification system is based on the geomorphic setting and hydrological processes associated with a wetland. The classification allocates individual wetlands with shared characteristics to wetland suites. According to the geomorphic classification system of Semeniuk (1987), the wetlands within the site are classified as palusplain and sumpland wetland types, both of which are ephemeral or seasonally inundated wetlands. **Table 1** below indicates the wetland types and their geomorphic setting.

Table 1: Geomorphic Wetland Classification, adapted from Semeniuk and Semeniuk (DEC 2007)

	BASIN	FLAT	CHANNEL	SLOPE
Permanently inundated	Lake	River		
Seasonally inundated	Sumpland	Floodplain	Creek	
Seasonally waterlogged	Dampland	Palusplain		Paluslope

The Hill *et al*. (1996) wetland mapping was digitised by the Department of Environment and Conservation (DEC) to create the Geomorphic Wetland Swan Coastal Plain dataset (the dataset), which is managed and maintained by the DEC. Each classified wetland listed in the dataset has a Unique Feature Identifier (UFI), however in the case of many large wetlands that have sustained a degree of disturbance; a separate management category may be assigned to parts of the wetland in order to reflect the current values. The description and management objectives of each management category are listed in **Table 2**. The wetland management category is important as it categorises wetlands on their significance, based on hydrological, biological and human use features. This dynamic dataset is continually updated with site-specific wetland surveys providing new and relevant information.

Table 2: Wetland Management Categories and Objectives (WAPC 2005)

MANAGEMENT CATEGORY	DESCRIPTION OF WETLAND	MANAGEMENT OBJECTIVES
Conservation Category Wetland (CCW)	Wetlands that support high levels of attributes and functions.	To preserve wetland attributes and functions through reservation in national parks, crown reserves, state owned land and protection under environmental protection policies.
Resource Enhancement Wetland (REW)	Wetlands that have been partly modified but still support substantial functions and attributes.	To restore wetlands through maintenance and enhancement of wetland functions and attributes by protection in crown reserves, state or local government owned land and by environmental protection policies, or in private property by sustainable management.
Multiple Use Wetland (MUW)	Wetlands with few attributes, which still provide important wetland functions.	Use, development and management should be considered in the context of water, town and environmental planning through landcare.

The Geomorphic Wetlands of the Swan Coastal Plain dataset indicates that there are three wetlands wholly or partially within the site. The locations of the wetlands are shown in **Figure 2**.

The Palusplain UFI 15732 wetland is categorised as a Multiple Use Wetland (MUW), which is a wetland with few ecological values but retains some wetland functions. UFI 15732 occupies the extensive sandy flats that occur over most of the site. The Sumplands UFI 9173 and UFI 9174 wetlands are categorised as Resource Enhancement Wetlands (REW), which are wetlands that have been partly modified but still support substantial ecological functions. UFI 9173 is located in the northern part of the site and UFI 9174 is located in the south central part of the site.

In addition to the Geomorphic Swan Coastal Plain dataset, the *Environmental Protection (Swan Coastal Plain lakes) Policy* 1992 (EPP 1992) under the *Environmental Protection Act* 1986 (EP Act) is designed to protect listed wetlands against activities such as draining, filling, polluting, or the alteration of the hydrological function of the wetland. It is the responsibility of landowners, proponents, and the

state and local Government Authorities to ensure that these wetlands are not detrimentally affected by any adverse activities. No mapped EPP wetlands occur within the subject site.

1.7 Ecological Linkages

Ecological linkages are important conservation tools that allow the movement of fauna, flora and genetic material between areas of remnant habitat. The movement of fauna and the exchange of genetic material between vegetation remnants improves the viability of those remnants by allowing greater access to breeding partners, food sources, refuge from disturbances such as fire and maintains the genetic diversity of plant communities and populations. The remnant banksia woodland adjacent to the eastern boundary of the site and the vegetation of UFI 9174 form part of a local ecological linkage that connects to a regional ecological linkage to the west of the site. Local ecological linkages seek to improve the viability of local natural areas by providing connections to other local or regionally significant natural areas and regional ecological linkages (Shire of Chittering 2010).

1.8 Conservation Significant Flora

Under the *Wildlife Conservation Act* 1950 (WC Act), the Minister for the Environment produces a gazetted '*Wildlife Conservation (Rare Flora) Notice*' that lists Threatened (or Declared Rare) Flora under two Schedules; extant and presumed extinct. The DEC also produces a list of Priority Flora that have not been assigned statutory protection under the *WC Act* but may be under some degree of threat. The DEC recognises five Priority Flora levels. The definitions for each category of Threatened and Priority Flora are shown in **Table 3**.

Table 3: Definitions for categories of Threatened and Priority Flora (Department of Environment and Conservation 2012)

CATEGORY	DEC DEFINITION
Schedule 1—Extant Flora T: Threatened Flora (Declared Rare Flora – Extant)	Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such (Schedule 1 under the *Wildlife Conservation Act* 1950). Threatened Flora (Schedule 1) are further ranked by the Department according to their level of threat using IUCN Red List criteria: - CR: Critically Endangered – considered to be facing an extremely high risk of extinction in the wild. - EN: Endangered – considered to be facing a very high risk of extinction in the wild. - VU: Vulnerable – considered to be facing a high risk of extinction in the wild.
Schedule 2—Extinct Flora X: Presumed Extinct Flora (Declared Rare Flora - Extinct)	Taxa which have been adequately searched for and there is no reasonable doubt that the last individual has died, and have been gazetted as such (Schedule 2 under the *Wildlife Conservation Act 1950*).
P1: Priority One: Poorly Known Taxa	Species that are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation,

CATEGORY	DEC DEFINITION
	e.g. agricultural or pastoral lands, urban areas, Shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes.
P2: Priority Two: Poorly Known Taxa	Species that are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes.
P3: Priority Three: Poorly Known	Species that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them.
P4: Priority Four: Rare, Near Threatened and other species in need of monitoring	a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands. b) Near Threatened. Species that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.
P5: Priority Five: Conservation Dependent Species	Species that are not threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

As well as protection under State legislation, selected flora species are also afforded statutory protection at a Federal level pursuant to the *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act). The EPBC Act provides for the protection of Threatened species, pursuant to Schedule 1 of the Act, and are defined as "Critically Endangered", "Endangered", "Vulnerable" or "Conservation Dependent" under Section 179. Definitions of these categories are shown in **Table 4**. Any action likely to have a significant impact on a species listed under the EPBC Act requires approval from the Commonwealth Minister for Sustainability, Environment, Water, Population and Communities.

Searches of both the State and Commonwealth databases identified 42 taxa with the potential to occur within the site (**Table 5**). Of these taxa, 13 are listed as Threatened under the *WC Act*, of which two are orchids and the remainder perennials and therefore observable at all times of the year. Orchid

species are perennial geophytes and usually only identifiable when flowering. *Thelymitra dedmaniarum* flowers from November to December but occurs near granite outcrops in the Darling Range to the east of Perth and is therefore unlikely to occur within the site. *Thelymitra stellata* flowers from October to November and has been recorded from sandy, gravelly as well as lateritic substrates and, therefore, may occur within the site.

Table 4: Categories of protection for species and communities listed under the EPBC Act.

EPBC ACT CATEGORY	DSEWPC DEFINITION
Extinct	A native species is eligible to be included in the extinct category at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
Extinct in the wild	A native species is eligible to be included in the extinct in the wild category at a particular time if, at that time:
	(a) it is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or
	(b) it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
Critically endangered	A native species is eligible to be included in the critically endangered category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
Endangered	A native species is eligible to be included in the endangered category at a particular time if, at that time
	(a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable	A native species is eligible to be included in the vulnerable category at a particular time if, at that time:
	(a) it is not critically endangered or endangered; and (b) it is facing a high risk of extinction in the wild in the medium term future, as determined in accordance with the prescribed criteria.
Conservation Dependent	A native species is eligible to be included in the conservation dependent category at a particular time if, at that time: (a) the species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered; or (b) the following subparagraphs are satisfied: (i) the species is a species of fish; (ii) the species is the focus of a plan of management that provides for management actions necessary to stop the decline of, and support the recovery of, the species so that its chances of long term survival in nature are maximised; (iii) the plan of management is in force under a law of the Commonwealth or of a State or Territory; (iv) cessation of the plan of management would adversely affect the conservation status of the species.

Table 5: Threatened and Priority Flora potentially occurring within the survey area based on database searches. (EN = Endangered; CR = Critically Endangered; T = Threatened; 1 – 4 = Priority Flora Category)

EPBC ACT CATEGORY	SEWPC DEFINITION	EPBC ACT CATEGORY
Acacia anomala	T	VU
Acacia drummondii subsp. affinis	3	
Adenanthos cygnorum subsp. chamaephyton	3	
Andersonia gracilis	T	EN
Centrolepis caespitosa	4	EN
Chamaescilla gibsonii	3	
Chamelaucium sp. Gingin (N.G. Marchant 6)	T	VU
Conospermum densiflorum subsp. unicephalatum	T	EN
Cyathochaeta teretifolia	3	
Darwinia foetida	T	EN
Drosera occidentalis subsp. occidentalis	4	
Drosera sewelliae	1	
Eucalyptus balanites	T	EN
Eryngium pinnatifidum subsp. palustre	3	
Grevillea althoferorum subsp. fragilis	T	CR
Grevillea candolleana	2	
Grevillea curviloba subsp. curviloba	T	CR
Grevillea curviloba subsp. incurva	T	EN
Guichenotia tuberculata	3	
Haemodorum loratum	3	
Hypocalymma sylvestre	1	
Hypolaena robusta	4	
Lasiopetalum lineare	3	
Ornduffia calthifolia	T	EN
Oxymyrrhine coronata	4	
Persoonia rudis	3	
Platysace ramosissima	3	
Schoenus griffinianus	3	
Schoenus sp. Bullsbrook (J.J. Alford 915)	2	

EPBC ACT CATEGORY	SEWPC DEFINITION	EPBC ACT CATEGORY
Stenanthemum sublineare	2	
Stylidium aceratum	2	
Stylidium cymiferum	3	
Stylidium longitubum	3	
Stylidium squamellosum	2	
Synaphea grandis	4	
Tetraria sp. Chandala (G.J. Keighery 17055)	2	
Thelymitra dedmaniarum	T	EN
Thelymitra stellata	T	EN
Trichocline sp. Treeton (B.J. Keighery & N. Gibson 564)	2	
Verticordia lindleyi subsp. lindleyi	4	
Verticordia plumosa var. pleiobotrya	T	VU
Verticordia serrata var. linearis	1	

1.9 Conservation Significant Communities

The DEC defines an ecological community as “a naturally occurring assemblage that occurs in a particular type of habitat” (DEC 2012). A Threatened Ecological Community (TEC) is one that has declined in area or was originally limited in distribution. Uncommon ecological communities that do not strictly meet TEC defined criteria, or are inadequately defined, are listed by the DEC as a Priority Ecological Community (PEC). Definitions of the categories of Threatened and Priority Ecological Communities are given in **Table 6**.

As well as protection under State legislation, selected ecological communities are also afforded statutory protection at a Federal level pursuant to the *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act). The EPBC Act provides for the protection of TECs, which are listed under Section 181 of the Act, and are defined as “Critically Endangered”, “Endangered” or “Vulnerable” under Section 182. Similar to flora species listed under the EPBC Act, any action likely to have a significant impact on a TEC listed under the EPBC Act requires Commonwealth approval.

A search of the DEC’s databases found two TECs recorded within two kilometres of the site:

- The Critically Endangered “Communities of Tumulus Springs (Organic Mound Springs, Swan Coastal Plain)”
- The Endangered “Shrublands and woodlands on Muchea Limestone”.

The database search also found two PECs recorded within two kilometres of the site:

- The Priority 3 “Swan Coastal Plain *Banksia attenuata* - *Banksia menziesii* woodlands (SCP23b)”
- The Priority 3 “Southern *Eucalyptus gomphocephala-Agonis flexuosa* woodlands (SCP25)”.

Table 6: Categories and definitions of Threatened and Priority Ecological Communities (DEC 2012)

EPBC ACT CATEGORY	DSEWPC DEFINITION
PD: Presumed Destroyed	An ecological community that has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future.
Critically Endangered	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated.
Endangered	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future.
Vulnerable	An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range.
Priority 1	Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤5 occurrences or a total area of ≤ 100ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist.
Priority 2	Communities that are known from few occurrences with a restricted distribution (generally ≤10 occurrences or a total area of ≤200ha). At least some occurrences are not believed to be under immediate threat of destruction or degradation.
Priority 3	(i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or: (ii) communities known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or; (iii) communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes.
Priority 4	Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring. (i) Rare. Ecological communities known from few occurrences that are

EPBC ACT CATEGORY	DSEWPC DEFINITION
	considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands. (ii) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. (iii) Ecological communities that have been removed from the list of threatened communities during the past five years.
Priority 5	Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

2 Methods

2.1 Field survey

The field survey was conducted by a botanist from Plantecology Consulting over three days on the 15th, 16th and 25th October 2012, using a standard phytosociological approach in accordance with EPA Guidance Statement No. 51.

A detailed survey of the vegetation was undertaken at 7 sampling points. In the stands of native wetland vegetation 400 m^2 relevés (20m x 20m quadrats) were established, selected to adequately sample the flora within a stand. Relevés were positioned to sample a representative and homogeneous (i.e. not located in transitional areas between communities) area of each community. In the banksia woodlands, the relevé size was increased to 1600 m^2 (40m x 40m).

The location of each corner of a relevé was recorded with a hand-held GPS unit and a photograph taken looking inward to the quadrat. All vascular plant species were recorded and an estimate of the Foliage Projective Cover (FPC) percentage was made for each species. In addition, opportunistic plant taxa that were observed, but not located at a particular survey location, were also recorded throughout the course of the survey.

The boundaries of the wetland associations in UFI 9174 were recorded with a Differential GPS (DGPS) to measure as accurately as possible the extent of each. As the introduced *Juncus acutus* subsp. *acutus* replaced the native *Juncus pallidus* in the mid-stratum as water depth decreased away from the core of the wetland, the criterion used for the definition of the boundary was the outer extent of *Juncus pallidus* dominance and then the outer extent of *Juncus acutus* subsp. *acutus*.

Environmental data recorded included topographic position, aspect, slope, soil colour and texture class, rock outcropping, litter cover as well as the degree of disturbance and an estimate of the time since the last fire event. The condition of the vegetation of the site was assessed to assist in determining the conservation values of the site. The vegetation condition was rated according to Keighery (1994), a vegetation condition scale commonly used in the Perth Metropolitan Region. The categories are listed and defined in **Table 7**. Data on the vegetation structure was also recorded and included the height of the three main strata and the dominant species within each stratum. The vegetation structural description follows that of the National Vegetation Information System (Thackway *et al.* 2006).

In addition to the relevés, the vegetation of disturbed and parkland-cleared areas was sampled using mapping points (unbound plots) at seven locations. At each mapping point, the same environmental and vegetation structure data described previously was recorded and a search made for any Priority or Threatened flora, and an inventory of the species present taken.

All plant specimens collected during the field survey were dried, pressed and then sorted in accordance with requirements of the Western Australian Herbarium. Identification of specimens occurred through comparison with named material and through the use of taxonomic keys. Taxonomic determinations were made using reference material at the Western Australian State Herbarium. Taxa names utilise the current terminologies from FloraBase (2012). Family names utilise the revised phylogeny of the Angiosperm Phylogeny Group - APGIII (FloraBase 2012).

Table 7: Vegetation Condition Scale (Keighery 1994)

VEGETATION CONDITION	DEFINITION
Pristine (1)	Pristine or nearly so, no obvious signs of disturbance.
Excellent (2)	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
Very Good	Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.

2.2 Data analysis and classification

The relevé data for each stand of remnant native vegetation was assigned a FCT using presence/absence species data so that a comparison could be made against the DEC's TEC database. The site data was reconciled with the SCP dataset of Gibson *et al.* (1994) by standardising the names of taxa with those used in the earlier study. This was necessary due to changes in nomenclature in the intervening period. Taxa that were only identified to genus level were excluded while some infra-species that have been identified since 1994 were raised to species level. The combined dataset was then analysed using a Sorenson distance measure (equivalent to the Czekanowski distance measure for presence/absence data used in the original analysis) with Group Average linkage in the analysis package PC-ORD (McCune and Mefford 2006). The analysis was first run without the addition of the Muchea data to check for misclassifications against the original output. There were some sites misclassified, but these were considered minor as other methods that were tried produced far more misclassifications. As data from a localised study is often highly spatially correlated compared to the data from a regional study, the data each sample site at Muchea was added to the SCP dataset and analysed individually. This removes the influence of spatial correlation when assigning a FCT to the local plant communities. For sites within the stands of banksia woodland, the non-native species were removed from the analysis as this can lead to spurious results in poor condition vegetation (most often classifying sites as FCT 6).

2.3 Study limitations and survey effort

Various factors can limit the effectiveness of a vegetation survey. Pursuant to *EPA Guidance Statement 51* (EPA 2004), these factors have been identified and their potential impact on the effectiveness of the survey has been assessed (**Table 8**).

There were no factors identified that were considered as being major impediments on the effectiveness of the vegetation survey.

Table 8: Potential limitations affecting the vegetation survey

POTENTIAL LIMITATIONS	CONSTRAINT	COMMENT
Competency and experience of the botanists undertaking the survey	No	The survey was undertaken by botanist with a comprehensive knowledge of Swan Coastal Plain vegetation, with at least 10 years experience in vegetation surveys in Western Australia.
Seasonality	Minor constraint	Rainfall was about average for September but well below average for October. Rainfall therefore may be considered a minor survey constraint as the dry conditions in October could have affected the flowering of some species.
Adequate ground coverage and intensity of survey effort	No	The survey area was traversed on foot. It is considered the survey quadrats and mapping points provided adequate coverage given the degraded nature of most of the site.
Proportion of Flora identified	No	The small size of the remnant vegetation and limited number of quadrats doesn't allow for analysis of the proportion of the flora sampled. However, single visit surveys in southwestern Australia of similar intensity usually sample between 75% and 85% of the estimated total flora.
Burn Cycle	No	There were no signs of recent fires.
Resources	No	Adequate resources were available to conduct the survey.
Access restrictions	No	There were no access restrictions and all requisite areas were visited. All areas were accessible.

3 Results

3.1 Flora

3.1.1 Floristic summary

A total of 72 native and 34 non-native (introduced and cultivated) taxa were recorded within the site, representing 23 families and 77 genera. Non-native taxa included Australian native species that do not naturally occur within the local area but have been planted in rehabilitation areas within the site. The dominant families containing mostly native taxa were Myrtaceae (16 native taxa, five non-native taxa), Fabaceae (seven native, five non-native taxa) and Cyperaceae (eight native, no non-native taxa). The most common genus was Eucalyptus spp. (nine taxa). For a complete species list and the individual site data refer to **Appendix A** and **Appendix C**, respectively.

3.1.2 Threatened and Priority flora

No Threatened Flora pursuant to the *Wildlife Conservation Act* 1950 nor the EPBC Act 1999 were recorded during the survey. Also, no Priority Flora listed by the DEC were recorded during the survey.

3.2 Vegetation

The survey identified eight vegetation communities within the site, including native remnants and areas of rehabilitation and agricultural grazing (**Figure 3**). A summary of species recorded within each vegetation type is provided in **Appendix B**. The eight vegetation communities are:

- BaBm: Open woodland of *Eucalyptus todtiana*, *Banksia attenuata* and *Banksia menziesii* over low open shrubland of *Eremaea pauciflora* var. *calyptra*, *Xanthorrhoea preissii* over open tussock grassland of **Ehrharta calycina* with *Dasypogon bromeliifolius* on grey sands.
- MpJp: Open woodland of *Melaleuca preissiana* over open sedgeland of *Juncus pallidus* over grassland of **Cynodon dactylon* in saturated black loams with free water at the surface.
- MoJp: Tall open shrubland of *Melaleuca osullivanii* over open sedgeland of *Juncus pallidus* over closed forbland of **Cotula coronopifolia*, **Briza maxima* and **Lotus subbiflorus* in saturated black loams.
- Rehab: Revegetated areas of mixed native and introduced Eucalypt and Melaleuca species.
- MpJa: Woodland of *Melaleuca preissiana* over sedgeland of **Juncus acutus* subsp. *acutus* over grassland of **Cynodon dactylon* in saturated black loams.
- MpPg: Woodland of *Melaleuca preissiana* over mixed pasture grasses.
- Pasture: Cleared pastures with isolated paddock trees.
- MoCp: Tall shrubland of *Melaleuca osullivanii* over sparse rushland of *Dielsia stenostachya* over forbland of **Cotula coronopifolia, Angianthus preissianus* and **Hordeum hystrix* in damp grey/black sands.

Most of the site has been cleared of native vegetation now consists of pastures with isolated trees. Some small areas near UFI 9174 have been rehabiltated with eucalypt and melaleuca species. Community BaBm is the most species rich of the native vegetation communities and occurs on the shallow slopes to the east of UFI 9174.

The remaining communities are wetland associations. Community MoCp is a tall shrubland that occurs on damp soils with no free surface water in UFI 9173. It is relatively species poor and the

groundlayer is dominated by **Hordeum hystrix* and **Cotula coronopifolia*. Community MpJp is found in the core area of UFI 9174 in the deeper waters. While it has retained most of its structure, it is relatively species poor and the groundlayer is dominated by **Cynodon dactylon*. Community MoJp occurs in a small area adjacent to the western edge of the site on saturated soils and some free water. **Juncus acutus* subsp. *acutus* replaces *Juncus pallidus* in Community MpJa and occurs on the outer parts of the wetland where surface water is shallow or absent. It is very poor in native species richness and the understorey largely consists of introduced grasses as well as **Juncus acutus* subsp. *acutus*. Community MpPg occurs on the fringes of the wetland where **Juncus acutus* subsp. *acutus* has been replaced by pasture grasses but the overstorey of *Melaleuca preissiana* remains.

3.2.1 Assignment of plant associations

The results of the cluster analysis determined that Site 1 from Community BaBm to be FCT 21c – Low–lying *Banksia attenuata* woodlands or shrublands and Site 2 from the same community to be FCT 22 – *Banksia ilicifolia* woodlands (see **Appendix D**). These FCTs are very similar and either result is reasonable given the location and the condition of the vegetation. Although *Banksia ilicifolia* was recorded as a paddock tree nearby, it was not recorded within the remnant stand and therefore FCT 21c is a more plausible classification for the Community BaBm.

Communities MpJp, MpJa and MoJp were determined to be either FCTs 7, 11 or 15. FCT 11 – Wet forests and woodlands is the most reasonable result for all of these communities as it is dominated by *Melaleuca preissiana*, which is not listed as a dominant for FCT 15 (Gibson *et al*. 1994). Community MoCp was determined to be FCT 7 – Herb rich saline shrublands in clay pans. Although this community has been highly modified, FCT 7 appears to be a reasonable classification.

The remaining areas within the site have been too heavily modified to be assigned to a FCT and are no longer considered to be native vegetation.

3.2.2 Vegetation condition

The majority of the site is in a “Completely Degraded” condition and retains little of its original botanical value (**Figure 4**). All stands of native vegetation have been impacted by past and current uses such as cattle grazing and have been heavily infested by grassy weed species. The original structure of Communities MoJp, MoCp and MpJa has been substantially modified and all stands of these communities are now either “Degraded” or “Completely Degraded”. The groundlayer of Community MpJp has been invaded by **Cynodon dactylon* but still retains some native species and has been rated as “Good” to” Degraded” condition. Although Community BaBm has also been impacted by agricultural activities, it retains much of its vertical structure with a relatively high native species richness compared to the other vegetation communities within the site. Invasive grasses such as **Ehrharta calycina* are prevalent and dominate the ground layer but the shrub layer still remains reasonably intact.

3.3 Weeds

Almost one third of the taxa recorded during the survey were naturalised weeds or species not endemic to the local area. No Declared Plants pursuant to the *Agricultural and Related Resources Protection Act* 1976 were recorded in the survey. Twelve of the weed species were introduced grasses and six of the ten daisy species (*Asteraceae* spp.) recorded were weeds. A number of eucalypts not endemic to the area have been planted as part of previous rehabilitation efforts and

include *Eucalyptus ?saligna, Eucalyptus ?cornuta, Eucalyptus camaldulensis subsp. camaldulensis, Eucalyptus sargentii subsp. sargentii and Eucalyptus leucoxylon subsp. pruinosa*.

4 Discussion

The cluster analysis determined the native vegetation of Community BaBm to be FCT 21c. Whilst this result needs to be confirmed by the DEC's Species and Communities Branch, the result is consistent with descriptions given by Gibson *et al*. (1994). However, FCTs 21, 22 and 23 (and their sub-groups) are similar in species composition and the technique of adding new data to a hierarchical clustering almost always disrupts the original classification. This is especially the case when dealing with disturbed sites as the absence of species will also impact the cluster results. For example, Community BaBm also has many species in common with FCT 23b – Northern *Banksia attenuata-Banksia menziesii* woodlands but many which were not recorded.

FCT 21c is a PEC, listed as a Priority 3 community under DEC policy. Priority 3 communities are mainly widespread but may be threatened by a range of processes. FCT 22 is a Priority 2 community, which are communities restricted in distribution but mainly not under immediate threat. If future development of the site requires clearing of Community BaBm then it is suggested that confirmation from DEC of the community's status be sought.

The communities associated with UFI 9174 were determined to be FCT 11 – Wet forests and woodlands. FCT 11 is not listed as a TEC nor as a PEC. However, the vegetation within the wetland is part of the Yanga Vegetation Complex. Only 18% of this vegetation complex remains (EPA 2006) and is therefore considered a Critical Asset by the EPA. Clearing of this vegetation would likely be considered as being at variance to Principle (E) of Schedule 5 of the *Environmental Protection Act* 1986.

Both UFI 9173 and UFI 9174 are each categorised as a REW, the objectives for which is the restoration of ecological values and functions. Although both wetlands have been strongly impacted by grazing, the current condition of the vegetation is still compatible with this category and no change is recommended. The presence of **Juncus acutus* subsp*. acutus* in high densities suggests saline conditions, especially in the shallower parts of UFI 9174. It is likely that the condition of these wetlands will continue to decline without the removal of detrimental impacts and rehabilitation efforts.

The boundaries of UFI 9173 as mapped within the dataset, varies from the current extent of wetland-type vegetation. The current mapping shows some of the southern and eastern portions of UFI 9173 extending into pasture areas, which could not be considered as having REW values. Alternatively, on the western side of UFI 9173, some wetland vegetation lies outside the area currently mapped as REW.

Similarly, the extent of vegetation in UFI 9174 with values that are commensurate with categorising as REW, is slightly less extensive than currently mapped. The vegetation with REW values is Community MpJp, which has retained its basic structure with some native understorey species such as *Juncus pallidus*. In shallower parts of the wetland, *Juncus pallidus* is replaced by **Juncus actus* subsp. *acutus* and pasture grasses dominate the groundlayer. Only a native overstorey is retained and the condition of the vegetation is "Degraded" at best, becoming "Completely Degraded" farther out from the wetland's centre. It is recommended, therefore, that the dataset be amended to more accurately reflect the extent of REW values within the site or that the current extent of REW values within the site be used to inform development plans.

The remnant vegetation of UFI 9174 and Community BaBm forms part of a local ecological linkage. It is the policy of the Shire of Chittering that such linkages remain intact, and it is also a goal of the Muchea Employment Node Structure Plan that remnant native vegetation be retained.

A number of invasive weeds, mostly grasses, were recorded from the site. Whilst none are Declared Plants pursuant to the *Agricultural and Related Resources Protection Act* 1976, many are very invasive and may have a high impact on ecological processes. Grasses such as **Ehrharta calycina* and **Cynodon dactylon* may invade disturbed sites quickly and outcompete native species. The effects of weed invasion are evident in parts of the native vegetation stands within the site where disturbance to the understorey has resulted in replacement to varying degrees by invasive species.

5 Summary and Recommendations

The remnant native vegetation of Pt Lot M1313 Great Northern Highway, Muchea does not hold high intrinsic botanical values such as the presence of conservation-coded flora or communities. The values of the site relate to its regional context as part of a local ecological linkage, the potential presence of Priority Ecological Communities, the restricted extent of the Yanga Vegetation Complex and wetlands that perform important ecological functions. However, without protection and active intervention, the ecological values of the vegetation will likely continue to decline.

Given the ecological values of the site, it is suggested that:

- Development of the site includes plans or policies to improve the vegetation condition of the remnant vegetation.

Furthermore, it is recommended that:

- The Geomorphic Wetlands of the Swan Coastal Plain dataset be modified to reflect current extent of wetlands categorised as Resource Enhancement Wetlands or such extent be used to inform development plans for the site; and
- Any development of the site includes appropriate buffers or barriers to minimise adverse impacts to the native vegetation and wetlands within the site.

6 References

Bureau of Meteorology (2012) Climate Statistics for Pearce RAAF meteorological station 9053. Bureau of Meteorology. http://www.bom.gov.au/climate/data/

Department of Environment and Conservation (2012) *Definitions, Categories and Criteria for Threatened and Priority Ecological Communities*, Department of Environment and Conservation, Perth.

Environmental Protection Authority, (2004) *Guidance statement No. 51*. Guidance for the Assessment of Environmental Factors – Terrestrial flora and vegetation surveys for environmental impact assessment in Western Australia. Environmental Protection Authority, Perth.

Environmental Protection Authority, (2006) *Guidance statement No. 10*. Guidance for the Assessment of Environmental Factors – Level of assessment for proposals affectingareas within System 6 region and the Swan Coastal Plain portion of System 1. Environmental Protection Authority, Perth.

FloraBase (2012). FloraBase the Western Australian Flora. Department of Environment and Conservation, Como, Western Australia. http://Florabase.dec.wa.gov.au/

Gibson, N, Keighery, BJ, Keighery, GJ, Burbidge, AH and Lyons, MN (1994), *A floristic survey of the southern Swan Coastal Plain*, Unpublished Report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc), Perth.

Government of Western Australia (2000) *Bush Forever, Volume 1: Policies, Principles and Processes*, Western Australian Planning Commission, Perth.

Heddle, EM, Loneragan, OW and Havel, JJ 1980, 'Darling Systems – Vegetation Complexes' in *Atlas of Natural Resources Darling System, Western Australia,* Department of Conservation and Environment, Perth.

Hill, AL, Semeniuk, CA, Semeniuk, V and Del Marco, A 1996, *Wetlands of the Swan Coastal Plain. Vol 2a Wetland Mapping, Classification and Evaluation*, Water and Rivers Commission, Western Australia.

Keighery, BJ (1994), *Bushland plant survey: A Guide to Plant Community Survey for the Community*, Wildflower Society of WA (inc), Nedlands, Western Australia.

McCune, B. and Mefford, M.J. (2006) PC-ORD: Multivariate analysis of ecological data, Version 5, MJM Software, Gleneden Beach, Oregon.

Natural Resource Information Centre (1991) Digital Atlas of Australian Soils, Bureau of Rural Sciences, Canberra

Semeniuk, CA 1987, 'Wetlands of the Darling System – A geomorphic approach to habitat classification', *Journal of the Royal Society of Western Australia,* vol.69, pp. 95-112.

Shire of Chittering (2005) *Local Biodiversity Strategy,* Shire of Chittering, Bindoon.

Thackway, R., Neldner, J. and Bolton, M. (2006) *Chapter 8: Vegetation,* in: The Blue Book: Australian Soil and Land Survey Handbook Guidelines for Conducting Surveys, CSIRO, Canberra

Western Australian Planning Commission, 2005, *Guideline for the Determination of Wetland Buffer Requirements,* Western Australian Planning Commission, Perth.

Western Australian Planning Commission (2011) *Muchea Employment Node Structure Plan,* Government of Western Australia, Perth

FIGURES

Figure 1:	**Locality Plan**
Project:	Muchea Scheme Amendment - Flora and Vegetation Survey and Wetland Assessment
Client:	Westbridge Property Group Pty Ltd

Plan Number: EP12-052(01)--F21

Drawn:	GRO	Date:	04/01/13
Approved:	DRAFT	Date:	--/--/--
Checked:	DRAFT	Scale:	1:20,000@A4

0 200 400 800 Metres

emerge ASSOCIATES
Integrated Science & Design

Figure 2: Geomorphic Wetlands

Project:	Muchea Scheme Amendment - Flora and Vegetation Survey and Wetland Assessment
Client:	Westbridge Property Group Pty Ltd

Plan Number: EP12-052(01)--F22

Drawn:	GRO	Date:	04/01/13
Approved:	DRAFT	Date:	--/--/--
Checked:	DRAFT	Scale:	1:10,000@A4

0 100 200 400 Metres

emerge ASSOCIATES
Integrated Science & Design

Sources: The following datasets were used in the production of this map: Geomorphic Wetland - DEC WA (2012)

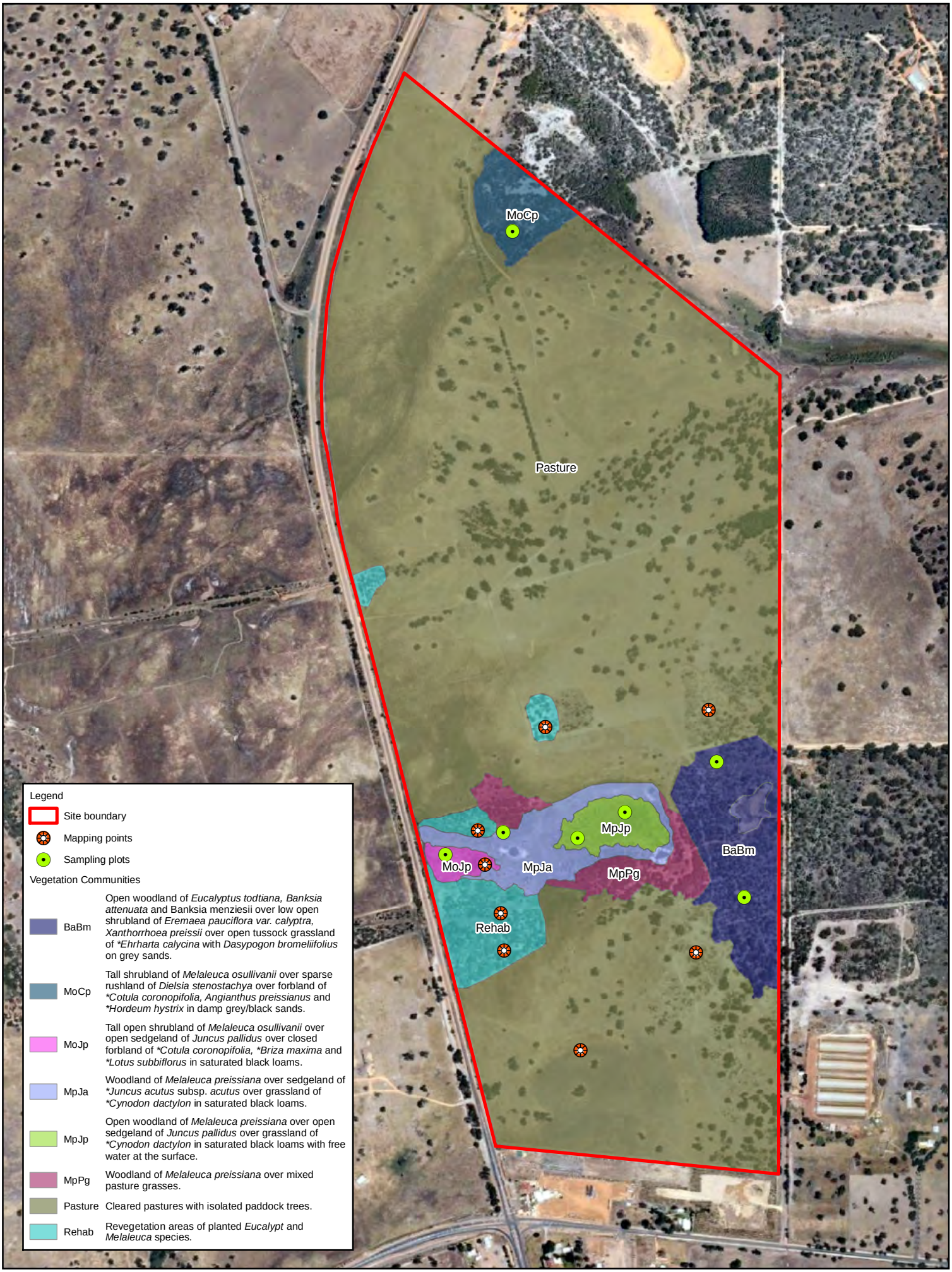


Figure 3: Vegetation Communities

Project: Muchea Scheme Amendment - Flora and Vegetation Survey and Wetland Assessment

Client: Westbridge Property Group Pty Ltd

Plan Number: EP12-052(01)--F23

Drawn:	GRO	Date:	03/01/13
Approved:	DRAFT	Date:	--/--/--
Checked:	DRAFT	Scale:	1:10,000@A4

0 90 180 360 Metres

emerge ASSOCIATES
Integrated Science & Design

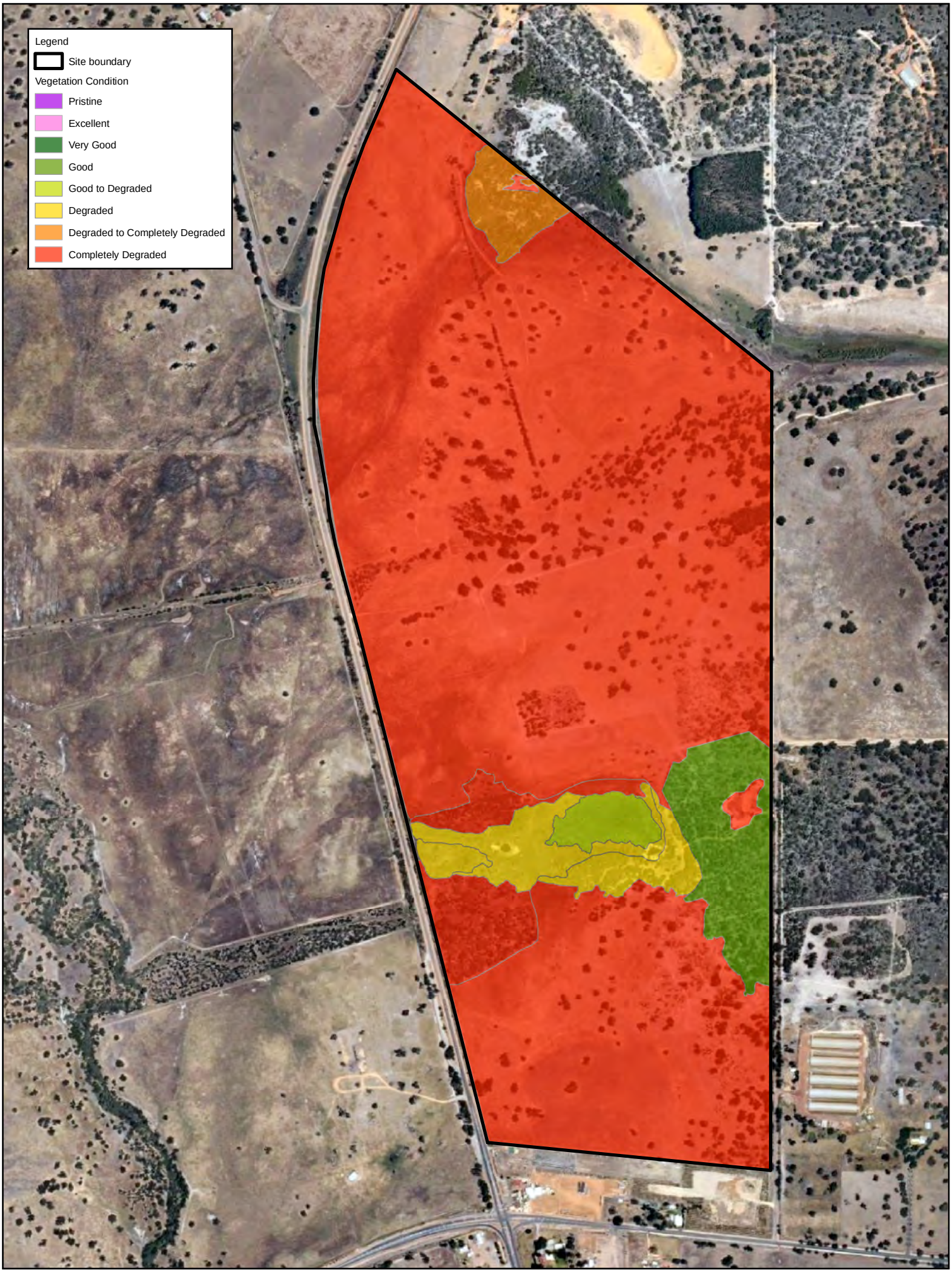


Figure 4: Vegetation Condition

Project: Muchea Scheme Amendment - Flora and Vegetation Survey and Wetland Assessment

Client: Westbridge Property Group Pty Ltd

Plan Number: EP12-052(01)--F24

Drawn:	GRO	Date:	03/01/13
Approved:	DRAFT	Date:	--/--/--
Checked:	DRAFT	Scale:	1:10,000@A4

0 90 180 360 Metres

emerge ASSOCIATES
Integrated Science & Design

APPENDIX A

LIST OF FLORA RECORDED WITHIN THE SURVEY AREA

Plantecology, December 2012

Family	Non-native	Taxon
Colchicaceae		*Burchardia congesta*
Orchidaceae	*	*Disa bracteata*
		Microtis media subsp. *media*
Iridaceae	*	*Gladiolus caryophyllaceus*
	*	*Moraea flaccida*
		Patersonia occidentalis
	*	*Romulea rosea*
Xanthorrhoeaceae		*Xanthorrhoea preissii*
Asparagaceae		*Lomandra sericea*
Hemerocallidaceae		*Arnocrinum preissii*
Haemodoraceae		*Conostylis aculeata* subsp. *aculeata*
		Conostylis juncea
		Conostylis teretifolia subsp. *teretifolia*
		Haemodorum laxum
		Haemodorum spicatum
Dasypogonaceae		*Dasypogon bromeliifolius*
Juncaceae		*Juncus acutus* subsp. *acutus*
		Juncus pallidus
		Juncus sp.
Cyperaceae		*Baumea juncea*
		Eleocharis acuta
		Isolepis cyperoides
		Lepidosperma longitudinale
		Lepidosperma pubisquameum
		Mesomelaena pseudostygia
		Schoenus caespititius
		Schoenus rigens
Restionaceae		*Alexgeorgea nitens*
		Desmocladus flexuosus
		Dielsia stenostachya
		Hypolaena exsulca
		Lyginia imberbis
		Meeboldina cana
Poaceae		*Amphipogon laguroides* subsp. *laguroides*
Poaceae	*	*Austrostipa compressa*
	*	*Briza maxima*

Family	Non-native	Taxon
	*	*Briza minor*
	*	*Bromus diandrus*
	*	*Cynodon dactylon*
	*	*Ehrharta calycina*
	*	*Ehrharta longiflora*
	*	*Hordeum hystrix*
	*	*Lolium rigidum*
	*	*Pentameris airoides* subsp. *airoides*
		Poa porphyroclados
	*	*Polypogon monspeliensis*
	*	*Vulpia myuros forma myuros*
Proteaceae		*Banksia attenuata*
		Banksia dallanneyi var. *dallanneyi*
		Banksia ilicifolia
		Banksia menziesii
		Petrophile linearis
		Stirlingia latifolia
		Synaphea spinulosa subsp. *spinulosa*
Dilleniaceae		*Hibbertia huegelii*
		Hibbertia hypericoides
Fabaceae		*Acacia huegelii*
		Acacia pulchella
		Acacia saligna
		Daviesia physodes
		Daviesia triflora
		Gompholobium tomentosum
		Hovea trisperma
	*	*Lotus subbiflorus*
	*	*Lupinus cosentinii*
	*	*Ornithopus compressus*
	*	*Ornithopus pinnatus*
	*	*Trifolium subterraneum*
Casuarinaceae		*Casuarina obesa*
Myrtaceae		*Astartea scoparia*
		Calytrix sylvana
		Corymbia calophylla
		Eremaea pauciflora var. *calyptra*
	*	*Eucalyptus ?cornuta*
	*	*Eucalyptus ?saligna*
Myrtaceae	*	*Eucalyptus camaldulensis* subsp. *camaldulensis*
		Eucalyptus gomphocephala
	*	*Eucalyptus leucoxylon* subsp. *pruinosa*

Family	Non-native	Taxon
		Eucalyptus rudis subsp. *rudis*
	*	*Eucalyptus sargentii* subsp. *sargentii*
		Eucalyptus todtiana
		Eucalyptus wandoo subsp. *wandoo*
		Hypocalymma angustifolium
		Leptospermum spinescens
		Melaleuca cuticularis
		Melaleuca osullivanii
		Melaleuca preissiana
		Melaleuca rhaphiophylla
		Melaleuca trichophylla
		Scholtzia involucrata
Loranthaceae		*Nuytsia floribunda*
Primulaceae	*	*Lysimachia arvensis*
Campanulaceae		*Lobelia anceps*
	*	*Wahlenbergia capensis*
Goodeniaceae		*Dampiera linearis*
Asteraceae		*Angianthus preissianus*
	*	*Arctotheca calendula*
		Brachyscome pusilla
	*	*Cotula coronopifolia*
	*	*Hypochaeris glabra*
		Podotheca angustifolia
		Podotheca gnaphalioides
	*	*Sonchus oleraceus*
	*	*Ursinia anthemoides*
	*	*Vellereophyton dealbatum*
Apiaceae		*Eryngium pinnatifidum* subsp. *pinnatifidum* ms

APPENDIX B

emerge ASSOCIATES
Integrated Science & Design

SPECIES PRESENCE IN EACH RECORDED COMMUNITY WITHIN THE SURVEY AREA

Plantecology, December 2012

Non - native	Taxon	Community						
		Rehab	Pasture	BaBm	MoJp	MpJp	MpJa	MoAp
	Acacia huegelii			X				
	Acacia pulchella			X				
	Acacia saligna						X	
	Alexgeorgea nitens			X				
	Amphipogon laguroides subsp.			X				
	Angianthus preissianus							X
*	*Arctotheca calendula*	X		X			X	
	Arnocrinum preissii			X				
	Astartea scoparia					X		
	Austrostipa compressa			X				
	Banksia attenuata		X	X				
	Banksia dallanneyi var. dallanneyi			X				
	Banksia ilicifolia		X					
	Banksia menziesii			X				
	Baumea juncea				X			
	Brachyscome pusilla							X
*	*Briza maxima*		X	X	X		X	X
*	*Briza minor*		X		X	X	X	
*	*Bromus diandrus*		X	X				
	Burchardia congesta			X				X
	Calytrix sylvana			X				
	Casuarina obesa	X			X		X	
	Conostylis aculeata subsp. aculeata			X				
	Conostylis juncea			X				
	Conostylis teretifolia subsp. teretifolia			X				
	Corymbia calophylla		X	X				

Non - native	Taxon	Community						
		Rehab	Pasture	BaBm	MoJp	MpJp	MpJa	MoAp
*	*Cotula coronopifolia*	X			X	X	X	X
*	*Cynodon dactylon*	X			X	X	X	
	Dampiera linearis			X				
	Dasypogon bromeliifolius			X				
	Daviesia physodes			X				
	Daviesia triflora			X				
	Desmocladus flexuosus			X				
	Dielsia stenostachya							X
*	*Disa bracteata*			X				
*	*Ehrharta calycina*	X		X				
*	*Ehrharta longiflora*	X		X	X	X	X	
	Eleocharis acuta					X		
	Eremaea pauciflora var. calyptra			X				
	Eryngium pinnatifidum subsp.							X
*	*Eucalyptus ?cornuta*	X						
*	*Eucalyptus ?saligna*	X						
*	*Eucalyptus camaldulensis subsp.*	X						
*	*Eucalyptus leucoxylon subsp. pruinosa*	X						
	Eucalyptus rudis subsp. rudis	X			X			
*	*Eucalyptus sargentii subsp. sargentii*	X						
	Eucalyptus todtiana		X	X				
*	*Gladiolus caryophyllaceus*			X				
	Gompholobium tomentosum			X				
	Haemodorum laxum			X				
	Haemodorum spicatum			X				
	Hibbertia huegelii			X				

Non - native	Taxon	Community						
		Rehab	Pasture	BaBm	MoJp	MpJp	MpJa	MoAp
	Hibbertia hypericoides			X				
*	*Hordeum hystrix*						X	X
	Hovea trisperma			X				
	Hypocalymma angustifolium			X		X		
*	*Hypochaeris glabra*		X	X				
	Hypolaena exsulca			X				
	Isolepis cyperoides				X		X	
*	*Juncus acutus subsp. acutus*	X			X	X	X	
	Juncus pallidus	X			X	X	X	
	Juncus sp.					X		
	Lepidosperma longitudinale				X		X	
	Lepidosperma pubisquameum			X				
	Leptospermum spinescens			X				
	Lobelia anceps				X	X	X	
*	*Lolium rigidum*	X	X	X	X	X	X	X
	Lomandra sericea			X				
*	*Lotus subbiflorus*	X	X		X		X	
*	*Lupinus cosentinii*		X	X				
	Lyginia imberbis			X				
*	*Lysimachea arvensis*		X			X		
	Meeboldina cana							X
	Melaleuca cuticularis	X						
	Melaleuca osullivanii				X		X	X
	Melaleuca preissiana	X	X		X	X	X	
	Melaleuca rhaphiophylla					X		X
	Melaleuca trichophylla			X				

Non - native	Taxon	Community						
		Rehab	Pasture	BaBm	MoJp	MpJp	MpJa	MoAp
	Mesomelaena pseudostygia			X				
	Microtis media subsp. media					X		
*	*Moraea flaccida*	X	X		X	X	X	
	Nuytsia floribunda			X				
*	*Ornithopus compressus*			X				
*	*Ornithopus pinnatus*			X				
	Patersonia occidentalis			X	X			
*	*Pentameris airoides subsp. airoides*		X	X				
	Petrophile linearis			X				
	Poa porphyroclados							X
	Podotheca angustifolia			X				
	Podotheca gnaphalioides			X				
*	*Polypogon monspeliensis*		X		X		X	X
*	*Romulea rosea*			X				X
	Schoenus caespititius				X		X	
	Schoenus rigens							X
	Scholtzia involucrata			X				
*	*Sonchus oleraceus*				X		X	
	Stirlingia latifolia			X				
	Synaphea spinulosa subsp. spinulosa			X				
*	*Trifolium subterraneum*		X			X	X	
*	*Ursinia anthemoides*		X	X				
	Vellereophyton dealbatum					X		
*	*Vulpia myuros forma myuros*		X	X				
*	*Wahlenbergia capensis*			X				
	Xanthorrhoea preissii	X	X	X				

APPENDIX C

emerge ASSOCIATES
Integrated Science & Design

SAMPLING PLOT RAW DATA

Plantecology, December 2012

Site Number	1	**Date**	15 10 12
Recorder/s	SC	**Zone**	50
Datum	GDA94		
Photo No.	**Easting**	**Northing**	
7045-7049	405155	6507006	
Observations			
Environment			
Soils:	**Soil texture**	**Soil Colour**	**Soil Comments**
	Sand	Grey	
Outcrop	**Type**	**Amount**	**Bare Ground (%)**
		N/A	45
Geomorphology:	**Topography**	**Aspect**	**Slope (o)**
	LS	NW	0 - 5
Weeds:	**% Cover**	**No. Plants**	
	15	>1000	
Disturbance:	**Type**	**Time Since Fire**	**Level of Human Impact**
	Grazing	>5	Medium
Vegetation Condition	Good - Degraded		
Vegetation Structure			
Strata	**Canopy Height (m)**	**Dominant Species**	**% Cover**
Upper	10	*Corymbia calophylla* , *Eucalyptus todtiana*	2
Mid	5	*Banksia menziesii* , *Banksia attenuata*	5
Lower	0.8	*Eremaea pauciflora var. calyptra*, *Dasypogon bromeliifolius*, *Ehrharta calycina*	15

Floristics

	Species	FPC
	Eremaea pauciflora var. calyptra	4
	Banksia attenuata	3
*	*Ehrharta calycina*	3
	Banksia menziesii	2
	Eucalyptus todtiana	1.5
	Dasypogon bromeliifolius	1
*	*Vulpia myuros forma myuros*	1
*	*Arctotheca calendula*	+
	Arnocrinum preissii	+
	Banksia dallanneyi var. dallanneyi	+
*	*Briza maxima*	+
*	*Bromus diandrus*	+
	Burchardia congesta	+
	Calytrix sylvana	+
	Conostylis aculeata subsp. aculeata	+
	Conostylis teretifolia subsp. teretifolia	+
	Dampiera linearis	+
	Daviesia physodes	+
	Daviesia triflora	+
	Desmocladus flexuosus	+
*	*Ehrharta calycina*	+
*	*Ehrharta longiflora*	+
*	*Gladiolus caryophyllaceus*	+
	Gompholobium tomentosum	+
	Haemodorum spicatum	+
	Hibbertia hypericoides	+
*	*Hypochaeris glabra*	+
	Lepidosperma pubisquameum	+
	Leptospermum spinescens	+
*	*Lolium rigidum*	+
*	*Lupinus cosentinii*	+
	Lyginia imberbis	+
	Melaleuca trichophylla	+
	Mesomelaena pseudostygia	+
*	*Ornithopus compressus*	+
*	*Ornithopus pinnatus*	+
	Patersonia occidentalis	+
*	*Pentameris airoides subsp. airoides*	+
	Petrophile linearis	+
	Podotheca gnaphalioides	+
*	*Romulea rosea*	+
	Scholtzia involucrata	+
	Stirlingia latifolia	+
	Synaphea spinulosa subsp. spinulosa	+
*	*Ursinia anthemoides*	+
*	*Wahlenbergia capensis*	+
	Xanthorrhoea preissii	+

Site Number	2	**Date**	15 10 12
Recorder/s	SC	**Zone**	50
Datum	GDA94		
Photo No.	**Easting**	**Northing**	
7051-7055	405212	6506723	
Observations			
Environment			
Soils:	**Soil texture**	**Soil Colour**	**Soil Comments**
	Sand	Grey	
Outcrop	**Type**	**Amount**	**Bare Ground (%)**
		none	45
Geomorphology:	**Topography**	**Aspect**	**Slope (o)**
	LS	W	0 - 5
Weeds:	**% Cover**	**No. Plants**	
	25	>1000	
Disturbance:	**Type**	**Time Since Fire**	**Level of Human Impact**
	Grazing , sand extraction	>5	medium
Vegetation Condition	Good		
Vegetation Structure			
Strata	**Canopy Height (m)**	**Dominant Species**	**% Cover**
Upper	8	*Eucalyptus todtiana* , *Banksia attenuata* , *Banksia menziesii*	15
Mid	1.5	*Xanthorrhoea preissii* , *Eremaea pauciflora var. calyptra*	5
Lower	0.5	*Dasypogon bromeliifolius* , *Ehrharta calycina*	25

Floristics

	Species	FPC
*	*Ehrharta calycina*	10
	Banksia menziesii	6
	Banksia attenuata	5
	Dasypogon bromeliifolius	2
	Eucalyptus todtiana	2
*	*Hypochaeris glabra*	1
	Acacia huegelii	+
	Acacia pulchella	+
	Alexgeorgia nitens	+
	Amphipogon laguroides subsp. laguroides	+
*	*Arctotheca calendula*	+
	Austrostipa compressa	+
*	*Briza maxima*	+
*	*Bromus diandrus*	+
	Burchardia congesta	+
	Conostylis aculeata subsp. aculeata	+
	Conostylis juncea	+
	Dampiera linearis	+
	Desmocladus flexuosus	+
*	*Disa bracteata*	+
*	*Ehrharta calycina*	+
*	*Ehrharta longiflora*	+
	Eremaea pauciflora var. calyptra	+
*	*Gladiolus caryophyllaceus*	+
	Haemodorum laxum	+
	Haemodorum spicatum	+
	Hibbertia huegelii	+
	Hibbertia hypericoides	+
	Hovea trisperma	+
	Hypocalymma angustifolium	+
	Hypolaena exsulca	+
*	*Lolium rigidum*	+
	Lomandra sericea	+
	Lyginia imberbis	+
	Melaleuca trichophylla	+
	Mesomelaena pseudostygia	+
*	*Ornithopus compressus*	+
*	*Ornithopus pinnatus*	+
	Patersonia occidentalis	+
*	*Pentameris airoides subsp. airoides*	+
	Petrophile linearis	+
	Podotheca angustifolia	+
*	*Romulea rosea*	+
	Scholtzia involucrata	+
	Stirlingia latifolia	+
	Synaphea spinulosa subsp. spinulosa	+
*	*Ursinia anthemoides*	+
	Xanthorrhoea preissii	+

Site Number	Site 03	**Date**	16 10 12
Recorder/s	SC	**Zone**	50
Datum	GDA94		
Photo No.	**Easting**	**Northing**	
7083-7087	404587	6506812	
Observations			
Environment			
Soils:	**Soil texture**	**Soil Colour**	**Soil Comments**
	Sand / loam	Black	Wet at surface , some free water
Outcrop	**Type**	**Amount**	**Bare Ground (%)**
		none	5
Geomorphology:	**Topography**	**Aspect**	**Slope (o)**
	flat	n/a	0
Weeds:	**% Cover**	**No. Plants**	
	80	>1000	
Disturbance:	**Type**	**Time Since Fire**	**Level of Human Impact**
	grazing	>10	med - High
Vegetation Condition	Degraded		
Vegetation Structure			
Strata	**Canopy Height (m)**	**Dominant Species**	**% Cover**
Upper	5	*Melaleuca osullivanii*	5
Mid	4	*Juncus pallidus*	5
Lower	0.6	*Cotula coronopifolia Briza minor , Lotus subbiflorus*	80

Floristics

	Species	**FPC**
*	*Lotus subbiflorus*	25
*	*Briza minor*	20
	Cotula coronopifolia	15
	Juncus pallidus	5
	Melaleuca osullivanii	5
	Isolepis cyperoides	1
*	*Briza maxima*	+
	Casuarina obesa	+
*	*Ehrharta longiflora*	+
*	*Juncus acutus subsp. acutus*	+
	Lepidosperma longitudinale	+
	Lobelia anceps	+
*	*Lolium rigidum*	+
*	*Polypogon monspeliensis*	+
*	*Sonchus oleraceus*	+

Site Number	Site 04	**Date**	16 10 12
Recorder/s	SC	**Zone**	50
Datum	GDA94		
Photo No.	**Easting**	**Northing**	
7088-7092	404963	6506901	
Observations			
Environment			
Soils:	**Soil texture**	**Soil Colour**	**Soil Comments**
	Sand / loam	Black	Wet at surface , free water to 20 cm
Outcrop	**Type**	**Amount**	**Bare Ground (%)**
		none	1
Geomorphology:	**Topography**	**Aspect**	**Slope (o)**
	flat	n/a	0
Weeds:	**% Cover**	**No. Plants**	
	20	>1000	
Disturbance:	**Type**	**Time Since Fire**	**Level of Human Impact**
	grazing	>10	med - High
Vegetation Condition	Degraded - good		
Vegetation Structure			
Strata	**Canopy Height (m)**	**Dominant Species**	**% Cover**
Upper	4	*Melaleuca preissiana*	5
Mid	1.3	*Juncus pallidus*	50
Lower	0.2	*Cynodon dactylon*	20

Floristics

	Species	
	Juncus pallidus	50
*	*Cynodon dactylon*	20
	Melaleuca preissiana	5
	Astartea scoparia	+
	Eleocharis acuta	+
	Juncus sp.	+
	Lobelia anceps	+
*	*Lolium rigidum*	+
	Melaleuca rhaphiophylla	+

Site Number	Site 05	**Date**	16 10 12
Recorder/s	SC	**Zone**	50
Datum	GDA94		
Photo No.	**Easting**	**Northing**	
7098-7102	404708	6506859	
Observations			
Environment			
Soils:	**Soil texture**	**Soil Colour**	**Soil Comments**
	Sand / loam	Black	Wet at surface , no free water
Outcrop	**Type**	**Amount**	**Bare Ground (%)**
		none	3
Geomorphology:	**Topography**	**Aspect**	**Slope (o)**
	flat	n/a	0
Weeds:	**% Cover**	**No. Plants**	
	90	>1000	
Disturbance:	**Type**	**Time Since Fire**	**Level of Human Impact**
	grazing	>10	High
Vegetation Condition			
Vegetation Structure			
Strata	**Canopy Height (m)**	**Dominant Species**	**% Cover**
Upper	4	*Melaleuca preissiana*	20
Mid	0.8	*Juncus acutus subsp. acutus*	10
Lower	0.2	*Cynodon dactylon*	70

Floristics

	Species	FPC
*	*Cynodon dactylon*	70
	Melaleuca preissiana	20
*	*Juncus acutus subsp. acutus*	10
*	*Cotula coronopifolia*	+
*	*Ehrharta longiflora*	+
	Juncus pallidus	+
*	*Moraea flaccida*	+
	Lobelia anceps	+

Site Number	Site 06	**Date**	16 10 12
Recorder/s	SC	**Zone**	50
Datum	GDA94		
Photo No.	**Easting**	**Northing**	
7103-7107	404864	6506847	
Observations			
Environment			
Soils:	**Soil texture**	**Soil Colour**	**Soil Comments**
	Sand / loam	Black	Wet at surface , some free water to 15 cm
Outcrop	**Type**	**Amount**	**Bare Ground (%)**
		none	2
Geomorphology:	**Topography**	**Aspect**	**Slope (o)**
	flat	n/a	0
Weeds:	**% Cover**	**No. Plants**	
	20	>1000	
Disturbance:	**Type**	**Time Since Fire**	**Level of Human Impact**
	grazing	>10	medium - High
Vegetation Condition	Degraded		
Vegetation Structure			
Strata	**Canopy Height (m)**	**Dominant Species**	**% Cover**
Upper	4	*Melaleuca preissiana*	8
Mid	0.8	*Juncus acutus subsp. acutus , Juncus pallidus*	40
Lower	0.2	*Cynodon dactylon*	20

Floristics

	Species	FPC
	Juncus pallidus	35
*	*Cynodon dactylon*	20
	Melaleuca preissiana	8
*	*Juncus acutus subsp. acutus*	5
*	*Lysimachea arvensis*	+
*	*Briza minor*	+
*	*Trifolium subterraneum*	+
*	*Cotula coronopifolia*	+
*	*Ehrharta longiflora*	+
	Eleocharis acuta	+
	Hypocalymma angustifolium	+
	Vellereophyton dealbatum	+
*	*Moraea flaccida*	+
	Microtis media subsp. media	+
	Lobelia anceps	+

Site Number	Site 7	**Date**	25/10/12
Recorder/s	SC	**Zone**	50
Datum	GDA94		
Photo No.	**Easting**	**Northing**	
7121-7125	404728	6508127	
Observations			
Environment			
Soils:	**Soil texture**	**Soil Colour**	**Soil Comments**
	Loamy sands	grey - black	damp at surface no free water. firm to walk on
Outcrop	**Type**	**Amount**	**Bare Ground (%)**
		none	20
Geomorphology:	**Topography**	**Aspect**	**Slope (o)**
	flat - slight depression	n/a	0
Weeds:	**% Cover**	**No. Plants**	
	50	>1000	
Disturbance:	**Type**	**Time Since Fire**	**Level of Human Impact**
	grazing	>10	High
Vegetation Condition	CD		
Vegetation Structure			
Strata	**Canopy Height (m)**	**Dominant Species**	**% Cover**
Upper	4	*Melaleuca osullivanii* , *Melaleuca rhaphiophylla*	35
Mid	0.3	*Dielsia stenostachya*	+
Lower	0.1	*Cotula coronopifolia* , *Hordeum hystrix* , *Angianthus preissianus*	60

Floristics

	Species	FPC
	Melaleuca osullivanii	30
*	*Hordeum hystrix*	25
*	*Cotula coronopifolia*	10
	Angianthus preissianus	1
	Brachyscome pusilla	+
*	*Briza maxima*	+
	Burchardia congesta	+
	Dielsia stenostachya	+
	Eryngium pinnatifidum subsp. pinnatifidum ms	+
*	*Lolium rigidum*	+
	Meeboldina cana	+
	Melaleuca rhaphiophylla	+
	Poa porphyroclados	+
*	*Polypogon monspeliensis*	+
*	*Romulea rosea*	+
	Schoenus rigens	+

Site Number	MP01	**Date**	15 10 12
Recorder/s	SC	**Zone**	50
Datum	GDA94		
Photo No.	**Easting**	**Northing**	
7056-7060	405112	6506607	
Observations	Parkland cleared		
Environment			
Soils:	**Soil texture**	**Soil Colour**	**Soil Comments**
	Sand	Grey	
Outcrop	**Type**	**Amount**	**Bare Ground (%)**
		none	25
Geomorphology:	**Topography**	**Aspect**	**Slope (o)**
	flat	n/a	0
Weeds:	**% Cover**	**No. Plants**	
	40	>1000	
Disturbance:	**Type**	**Time Since Fire**	**Level of Human Impact**
	Grazing	>10	
Vegetation Condition	CD		
Vegetation Structure			
Strata	**Canopy Height (m)**	**Dominant Species**	**% Cover**
Upper	12	*Corymbia calophylla*	1
Mid	1.5	*Xanthorrhoea preissii*	10
Lower	0.2	*Arctotheca calendula , pasture grasses*	65

Site Number	MP02	**Date**	15 10 12
Recorder/s	SC	**Zone**	50
Datum	GDA94		
Photo No.	**Easting**	**Northing**	
7061-7065	404870	6506402	
Observations	Cleared pasture		
Environment			
Soils:	**Soil texture**	**Soil Colour**	**Soil Comments**
	Sand	Grey	
Outcrop	**Type**	**Amount**	**Bare Ground (%)**
		none	5
Geomorphology:	**Topography**	**Aspect**	**Slope (o)**
	flat	n/a	0
Weeds:	**% Cover**	**No. Plants**	
	90	>1000	
Disturbance:	**Type**	**Time Since Fire**	**Level of Human Impact**
	Grazing	>10	High
Vegetation Condition	CD		
Vegetation Structure			
Strata	**Canopy Height (m)**	**Dominant Species**	**% Cover**
Upper	12	*Corymbia calophylla*	1
Mid	0.8	*Lupinus cosentinii*	+
Lower	0.2	*Arctotheca calendula* and pasture species	90

Site Number	MP03	**Date**	16 10 12
Recorder/s	SC	**Zone**	50
Datum	GDA94		
Photo No.	**Easting**	**Northing**	
7066-7070	404710	6506611	
Observations	Planted trees		
Environment			
Soils:	**Soil texture**	**Soil Colour**	**Soil Comments**
	Sand	Grey	Humus layer at surface
Outcrop	**Type**	**Amount**	**Bare Ground (%)**
		none	5
Geomorphology:	**Topography**	**Aspect**	**Slope (o)**
	flat	n/a	0
Weeds:	**% Cover**	**No. Plants**	
	1	>1000	
Disturbance:	**Type**	**Time Since Fire**	**Level of Human Impact**
	grazing	>10	High
Vegetation Condition	CD		
Vegetation Structure			
Strata	**Canopy Height (m)**	**Dominant Species**	**% Cover**
Upper	10	*Eucalyptus rudis* , planted eucalypts	20
Mid	4	*Casuarina obesa* , *Melaleuca preissiana* ,	5
Lower	0.3	*Lolium rigidum* , *Lotus subbiflorus, Moraea flaccida*	1

Site Number	MP04	**Date**	16 10 12
Recorder/s	SC	**Zone**	50
Datum	GDA94		
Photo No.	**Easting**	**Northing**	
7073-7077	404703	6506689	
Observations	Planted trees		
Environment			
Soils:	**Soil texture**	**Soil Colour**	**Soil Comments**
	Sand / loam	Black	Wet at surface , no free water
Outcrop	**Type**	**Amount**	**Bare Ground (%)**
		none	5
Geomorphology:	**Topography**	**Aspect**	**Slope (o)**
	flat	n/a	0
Weeds:	**% Cover**	**No. Plants**	
	90	>1000	
Disturbance:	**Type**	**Time Since Fire**	**Level of Human Impact**
	grazing	>10	High
Vegetation Condition	CD		
Vegetation Structure			
Strata	**Canopy Height (m)**	**Dominant Species**	**% Cover**
Upper	10	Eucalyptus rudis	5
Mid	4	*Casuarina obesa, Melaleuca preissiana ,*	5
Lower	0.6	*Lolium rigidum , Lotus subbiflorus, Moraea flaccida*	95

Site Number	MP05	**Date**	16 10 12
Recorder/s	SC	**Zone**	50
Datum	GDA94		
Photo No.	**Easting**	**Northing**	
7078-7082	404655	6506862	
Observations			
	Planted trees		
Environment			
Soils:	**Soil texture**	**Soil Colour**	**Soil Comments**
	Sand / loam	Black	Wet at surface , no free water
Outcrop	**Type**	**Amount**	**Bare Ground (%)**
		none	5
Geomorphology:	**Topography**	**Aspect**	**Slope (o)**
	flat	n/a	0
Weeds:	**% Cover**	**No. Plants**	
	90	>1000	
Disturbance:	**Type**	**Time Since Fire**	**Level of Human Impact**
	grazing	>10	High
Vegetation Condition	CD		
Vegetation Structure			
Strata	**Canopy Height (m)**	**Dominant Species**	**% Cover**
Upper	10	*Eucalyptus sargentii subsp. sargentii, Melaleuca preissiana , Eucalyptus rudis*	5
Mid	4	*Juncus acutus subsp. acutus*	1
Lower	0.6	*Lolium rigidum , Lotus subbiflorus, Moraea flaccida*	90

Site Number	MP06	**Date**	16 10 12
Recorder/s	SC	**Zone**	50
Datum	GDA94		
Photo No.	**Easting**	**Northing**	
7093-7097	404670	6506791	
Observations			
Environment			
Soils:	**Soil texture**	**Soil Colour**	**Soil Comments**
	Sand / loam	Black	Wet at surface , some free water
Outcrop	**Type**	**Amount**	**Bare Ground (%)**
		none	5
Geomorphology:	**Topography**	**Aspect**	**Slope (o)**
	flat	n/a	0
Weeds:	**% Cover**	**No. Plants**	
	80	>1000	
Disturbance:	**Type**	**Time Since Fire**	**Level of Human Impact**
	grazing	>10	med - High
Vegetation Condition	Degraded		
Vegetation Structure			
Strata	**Canopy Height (m)**	**Dominant Species**	**% Cover**
Upper	5	*Melaleuca osullivanii* , *Melaleuca preissiana*	5
Mid	4	*Juncus pallidus* , *Juncus acutus subsp. acutus*	5
Lower	0.6	*Cynodon dactylon*	80

Site Number	MP07	**Date**	25/10/12
Recorder/s	SC	**Zone**	50
Datum	GDA94		
Photo No.	**Easting**	**Northing**	
7108-7112	404796	6507079	
Observations			
Environment			
Soils:	**Soil texture**	**Soil Colour**	**Soil Comments**
	Sand	Grey	
Outcrop	**Type**	**Amount**	**Bare Ground (%)**
		N/A	75
Geomorphology:	**Topography**	**Aspect**	**Slope (o)**
	Flat	none	0
Weeds:	**% Cover**	**No. Plants**	
	20	>1000	
Disturbance:	**Type**	**Time Since Fire**	**Level of Human Impact**
	Grazing	>10	High
Vegetation Condition	CD		
Vegetation Structure			
Strata	**Canopy Height (m)**	**Dominant Species**	**% Cover**
Upper	8	*Eucalyptus gomphocephala* , *Banksia attenuata* , *Banksia attenuata*	8
Mid			
Lower	0.5	*Ehrharta calycina* , *Vulpia myuros* , *Lolium rigidum* , *Bromus diandrus*	20

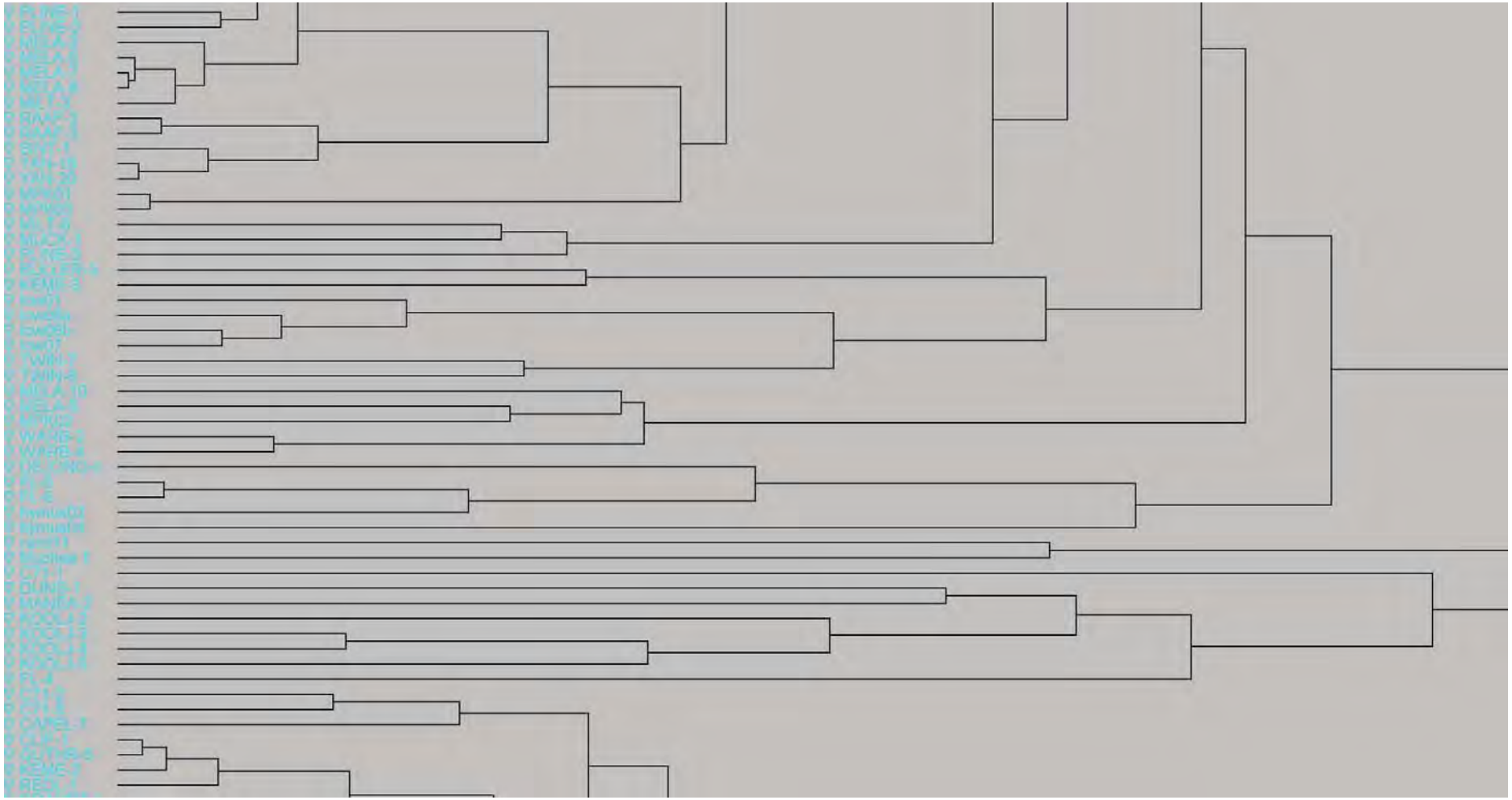
Site Number	MP08	**Date**	25/10/12
Recorder/s	SC	**Zone**	50
Datum	GDA94		
Photo No.	**Easting**	**Northing**	
7116-7120	405138	6507115	
Observations			
Environment			
Soils:	**Soil texture**	**Soil Colour**	**Soil Comments**
	Sand	Grey	
Outcrop	**Type**	**Amount**	**Bare Ground (%)**
		N/A	75
Geomorphology:	**Topography**	**Aspect**	**Slope (o)**
	LS	none	0-5
Weeds:	**% Cover**	**No. Plants**	
	20	>1000	
Disturbance:	**Type**	**Time Since Fire**	**Level of Human Impact**
	Grazing	>10	High
Vegetation Condition	CD		
Vegetation Structure			
Strata	**Canopy Height (m)**	**Dominant Species**	**% Cover**
Upper	8	*Eucalyptus todtiana* , *Banksia attenuata* , *Banksia attenuata*	3
Mid			
Lower	0.5	*Ehrharta calycina* , *Xanthorrhoea preissii* ,	20

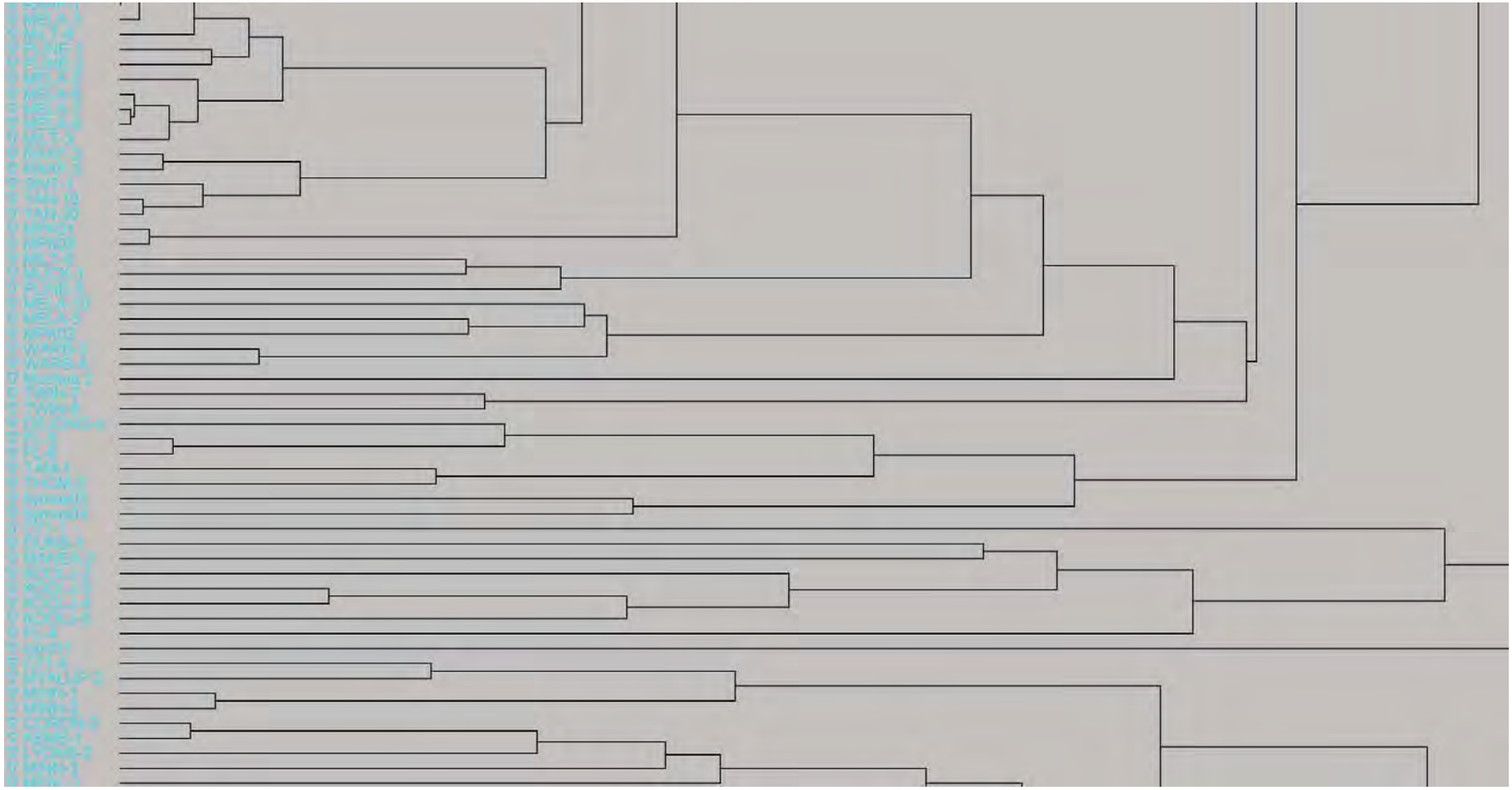
APPENDIX D

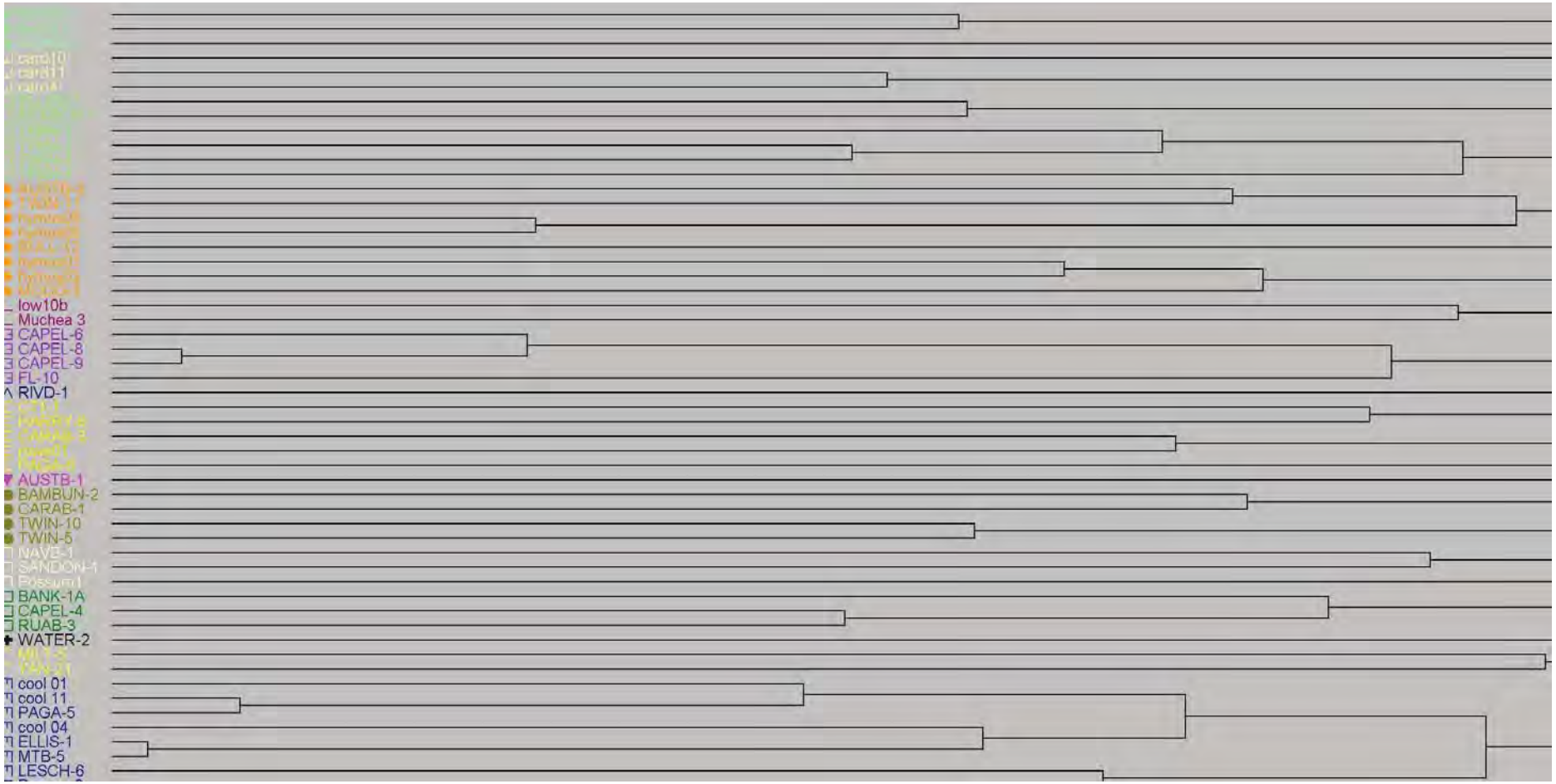
CLUSTER DENDROGRAMS

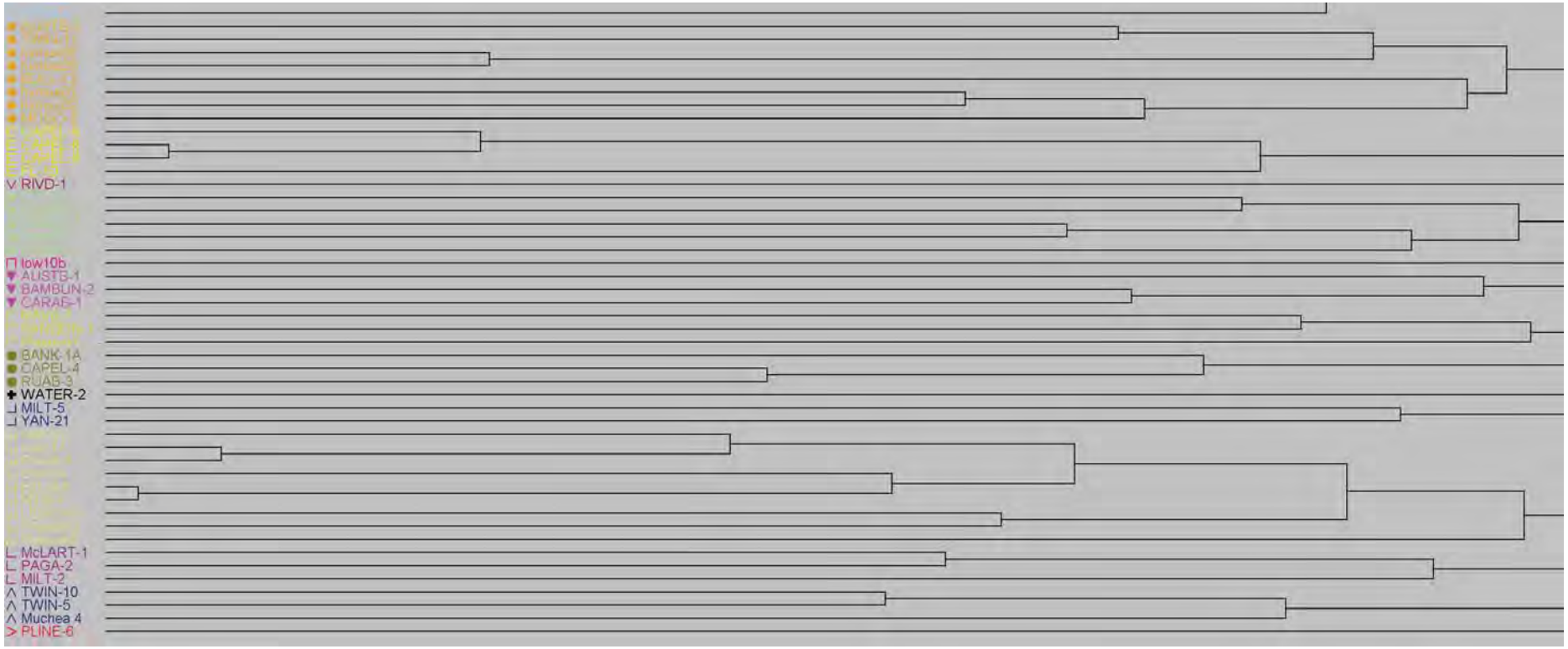
Relevant portion of each dendrogram of FCT assignment

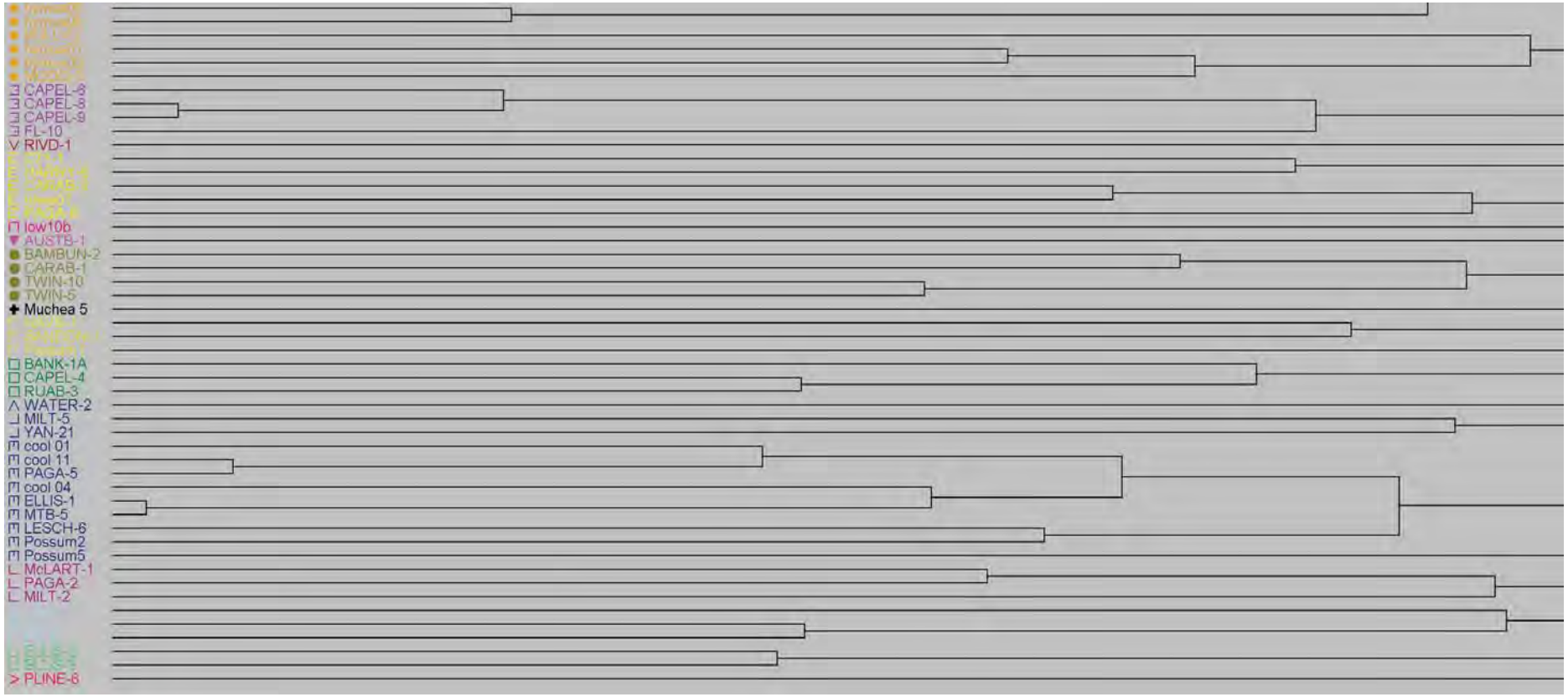
Plantecology, December 2012

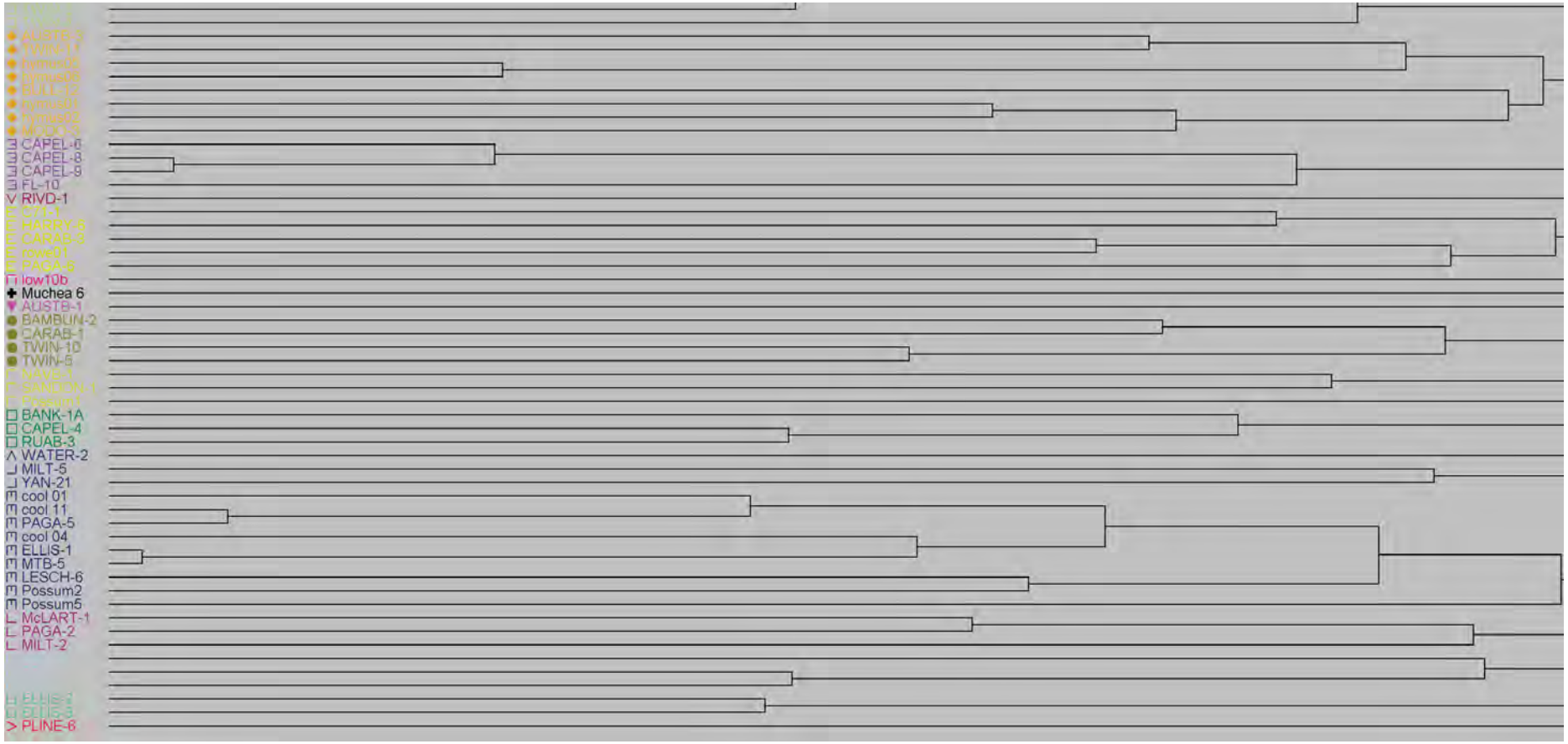


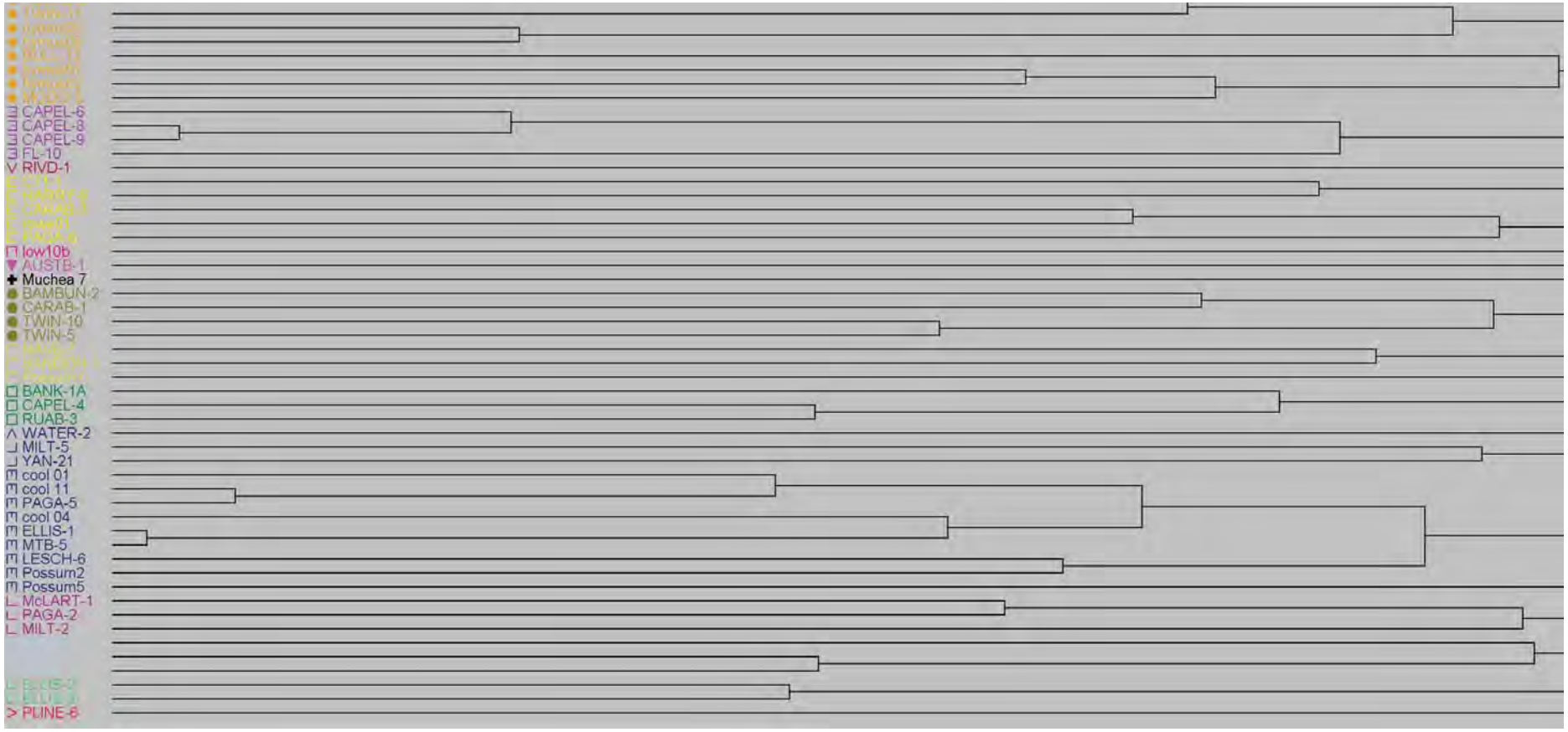



low10b
Muchea 3
CAPEL-6
CAPEL-8
CAPEL-9
FL-10
RIVD-1
AUSTB-1
BAMBUN-2
CARAB-1
TWIN-10
TWIN-5
NAVE-1
SANDON-1
Possum1
BANK-1A
CAPEL-4
RUAB-3
WATER-2
cool 01
cool 11
PAGA-5
cool 04
ELLIS-1
MTB-5
LESCH-6


RIVD-1
low10b
AUSTB-1
BAMBUN-2
CARAE-1
BANK-1A
CAPEL-4
RUAB-3
WATER-2
MILT-5
YAN-21
McLART-1
PAGA-2
MILT-2
TWIN-10
TWIN-5
Muchea 4
PLINE-6


CAPEL-8
CAPEL-8
CAPEL-9
FL-10
RIVD-1
low10b
AUSTB-1
BAMBUN-2
CARAB-1
TWIN-10
TWIN-5
Muchea 5
BANK-1A
CAPEL-4
RUAB-3
WATER-2
MILT-5
YAN-21
cool 01
cool 11
PAGA-5
cool 04
ELLIS-1
MTB-5
LESCH-6
Possum2
Possum5
McLART-1
PAGA-2
MILT-2
PLINE-6


CAPEL-6
CAPEL-8
CAPEL-9
FL-10
RIVD-1
HARRY-6
CARAB-3
rowe01
PAGA-6
low10b
Muchea 6
AUSTB-1
BAMBUN-2
CARAB-1
TWIN-10
TWIN-5
BANK-1A
CAPEL-4
RUAB-3
WATER-2
MILT-5
YAN-21
cool 01
cool 11
PAGA-5
cool 04
ELLIS-1
MTB-5
LESCH-6
Possum2
Possum5
McLART-1
PAGA-2
MILT-2
PLINE-6


CAPEL-6
CAPEL-8
CAPEL-9
FL-10
RIVD-1
low10b
AUSTB-1
Muchea 7
BAMBUN-2
CARAB-1
TWIN-10
TWIN-5
BANK-1A
CAPEL-4
RUAB-3
WATER-2
MILT-5
YAN-21
cool 01
cool 11
PAGA-5
cool 04
ELLIS-1
MTB-5
LESCH-6
Possum2
Possum5
McLART-1
PAGA-2
MILT-2
PLINE-6

APPENDIX E

MATTERS OF NATIONAL ENVIRONEMTNAL SIGNIFICANCE REPORT

SEWPaC, 2012

Australian Government
Department of Sustainability, Environment, Water, Population and Communities

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

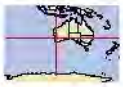
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information about the EPBC Act including significance guidelines, forms and application process details can be found at http://www.environment.gov.au/epbc/assessmentsapprovals/index.html

Report created: 09/08/12 13:07:59

This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates
Buffer: 1.0Km



Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance - see http://www.environment.gov.au/epbc/assessmentsapprovals/guidelines/index.html

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Threatened Ecological Communities:	None
Threatened Species:	16
Migratory Species:	9

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage/index.html

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species. Information on EPBC Act permit requirements and application forms can be found at http://www.environment.gov.

Commonwealth Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	6
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

Place on the RNE:	None
State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	18
Nationally Important Wetlands:	None

Details

Matters of National Environmental Significance

Threatened Species		[Resource Information]
Name	Status	Type of Presence
BIRDS		
Calyptorhynchus banksii naso		
Forest Red-tailed Black-Cockatoo [67034]	Vulnerable	Species or species habitat may occur within area

ATTACHMENT 3: FLORA AND VEGETATION TECHNICAL MEMORANDUM

TECHNICAL MEMORANDUM

PROJECT NUMBER	EP15-037	**DOC. NUMBER**	EP15-037(01)—030A
PROJECT NAME	Lot 102 Great Northern Highway, Muchea		
AUTHOR	RAO	**REVIEWER**	TAA
VERSION	A	**DATE**	9/11/2017
PURPOSE	Summary of flora and vegetation values within the site focussing on wetland vegetation		

1. INTRODUCTION

Sirona Capital Management Pty Ltd proposes to develop Lot 102 Great Northern Highway, Muchea (referred to herein as 'the site') for industrial purposes as part of the Muchea Employment Node Local Structure Plan 1 (LSP) area. The site is approximately 45 kilometres (km) north of the Perth Central Business District and is bounded by Muchea East Road to the south, Guillente Road to the east and the great Northern Highway to the west.

Emerge Associates (Emerge) undertook a flora and vegetation survey and wetland assessment of the site in 2012 (Emerge Associates 2013). In July 2016 the Department of Planning, Lands and Heritage (DPLH) (previously Department of Planning (DoP)) notified the project team and respective agencies that the threatened ecological community (TEC) 'clay pans of the Swan Coastal Plain' may be present within the site. This TEC is listed as 'critically endangered' under the EPBC Act and is hereafter referred to as the 'clay pan TEC'.

The DoP had formed the conclusion that the claypan TEC was present because Coffey Environments had recorded an occurrence within the central portion of the site, as part of a larger survey for the Northlink WA Project (Coffey Environments 2015). The Coffey Environments (2015) result was at odds with the findings of the previous survey (Emerge Associates 2013), which had not identified any clay pan vegetation at that particular location.

Subsequently, in 2016, Emerge undertook further surveys of the wetland vegetation within the site to provide clarification on this matter and ascertain whether the clay pan TEC was in fact present. One of the surveys conducted in 2016 was more detailed and focused on all wetland vegetation within the site relevant to the Foreshore Area Report and Biophysical Assessment (Emerge Associates 2017). This included wetland vegetation located in the central and northern portions of the site and the 'central waterway' which flows in an east-west direction through the site.

The purpose of this technical memorandum is to update the wetland flora and vegetation information for the site, through combining pre-existing data (Emerge Associates 2013) with the results of the 2016 surveys. Information regarding the regional setting of the site is provided in the Emerge Associates (2013) report.

2. REVIEW OF CONSERVATION SIGNIFICANT FLORA AND VEGETATION THAT MAY POTENTIALLY BE PRESENT

2.1. Threatened and priority flora

A search was conducted for threatened and priority flora within a 10 km radius of the site using the Protected Matters Search Tool (DoEE 2016) and NatureMap (DPaW 2016). A total of 82 species comprising 26 threatened and 56 priority flora species were identified as potentially occurring in the wider local area as listed in **Table 1**.

Table 1: Significant flora species known or likely to occur within 10 km of the site

Species	Level of significance	
	State	EPBC Act
Acacia anomala	T	VU
Andersonia gracilis	T	EN
Anigozanthos viridis subsp. *terraspectans*	T	VU
Caladenia huegelii	T	E
Calectasia cyanea	T	CR
Chamelaucium sp. Gingin	T	VU
Conospermum densiflorum subsp. *unicephalatum*	T	EN
Darwinia foetida	T	EN
Diuris micrantha	T	VU
Diuris purdiei	T	EN
Drakaea elastica	T	EN
Eleocharis keigheryi	T	VU
Eucalyptus x balanites	T	EN
Eucalyptus leprophloia	T	EN
Grevillea althoferorum subsp. *althoferorum*	T	EN
Grevillea althoferorum subsp. *fragilis*	T	CR
Grevillea corrugata	T	EN
Grevillea curviloba subsp. *curviloba*	T	CR
Grevillea curviloba subsp. *incurva*	T	EN
Lepidosperma rostratum	T	EN
Ptychosema pusillum	T	VU
Thelymitra dedmaniarum	T	EN
Thelymitra stellata	T	EN
Trithuria occidentalis	T	EN
Diplolaena andrewsii	T	-
Hypocalymma sylvestre	T	-
Gastrolobium crispatum	P1	-
Grevillea evanescens	P1	-
Hibbertia glomerata subsp. *ginginensis*	P1	-
Lasiopetalum sp. Toodyay	P1	-

Table 1: Significant flora species known or likely to occur within 10 km of the site (continued)

Species	Level of significance	
	State	EPBC Act
Drosera sewelliae	P2	-
Grevillea candolleana	P2	-
Schoenus sp. Bullsbrook	P2	-
Stenanthemum sublineare	P2	-
Stylidium aceratum	P2	-
Stylidium squamellosum	*P2*	-
Tetraria sp. Chandala	P2	-
Calectasia elegans	P2	-
Caustis gigas	P2	-
Eryngium pinnatifidum subsp. *umbraphilum*	P2	-
Gastrolobium nudum	P2	-
Isotropis cuneifolia subsp. *glabra*	P2	-
Leucopogon squarrosus subsp. *trigynus*	P2	-
Millotia tenuifolia var. *laevis*	P2	-
Poranthera moorokatta	P2	-
Acacia drummondii subsp. *affinis*	P3	-
Adenanthos cygnorum subsp. *chamaephyton*	P3	-
Chamaescilla gibsonii	P3	-
Cyathochaeta teretifolia	P3	-
Eryngium pinnatifidum subsp. *palustre*	P3	-
Guichenotia tuberculata	P3	-
Haemodorum loratum	P3	-
Persoonia rudis	P3	-
Platysace ramosissima	P3	-
Stylidium cymiferum	P3	-
Verticordia serrata var. *linearis*	P3	-
Acacia cummingiana	P3	-
Acacia oncinophylla subsp. *oncinophylla*	P3	-
Acacia pulchella var. *reflexa* acuminate bracteole variant	P3	-
Beaufortia purpurea	P3	-
Lasiopetalum glutinosum subsp. *glutinosum*	P3	-
Meionectes tenuifolia	P3	-
Myriophyllum echinatum	P3	-
Phlebocarya pilosissima subsp. *pilosissima*	P3	-
Pithocarpa corymbulosa	P3	-
Schoenus capillifolius	P3	-
Stylidium paludicola	P3	-
Tetratheca pilifera	P3	-

Table 1: Significant flora species known or likely to occur within 10 km of the site (continued)

Species	Level of significance	
	State	EPBC Act
Verticordia rutilastra	P3	-
Centrolepis caespitosa	P4	-
Drosera occidentalis subsp. *occidentalis*	P4	-
Hypolaena robusta	P4	-
Oxymyrrhine coronata	P4	-
Schoenus griffinianus	P4	-
Stylidium longitubum	P4	-
Synaphea grandis	P4	-
Verticordia lindleyi subsp. *lindleyi*	P4	-
Caladenia speciosa	P4	-
Hibbertia helianthemoides	P4	-
Ornduffia submersa	P4	-
Rumex drummondii	P4	-
Tripterococcus sp. *brachylobus*	P4	-

Note: T=threatened, CR=critically endangered, E=endangered, VU=vulnerable, P1=Priority 1, P2=Priority 2, P3=Priority 3, P4=Priority 4.

2.2. Threatened and priority ecological communities

Known locations of TECs and PECs within 10 km of the site were searched for using the publicly available *Weed and native flora dataset* (Keighery *et al.* 2012) and the *Protected Matters Search Tool* (DoEE 2016). These search results indicate no TECs or PECs are known to occur within the site, but that five TECs and two PECs are likely to occur within 10 km of the site as listed in **Table 2**.

Table 2: TECs and PECs known or likely to occur within 10 km of the site.

Code	Community name	TEC/ PEC	Level of significance	
			State	EPBC Act
Multiple	Clay pans of the Swan Coastal Plain ('clay pan TEC')	TEC	Endangered /Vulnerable	Critically Endangered
Mound Springs SCP	Assemblages of plants and invertebrate animals of tumulus (organic mound) springs of the Swan Coastal Plain	TEC	Critically Endangered	Endangered
MUCHEA LIMESTONE	Shrublands and woodlands on Muchea limestone of the Swan Coastal Plain	TEC	Endangered	Endangered
SCP3c	*Corymbia calophylla – Xanthorrhoea preissii* woodlands and shrublands of the Swan Coastal Plain	TEC	Critically Endangered	Endangered
Multiple	Banksia Woodlands of the Swan Coastal Plain	TEC	-	Endangered - Banksia woodlands of the Swan Coastal Plain ('banksia woodland TEC')
SCP 21c	Low lying *Banksia attenuata* woodlands or shrublands	PEC/ TEC	Priority 3	
SCP 23b	Swan Coastal Plain *Banksia attenuata - Banksia menziesii* woodlands	PEC/ TEC	Priority 3	

Table 3: TECs and PECs known or likely to occur within 10 km of the site. (continued)

Code	Community name	TEC/ PEC	Level of significance	
			State	EPBC Act
SCP 25	Southern Swan Coastal Plain *Eucalyptus gomphocephala - Agonis flexuosa* woodlands	PEC	Priority 3	-

No TECs or PECs were previously recorded in wetland vegetation within the site during the Emerge Associates (2013) survey. However, vegetation on the northern boundary of the site was determined to represent FCT 7 'herb-rich saline shrublands in clay pans' (Emerge Associates 2013). This FCT is one of four clay pan and clay flat FCTs directly associated with the 'claypans of the Swan Coastal Plain' (hereafter referred to as the 'clay pan TEC'). As previously outlined the Coffey Environments (2015) survey concluded that vegetation in the central portion of the site represented the clay pan TEC. Therefore, the current survey was conducted on the understanding that the clay pan TEC may occur in the site, and in particular within the central and northern boundary vegetation.

The banksia woodland type vegetation in the east of the site was previously identified as potentially representing the 'Low lying *Banksia attenuata* woodlands or shrublands' PEC (Emerge Associates 2013). Since the 2012 survey, the 'banksia woodlands of the Swan Coastal Plain' TEC has been listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (on 16th September 2016). This TEC is hereafter referred to as the 'banksia woodland TEC'. The aforementioned PEC is directly associated with the banksia woodland TEC. Based on the results of the previous survey (Emerge Associates 2013) the banksia woodland vegetation on site is likely to qualify as a patch of the banksia woodland TEC. Aside from refining vegetation patch boundaries, no additional assessment was made of banksia woodland vegetation or any other terrestrial vegetation during the 2016 surveys.

3. METHODS

3.1. Field surveys

Four surveys were undertaken within the site by Emerge in 2016. These surveys focused on ascertaining whether the clay pan TEC was present in the site as well as assessing wetland vegetation within the site that was relevant to the *Foreshore Area Report and Biophysical Assessment* (Emerge Associates 2017). Therefore the survey effort was concentred over the wetlands located in the central portion of the site and along the central waterway in the northern portion of the site. Specific focus was applied to the area identified as a clay pan by Coffey Environments (2015).

In addition, a wetland feature predominantly located outside of the northern boundary of the site, that was previously identified by (Emerge Associates 2013) as representing FCT 7, was assessed as a means to provide an appropriate reference site for local clay pan vegetation. A small patch of vegetation associated with this northern wetland feature is located within the site and was also assessed.

Emerge undertook four surveys in 2016 between August and September, as summarised in **Table 4.**

Table 4: Summary of field surveys in 2016

Date	Survey type	Surveyors	Reference sites visited
12/08/2016	Reconnaissance	1 Emerge ecologist	Bullsbrook Nature Reserve Adjacent north wetland
02/09/2016	Reconnaissance	3 Emerge staff, 3 DBCA staff	Adjacent north wetland
31/10/2016	Detailed	1 Emerge ecologist, 1 Emerge botanist	Adjacent north wetland
02/12/2016	Reconnaissance	1 Emerge ecologist	Adjacent north wetland

The site was traversed on foot and the composition and condition of vegetation was recorded. Searches were conducted for threatened and priority flora species with potential to occur in the wetland areas of the site.

During the detailed survey visit, sampling was conducted using permanent 10 m x 10 m quadrats. The quadrats were established using fence droppers bound by measuring tape. One new quadrat was surveyed in the area that Coffey Environments (2015) had recorded the clay pan TEC and one new quadrat was surveyed in the reference wetland to the north of the site. In addition the quadrat surveyed by Coffey Environments (2015) for the Northlink WA Project was re-surveyed.

The position of each quadrat was recorded with a hand-held GPS unit, as shown on **Figure 1.**

The data recorded within each quadrat included:

- site details (site name, site number, observers, date, location)
- environmental information (slope, aspect, bare-ground, rock outcropping soil type and colour class, litter layer, topographical position, time since last fire event)
- biological information (vegetation structure and condition, degree of disturbance, species present and foliage projective cover' (FPC)).

The entire length of the central waterway in the northern portion of the site was traversed and vegetation composition was recorded. Additional plant taxa not observed within sampling points were recorded opportunistically as the botanist traversed the site. Photographs were taken throughout the field visit to show particular site conditions.

All plant specimens collected during the field survey were dried, pressed and then named in accordance with requirements of the Western Australian Herbarium. Identification of specimens occurred through comparison with named material and through the use of taxonomic keys. Flora species not native to Western Australia are denoted by an asterisk (*) in text and raw data.

Vegetation condition was assigned at each sample point and changes in vegetation condition were also noted and mapped across the wetland vegetation in the site, including the central waterway. The condition of the wetland vegetation was assessed using methods from Keighery (1994). The condition of banksia woodland vegetation in the site was not reassessed in 2016.

Table 5: Vegetation condition scale applied during the field assessment

Condition	Definition (Keighery 1994)
Pristine	Pristine or nearly so, no obvious signs of disturbance.
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
Very good	Vegetation structure altered obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
Completely degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.

3.2. Mapping and data analysis

3.2.1. Plant communities

The local plant communities within the site were identified from the sample data collected during the field survey and from 2012 data analysis (Emerge Associates 2013) for vegetation without 2016 quadrats. The local plant communities within the site were identified from the sample data collected during the field survey. A cluster analysis was performed by converting the FPC for each species at each quadrat location to a Domin value (Kent and Coker 1994). Classification was undertaken using hierarchical clustering within the analysis package Primer-6 (Clarke and Gorley 2006), with groups defined using the Bray-Curtis distance measure and further refined using a similarity probability measure (significance level of 0.05).

Once a group was defined from the cluster analysis, the vegetation was described according to the dominant species present using the structural formation descriptions of the *National Vegetation Inventory System* (NVIS) (ESCAVI 2003). The identified plant community was then mapped on aerial photography (1:15,000) from the sample points and boundaries were interpreted from aerial photography. Vegetation condition was mapped on aerial photography (1:13,000) based on the locations recorded during the field survey to define areas with changes in condition.

3.2.2. Floristic community type assignment

Only the 2016 data was statistically analysed to determine FCT and the previous statistical analysis (Emerge Associates 2013) was retained for the other plant communities in the site.

The identified plant communities from the 2016 data were compared to the regional 'floristic community type' (FCT) dataset *A Floristic survey of the southern Swan Coastal Plain* by Gibson *et al.* (1994). The sample data (presence/absence) was reconciled with Gibson *et al*. (1994) by standardising the names of taxa with those used in the earlier study. This was necessary due to changes in nomenclature in the intervening period. Taxa that were only identified to genus level

were excluded, while some infra-species that have been identified since 1994 were reduced to species level.

The combined dataset was then imported into the statistical analysis package Primer-6 (Clarke and Gorley 2006). As data from a localised survey is often spatially correlated, data for each sample point was compared to Gibson *et al*. (1994) separately. This removed the influence of spatial correlation when assigning a FCT. Classification was then undertaken using a group-average hierarchical clustering technique using the Bray-Curtis distance measure (as described above for plant community determination).

Where the sample tended to cluster with a grouping of different FCTs, individual sample point similarity was assessed separately to differentiate between FCTs. Ultimately the cluster analysis, as well as contextual information relating to the soils, landforms and known locations of FCTs within the region and the information obtained from the northern wetland used as a reference for clay pan vegetation was considered in the final determination of an FCT for vegetation within the site.

4. RESULTS

The 2016 survey confirmed that the majority of the site shows evidence of long-term historical disturbance in the form of grazing and predominately contains scattered trees over non-native pasture grasses. The central waterway has been highly disturbed and is accessible to stock, with erosion evident along the banks. Vegetation associated with the central waterway consists of scattered canopy trees (predominantly *Corymbia calophylla*) over occasional native rushes and a dense layer of non-native pasture grasses.

Similarly, the wetland vegetation in the central and western portion of the site has been disturbed by grazing and contains moderate to high cover of non-native pasture species. Revegetation using eucalypt and melaleuca species is present near this wetland system.

4.1. Flora

A total of 15 native and 18 non-native (weed) species were recorded within the site during the field survey. As this survey focused on wetland vegetation it did not record all species in the site and a comprehensive species list is presented in the Emerge Associates (2013) report. A total of 27 species were recorded in the reference wetland quadrat outside of the site. An additional 27 species were recorded opportunistically in the reference wetland. Thirty seven species were recorded in the reference wetland that were not recorded within the site.

The dominant families within the site containing native taxa were Cyperaceae (four native taxa only) and Myrtaceae (three native taxa and one weed taxa). The dominant family containing weed taxa in the site was Poaceae (seven weed taxa only). In the reference wetland outside of the site, the dominant families containing native taxa were Cyperaceae (eight native taxa only), Myrtaceae (six native taxa only) and Asteraceae (five native taxa and one weed taxa).

A complete species list is provided in **Appendix A** and sample data in **Appendix B**.

4.2. Threatened and priority flora

No threatened or priority flora were recorded within the wetland vegetation including the central waterway in the site during the Emerge Associates (2013)or 2016 surveys.

Two Priority 3 species, *Angianthus drummondii* and *Eryngium pinnatifidum* subsp. *palustre*, were recorded opportunistically within the reference wetland outside of the site. No individuals of these species were recorded in the area of nearby vegetation within the site.

4.3. Plant communities

Five native plant communities were identified within wetland areas in the site. One terrestrial plant community (**BaBm**) is present in the site, but as previously outlined this banksia woodland community was not reassessed in the 2016 survey. The vegetation across the remainder of the site is dominated by non-native pasture grasses with scattered native trees. A description and the area of each plant community is provided in **Table 6** and the location of each is shown in **Figure 1**.

The location of plant communities was mapped at a finer scale than during the (Emerge Associates 2013) survey and hence the boundaries of some plant communities were modified. The original labels and descriptions of plant communities provided in the 2012 survey were largely retained,

though some were slightly altered to remove misspellings and better reflect current species composition. In addition, the location of the **BaBm** plant community was refined to excise a central disturbed portion that appears to have previously comprised a quarry.

Table 6: Plant communities identified within the site

Plant community	Description	Area (ha)
MoAp (previously MoCp)	Tall shrubland of *Melaleuca osullivanii* over sparse rushland of *Dielsia stenostachya* over forbland of *Angianthus preissianus, *Cotula coronopifolia* and **Hordeum hystrix* in damp grey/black sands.	0.02
MoJp	Tall open shrubland of *Melaleuca osullivanii* over open sedgeland of *Juncus pallidus* over closed forbland of **Cotula coronopifolia*, **Briza maxima* and **Lotus subbiflorus* in saturated black loams.	0.58
Mp (previously MpPg)	Woodland of *Melaleuca preissiana* over mixed pasture grasses.	3.34
MpJa	Woodland of *Melaleuca preissiana* over sedgeland of **Juncus acutus* subsp. *acutus* over grassland of **Cynodon dactylon* in saturated black loams.	0.55
MpJaJk (previously MpJp)	Open woodland of *Melaleuca preissiana* over open sedgeland of *Juncus acutus* subsp. *acutus* and *Juncus pallidus* over grassland of **Cynodon dactylon* in saturated black loams with free water at the surface.	1.61
BaBm (not surveyed in 2016)	Open woodland of *Eucalyptus todtiana, Banksia attenuata* and Banksia menziesii over low open shrubland of *Eremaea pauciflora* var. *calyptra, Xanthorrhoea preissii* over open tussock grassland of **Ehrharta calycina* with *Dasypogon bromeliifolius* on grey sands.	7.17
Non-native vegetation	Scattered native trees over closed forbland non-native pasture species.	130.52 +5.29 ha revegetation

4.4. Vegetation condition

The majority of the site contains predominately non-native vegetation in 'completely degraded' condition, including the full length of the central waterway. This completely degraded vegetation consists of scattered trees over non-native pasture species. The wetland system in the central portion of the site contains areas of relatively intact native vegetation. This vegetation, including plant communities **MoJp**, **MoJa** and **MpJaJk**, shows evidence of historical disturbances such as grazing, and remains in 'good' and 'degraded' condition. Although moderate to high cover of non-native grasses are present, the areas of vegetation in 'good' condition retain some structure and contain isolated occurrences to scattered patches of native understorey species. Where this vegetation was mapped in 'degraded' condition it lacks structure, has very low native species diversity and has a ground layer that is dominated by non-native species.

The wetland vegetation within the reference wetland (**MoAp**) outside of the site was mapped as being in very good condition. This was a higher condition rating than had been assigned in 2012, when the vegetation was mapped as degraded. The southern edge of this wetland is disturbed and contains a higher density and proportion of non-native species in the ground layer. Consequently, the small patch of vegetation near the edge of the reference wetland that is within the site was classified as being in 'good' condition.

The banksia woodland vegetation in the eastern portion of the site (**BaBm**) was previously determined to be present in 'good' condition by Emerge Associates (2013). This vegetation was not resurveyed in 2016 and so the 2012 vegetation condition classification is assumed to be still current for the areas mapped in 2016.

The condition of the vegetation in the site is shown in **Figure 2**.

4.5. Floristic community type assignment

The **MoJp** vegetation in the central western portion of the site was resurveyed in detail in 2016. This community was determined to represent FCT 11 'wet forests and woodlands'. Assignment to FCT 11 is consistent with the Emerge Associates (2013) results which determined all central wetland communities (**MoJp**, **MpJaJk**, **Mp** and **MpJa**) to represent this FCT. FCT 11 is listed as 'well reserved' and 'low risk' by Gibson *et al*. (1994).

Plant community **MoAp**, located in the north of the site adjoining the reference wetland, was determined to represent FCT 7 'herb rich saline shrublands in clay pans'. This result is also consistent with the Emerge Associates (2013) results which deemed the northern wetland vegetation to comprise this FCT. FCT 7 is considered 'well reserved' and 'susceptible' by Gibson *et al*. (1994). (1994).

The **BaBm** plant community was previously assigned to FCT 21c (Emerge Associates 2013).

The non-native vegetation across the majority of the site including the central waterway was too degraded to assign to an FCT.

4.6. Threatened and priority ecological communities

FCT 11 does not represent a TEC or PEC.

Contrary to the findings of Coffey Environments (2015), the vegetation in the wetland areas in the centre of the site was not found to represent the clay pan TEC. The absence of any clay pan TEC in the central parts of the site was confirmed through correspondence with the DBCA (formerly DPaW) (Val English 2016, pers. comms., 13 December).

FCT 7 represents the EPBC Act listed clay pan TEC. The conservation advice states that vegetation must be in 'good' or better condition to classify as the clay pan TEC (DoEE 2016b). No minimum patch size applies when identifying an occurrence of this TEC. The small portion (0.58 ha) of FCT 7 vegetation in the north of the site should be considered contiguous with the relatively intact and 'very good' condition FCT 7 vegetation that lies directly adjacent outside of the site. Therefore the small portion of FCT 7 in the site would comprise the clay pan TEC. The location of this TEC in the site is shown in **Figure 3**.

FCT 21c is associated with the banksia woodland TEC. The vegetation representing this FCT in the site was not assessed in relation to the recently released conservation advice for the banksia woodland TEC (DoEE 2016a). However, the **BaBm** plant community previously identified in the site (Emerge Associates 2013) would represent the banksia woodland TEC. The current (updated) boundary of this TEC in the site is shown in **Figure 3**.

5. CONCLUSIONS

The majority of the site has been historically cleared and modified by grazing. The vegetation along the central waterway has few of its original flora and vegetation values due to the high level of historical disturbance. Although showing signs of degradation and non-native species invasion, the wetland areas in the centre of the site contain vegetation with moderately intact structure and native species diversity. A small portion of wetland vegetation on the northern boundary has a similar degraded structure and composition, but is contiguous with relatively intact wetland vegetation that lies beyond the site boundary.

No threatened or priority flora species were recorded or considered likely to occur in the wetland vegetation in the site due to a lack of suitable habitat.

The wetland vegetation in the central wetland system in the site does not represent a TEC or PEC. Specifically the clay pan TEC is not present in this part of the site.

The clay pan TEC is present within the reference wetland located outside of the site to the north. A small portion of clay pan TEC vegetation extends into the site on the northern boundary. This TEC is listed as 'critically endangered' under the EPBC Act.

The banksia woodland vegetation in the eastern portion of the site is likely to represent a patch of banksia woodland TEC which is listed as 'endangered' under the EPBC Act.

FIGURES

APPENDICES

REFERENCES

General references

Clarke, K. R. and Gorley, R. N. 2006, *PRIMER v6: User Manual/Tutorial*, PRIMER-E, Plymouth.

Coffey Environments 2015, *Level 2 Flora and Vegetation Assessment: Perth-Darwin National Highway*, prepared for Main Roads WA, Perth, Western Australia.

Department of the Environment and Energy (DoEE) 2016a, *Banksia Woodlands of the Swan Coastal Plain in Community and Species Profile and Threats Database*, Canberra.

Department of the environment and Energy (DoEE) 2016b, *Clay Pans of the Swan Coastal Plain in Community and Species Profile and Threats Database*, Canberra.

Emerge Associates 2013, *Flora and Vegetation Survey and Wetland Assessment -Pt Lot M1313 Great Northern Highway Muchea*, prepared for Westbridge Property Group Pty Ltd, Subiaco.

Emerge Associates 2017, *Foreshore Area Report: Lot 102 Great Northern Highway Muchea*, unpublished report prepared by Emerge Associates, Subiaco.

ESCAVI 2003, *Australian Vegetation Attribute Manual: National Vegetation Information System, Version 6.0*, Department of the Environment and Heritage, Canberra.

Gibson, N., Keighery, B., Keighery, G., Burbidge, A. and Lyons, M. 1994, *A Floristic survey of the southern Swan Coastal Plain*, Department of Conservation and Land Management and the Conservation Council of Western Australia, Perth.

Keighery, B. 1994, *Bushland Plant Survey: A guide to plant community survey for the community*, Wildflower Society of WA (Inc), Nedlands.

Keighery, B. J., Keighery, G. J., Longman, V. M. and Clarke, K. A. 2012, *Weed and Native Flora Data for the Swan Coastal Plain*, Data compiled for the Departments of Environmental Protection and Conservation and Land Management, Western Australia.

Kent, M. and Coker, P. 1994, *Vegetation description and analysis: A practical approach*, John Wiley & Sons, Chichester.

Online references

Department of the Environment (DoEE) 2016, *Protected Matters Search Tool*, viewed 7th February 2017 <https://www.environment.gov.au/epbc/protected-matters-search-tool>.

Department of Parks and Wildlife (DPaW) 2016, *NatureMap,* viewed 7th February 2017< https://naturemap.dpaw.wa.gov.au/>.

Figures

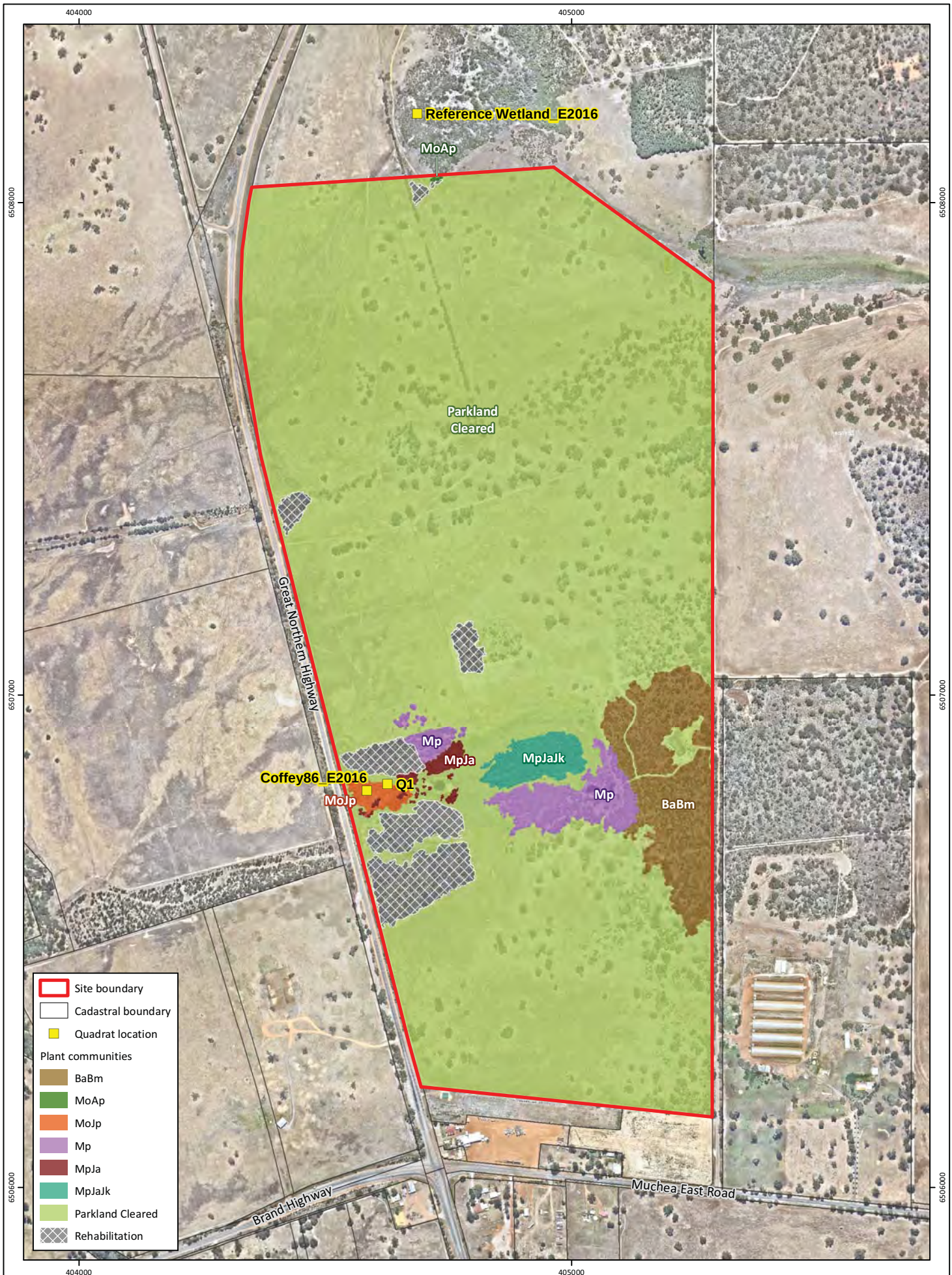


Figure 1: Plant Communities

Project: Technical Memorandum
Lot 102 Great Northern Highway Muchea
Client: Sirona Capital Management Pty Ltd

Plan Number:
EP15-037(01)--F66

Drawn:	ADB
Date:	02/05/2017
Checked:	TAA
Approved:	TAA
Date:	02/05/2017

N

0 100 200
Metres

Scale: 1:10,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

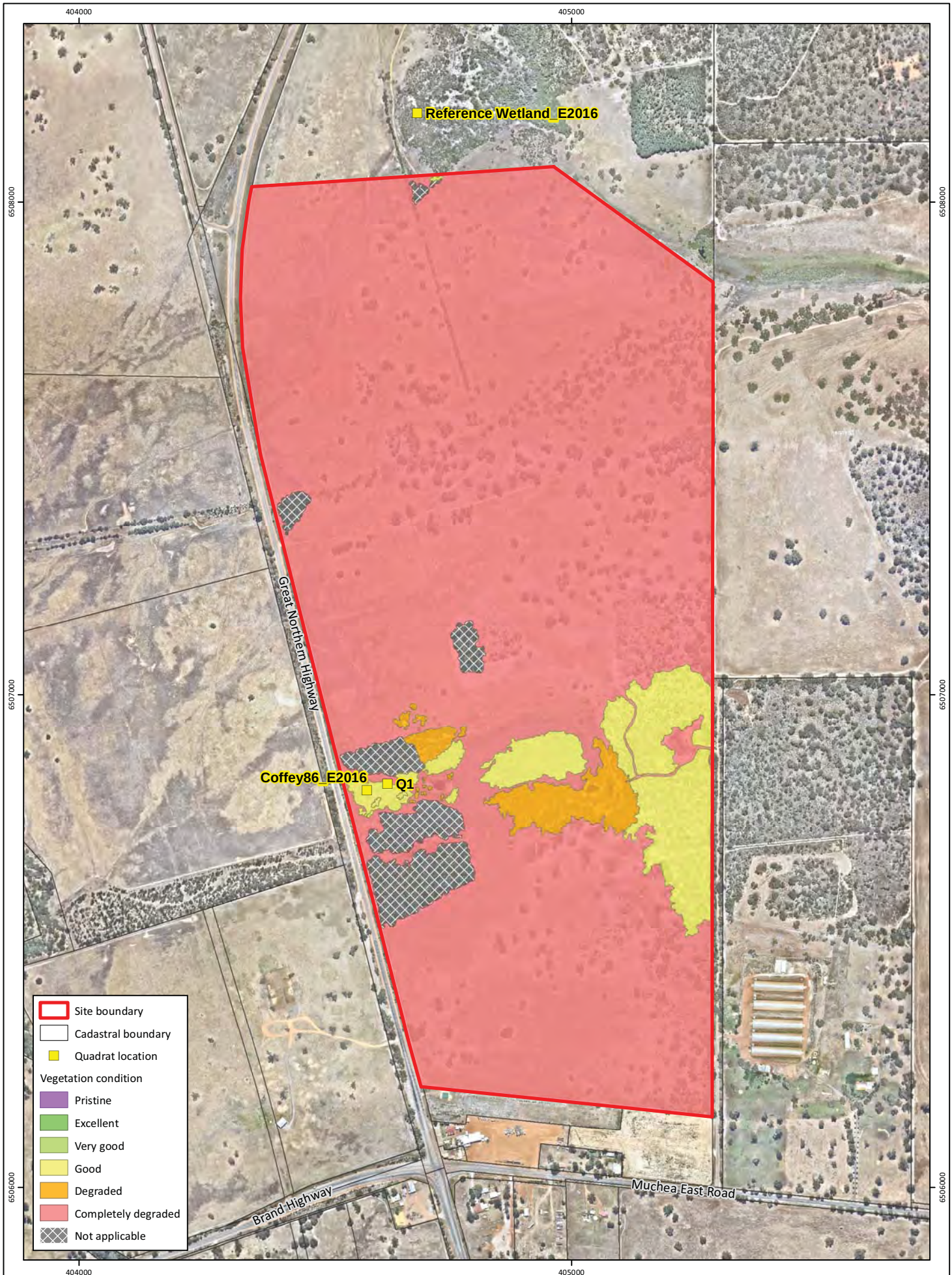


Figure 2: Vegetation Condition

Project: Technical Memorandum
Lot 102 Great Northern Highway Muchea
Client: Sirona Capital Management Pty Ltd

Plan Number:
EP15-037(01)--F67

Drawn:	ADB
Date:	02/05/2017
Checked:	TAA
Approved:	TAA
Date:	02/05/2017

N

0 100 200
Metres
Scale: 1:10,000@A4
GDA 1994 MGA Zone 50

emerge ASSOCIATES

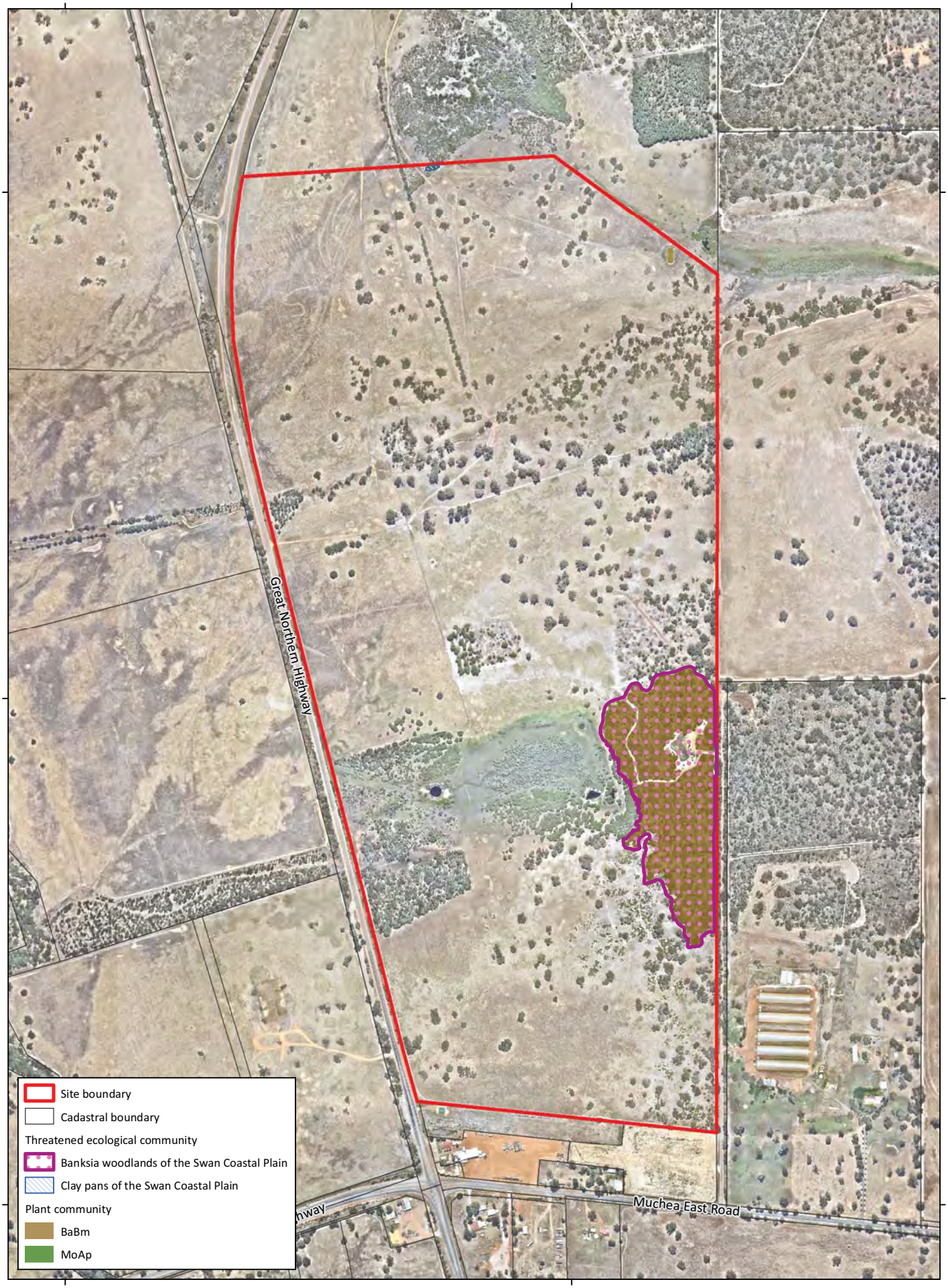


Figure 3: Threatened Ecological Communities

Project: Technical Memorandum
Lot 102 Great Northern Highway Muchea
Client: Sirona Capital Management Pty Ltd

Plan Number:
EP15-037(01)--F68

Drawn:	RAO
Date:	09/11/2017
Checked:	TAA
Approved:	TAA
Date:	09/11/2017

N

0 100 200
Metres
Scale: 1:10,000@A4
GDA 1994 MGA Zone 50

emerge ASSOCIATES

Appendix A

Species List

2016 Species List: Lot 102 Great Northern Highway, Muchea

Family	Status	Species	Coffey Q86-Emerge 2016	Q1-Emerge 2016	Reference wetland quadrat
Apiaceae	P3	*Eryngium pinnatifidum* subsp. *palustre*			
		Schoenolaena juncea			
Asparagaceae		*Thysanotus patersonii*	X		
		Dichopogon preissii			
Asteraceae	*	*Cotula coronopifolia*	X	X	X
	*	*Sonchus oleraceus*	X	X	
	*	*Arctotheca calendua*	X		
		Helichrysum luteoalbum	X		
	*	*Hypochaeris glabra*	X		
	*	*Symphyotrichum squamatum*	X		
	P3	*Angianthus drummondii*			X
		Angianthus preissianus			X
		Siloxerus humifusus			X
		Brachyscome pusilla			
		Gnephosis tenuissima			
Campanulaceae		*Lobelia anceps*	X	X	X
Caryophyllaceae	*	*Spergularia rubra*	X	X	X
Casuarinaceae		*Casuarina obesa*	X	X	X
Colchicaceae		*Burchardia congesta*			X
		Burchardia bairdiae			
		Wurmbea dioica subsp. *alba*			
Cyperaceae		*Isolepis cernua* var. *setifomis*	X	X	X
		Lepidosperma longitudinale	X	X	X
		Isolepis cyperoides	X		X
		Schoenus subfascicularis	X		X
		Centrolepis polygyna			X
		Baumea juncea			
		Cyathochaeta avenacea			
		Schoenus unispiculatus			
Droseraceae		*Drosera menziesii* subsp. *menziesii*			

Family	Status	Species	Coffey Q86-Emerge 2016	Q1-Emerge 2016	Reference wetland quadrat
Fabaceae	*	*Lotus subbiflorus*	X	X	
		Aotus gracillima			
		Trifolium arvense			
	*	*Triofolium arvense*			X
Goodeniaceae		*Goodenia pulchella*			X
		Dampiera trigona			
		Velleia trinervis			
Iridaceae	*	*Moraea flaccida*		X	
Juncaceae	*	*Juncus bufonius*	X	X	X
		Juncus pallidus	X	X	X
	*	*Juncus acutus*		X	
		Juncus kraussii		X	
Juncaginaceae		*Triglochin calcitrapa*			
Myrtaceae		*Melaleuca osullivanii*	X	X	X
		Melaleuca preissiana		X	X
	*	*Melaleuca cuticularis*		X	
		Melaleuca viminea	X		X
		Melaleuca rhaphiophylla			X
		Astartea scoparia			
		Hypocalymma angustifolium			
Philydraceae		*Philydrella drummondii*			X
		Philydrella pygmaea			
Poaceae	*	*Hordeum marinum*	X	X	X
	*	*Polypogon monspeliensis*	X	X	X
	*	*Briza minor*	X	X	
	*	*Lolium sp.*	X	X	X
	*	*Cynodon dactylon*	X	X	
	*	*Briza maxima*		X	
	*	*Ehrharta longiflora*	X		
		Rytidosperma caespitosa			X
	*	*Lolium ?rigidum*			

Family	Status	Species	Coffey Q86-Emerge 2016	Q1-Emerge 2016	Reference wetland quadrat
		Polypogon tenellus			
	*	*Parapholis incurva*			X
Primulaceae		*Samolus junceus*			X
Restionaceae		*Dielsia stenostachya*		X	X
		Leptocarpus canus	X		X
		Chaetanthus aristatus			
		Hypolaena exsulca			
Stylidiaceae		*Stylidium divaricatum*			
Xanthorrhoeaceae		*Xanthorrhoea preissii*			

Note: P3=Priority 3, *=non-native.

Appendix B

Quadrat Data

Emerge Associates
Field Survey Vegetation Data Sheet

Site Details			
Locality	15-037	Photo No.	1
Date	31/10/2016 & 02/12/2016	Photo direction	SE
Author	TAA	Geographic datum and zone	GDA94 50
Sampling unit	Quadrat	Easting	as previous
Sample number	1	Northing	

Geographic and Habitat Data			
Aspect	flat	Hydrology	near staurated
Slope	flat	Adjacent Vegetation	same and planted trees
Topographic position	low	Vegetation Condition	degraded
Altitude		Time since fire	no evidence
Bare ground %	2	Disturbance	moderate (weeds, stock)
Soil type/texture	sand with organic humus top layer	Rock type	N/A
Soil colour	grey brown	Rock %	0
Microclimate		Litter type and %	grass, sticks, logs 5%

Vegetation Description

Melaleuca osullivanii **over scattered *Juncus* spp. over dense *Cynodon dactylon* grass**

Q1 Species Data									
Coll. No.		Species			Layer	Life Form	Height	% Cover 31/10/2016	% Cover 02/12/2016
		Melaleuca osullivanii						50	50
planted	*	*Melaleuca cuticularis*						10	10
	*	*Cotula coronopifolia*						+	+
	*	*Cynodon dactylon*						95	95
opp		*Juncus pallidus*						2	2
	*	*Juncus acutus*						+	+
	*	*Sonchus oleraceus*						+	+
	*	*Lotus subbiflorus*						+	+
	*	*Lolium sp.*						+	+
		Dielsia stenostachya						+	+
		Lobelia anceps						+	N/A
	*	*Moraea flaccida*						+	+
		Lepidosperma longitudinale						+	+
	*	*Briza minor*						+	+
	*	*Briza maxima*						+	+
	*	*Spergularia rubra*						+	+
opp		*Casuarina obesa*						+	+
opp		*Melaleuca preissiana*						+	+
		Isolepis cernua var. *setiformis*				dead		25	25
opp		*Juncus kraussii*						+	+
	*	*Hordeum marinum*						+	+
	*	*Juncus bufonius*						+	+
	*	*Polypogon monspeliensis*						N/A	0.5
Note: * indicates non-native taxa									

Site Details			
Locality	15-037	Photo No.	1
Date	31/10/2016 & 02/12/2016	Photo direction	SE
Author	TAA	Geographic datum and zone	GDA94 50
Sampling unit	Quadrat	Easting	404584
Sample number	Coffey86_E2016	Northing	6506806

Geographic and Habitat Data			
Aspect	flat	Hydrology	moist, no surface water
Slope	flat	Adjacent Vegetation	same/more degraded
Topographic position	low/wetland	Vegetation Condition	degraded
Altitude		Time since fire	>10 yrs
Bare ground %		Disturbance	moderate
Soil type/texture	clay	Rock type	NA
Soil colour	dark brown black	Rock %	0
Microclimate		Litter type and %	leaves, branches, logs 33%

Vegetation Description

Sparse *Casuariana obesa* over *Melaleuca osullivanii* over *Lepidosperma longitudinale* and *Juncus pallidus* over *Cotula coronopifolia* and *Isolepis cernua* var. *setiformis*

Coffey86_E2016 Species Data							
Coll. No.		**Species**	**Layer**	**Height**	**Habit**	**% Cover 31/10/2016**	**% Cover 02/12/2016**
	*	*Arctotheca calendua*				+	N/A
		Casuarina obesa				1	1
	*	*Cotula coronopifolia*				40	40
	*	*Ehrharta longiflora*				+	+
	*	*Hypochaeris glabra*				+	+
		Isolepis cernua var. *setifomis*				35	35
		Juncus pallidus				5	5
		Lepidosperma longitudinale				12.5	12.5
	*	*Lotus subbiflorus*				+	+
	*	*Sonchus oleraceus*				+	+
		Melaleuca osullivanii				40	40
	*	*Polypogon monspeliensis*				+	+
	*	*Lolium sp.*				1	1
	*	*Briza minor*				+	+
		Thysanotus patersonii				+	+
		Lobelia anceps				+	+
	*	*Cynodon dactylon*				5	5
		Isolepis cyperoides				2	2
		Melaleuca viminea				+	+
		Schoenus subfascicularis				+	+
		Helichrysum luteoalbum				+	+
opp		*Leptocarpus canus*				+	+
	*	*Symphyotrichum squamatum*				+	+
	*	*Spergularia rubra*				+	+
	*	*Juncus bufonius*				+	+
	*	*Hordeum marinum*				N/A	+
Note: * indicates non-native taxa							

Site Details			
Locality	15-037	Photo No.	065
Date	31/10/2016	Photo direction	
Author	TAA	Geographic datum and zone	GDA94 50
Sampling unit	Quadrat	Easting	404687
Sample number	reference wetland_E2016	Northing	6508180

Geographic and Habitat Data			
Aspect	SW	Hydrology	dry surface
Slope	2%	Adjacent Vegetation	same/more degraded
Topographic position	low/wetland	Vegetation Condition	degraded
Altitude		Time since fire	>10 yrs
Bare ground %		Disturbance	moderate
Soil type/texture	clay	Rock type	NA
Soil colour	dark brown black	Rock %	0
Microclimate		Litter type and %	leaves, branches, logs 33%

Vegetation Description

Open shrubland of *Melaleuca osullivanii* over *Dielsia stenostachya, Lepidosperma longitudinale* and *Meeboldina cana* over *Angianthus preissianus, Cotula coronopifolia, Isolepis cernua* var. *setiformis* and a variety of other native and non-native herbs and grasses.

Reference wetland quadrat species data							
Coll. No.		**Species**	**Layer**	**Life Form**	**Height**	**Habit**	**% Cover**
opp		*Melaleuca priessiana*					
		Casuarina obesa					0.5
	*	*Cotula coronopifolia*		dead			20
		Melaleuca osullivanii					55
		Meeboldina cana					5
		Isolepis cernua var. *setifomis*		dead/dying off			5
		Lobelia anceps					1
		Lepidosperma longitudinale					15
		Dielsia stenostachya					25
		Melaleuca viminea					1
		Angianthus preissianus		dead/dying off			45
	*	*Polypogon monspeliensis*					+
	*	*Lolium sp.*					1
opp	P3	*Angianthus drummondii*					+
opp		*Siloxerus humifusus*					
		Schoenus subfascicularis					+
	*	*Parapholis incurva*					5
		Isolepis cyperoides		dead			1
	*	*Spergularia rubra*					+
	*	*Juncus bufonius*					+
	*	*Hordeum marinum*					+
TAA		*Philydrella drummondii*					+
TAA		*Samolus junceus*					+
		Rytidosperma caespitosa					+
		Centrolepsis polygyna					+
opp		*Melaleuca raphiophylla*					
opp	*	*Triofolium arvense*		dead			
TAA		*Goodenia pulchella*					+
		Burchardia congesta					
		Juncus pallidus					+
Note: * indicates non-native taxa							

ATTACHMENT 4: FAUNA SURVEY

Fauna Assessment
of
Lot 1313 (pt)
Great Northern Highway
Muchea

MARCH 2013
Version 2

On behalf of:
Emerge Associates
Suite 4, 6 Centro Ave
SUBIACO WA 6008
T: 08 9380 4988

Prepared by:
Greg Harewood B.Sc.
A.B.N. 95 536 627 336
PO Box 755
BUNBURY WA 6231
M: 0402 141 197
T/F: (08) 9725 0982
E: gharewood@iinet.net.au

TABLE OF CONTENTS

FIGURES

TABLES

PLATES

APPENDICES

DISCLAIMER

This fauna assessment report ("the report") has been prepared in accordance with the scope of services set out in the contract, or as otherwise agreed, between the Client and Greg Harewood ("the Author"). In some circumstances the scope of services may have been limited by a range of factors such as time, budget, access and/or site disturbance constraints. In accordance with the scope of services, the Author has relied upon the data and has conducted environmental field monitoring and/or testing in the preparation of the report. The nature and extent of monitoring and/or testing conducted is described in the report.

The conclusions are based upon field data and the environmental monitoring and/or testing carried out over a limited period of time and are therefore merely indicative of the environmental condition of the site at the time of preparing the report. Also it should be recognised that site conditions, can change with time.

Within the limitations imposed by the scope of services, the field assessment and preparation of this report have been undertaken and performed in a professional manner, in accordance with generally accepted practices and using a degree of skill and care ordinarily exercised by reputable environmental consultants under similar circumstances. No other warranty, expressed or implied, is made.

In preparing the report, the Author has relied upon data, surveys, analyses, designs, plans and other information provided by the Client and other individuals and organisations, most of which are referred to in the report ("the data"). Except as otherwise stated in the report, the Author has not verified the accuracy of completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report ("conclusions") are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. The Author will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to the Author.

The report has been prepared for the benefit of the Client and no other party. The Author assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report (including without limitation matters arising from any negligent act or omission of the Author or for any loss or damage suffered by any other party relying upon the matters dealt with or conclusions expressed in the report). Other parties should not rely upon the report or the accuracy or completeness of any conclusions and should make their own enquiries and obtain independent advice in relation to such matters.

The Author will not be liable to update or revise the report to take into account any events or emergent circumstances or facts occurring or becoming apparent after the date of the report.

SUMMARY

This report details the results of a fauna assessment of Lot 1313 (part) Great Northern Highway, Muchea (the study site). The area is located about 45 kms north east of the Perth central business district and is centred at approximately 31.56686°S and 115.99812°E. The study site has a total area of about 149 hectares (ha) and is mostly cleared of native vegetation (Figures 1 & 2)

It is understood that the proponents (Westbridge Property Group) are gathering information to support a scheme amendment for the site to allow for future development. The main aim of the assessment is to provide information on the fauna values of the area to allow for informed decisions to be made on the suitability of the proposed scheme amendment and any likely subsequent developments.

The scope of works was to conduct a level 1 fauna survey as defined by the Environmental Protection Authority (EPA 2004). Because some listed threatened species (i.e. several species of black cockatoo) are known to occur in the general area, the scope of the survey work was expanded to include targeted assessment of the site's significance to these particular species.

The assessment has included a desktop study and a site survey. Daytime field survey work at the site was carried out on the 28 January, 2013.

The broad scale fauna habitats within the study area are largely based on vegetation structure. The location and extent of the each of the defined units within the study site are shown in Figure 3 with a description of each given below. Additional information of the vegetation units present within the study area can be found in the vegetation and flora report for the site (Emerge Associates 2013).

- Open woodland of *Eucalyptus todtiana, Banksia attenuata* and *Banksia menziesii* over low open shrubland of *Eremaea pauciflora, Xanthorrhoea preissii* over open tussock grassland of **Ehrharta calycina* with *Dasypogon bromeliifolius* on grey sands.

- Tall shrubland of *Melaleuca osullivanii* over sparse rushland of *Dielsia stenostachya* over forbland of **Cotula coronopifolia, Angianthus preissianus* and **Hordeum hystrix* in damp grey/black sands.

- Tall open shrubland of *Melaleuca osullivanii* over open sedgeland of *Juncus pallidus* over closed forbland of **Cotula coronopifolia, *Briza maxima* and **Lotus subbiflorus* in saturated black loams.

- Woodland of *Melaleuca preissiana* over sedgeland of **Juncus acutus* subsp. *acutus* over grassland of **Cynodon dactylon* in saturated black loams.

- Open woodland of *Melaleuca preissiana* over open sedgeland of *Juncus pallidus* over grassland of **Cynodon dactylon* in saturated black loams with free water at the surface.
- Woodland of *Melaleuca preissiana* over mixed pasture grasses.
- Cleared pastures with isolated paddock trees (mainly *Corymbia calophylla, Eucalyptus todtiana, E. wandoo* and *E. marginata* over a range of introduced grasses and weeds.
- Revegetation areas of planted *Eucalypt* and *Melaleuca* species.
- Pine Plantation. A small area of pines (*Pinus radiata ?*) is present near the central section of the eastern boundary of the property (not shown in Figure 3).
- Seasonal creeklines. Two small seasonal creeklines run across the property and ultimately drain into Ellen Brook which is located about 700 m west of the study site.
- Manmade dams – the site contains five man made dams.

Opportunistic fauna observations are listed in Appendix B. A total of 28 native fauna species were observed (or positively identified from foraging evidence, scats, tracks, skeletons or calls) within the study area during the single day time survey. Evidence of four introduced species utilising the area was also seen.

Evidence of two conservation significant fauna species was observed (Carnaby's and the forest red-tailed black cockatoo - foraging evidence - chewed banksia cones, marri and mountain marri fruits and/or pine cones). No evidence of any migratory or DEC priority species using the area was found.

The tree assessment identified 404 specimens within the study area that fit the federal Department of Sustainability, Environment, Water, Population and Communities' (DSEWPaC's) criteria for black cockatoo breeding habitat (i.e. suitable tree species with a diameter at breast height (DBH) of >50cms (>30cm in the case of wandoo) (Figure 4).

Fifty five of the 404 trees were observed to contain hollows of some type with 13 possibly having large enough hollows for black cockatoos to use for nesting though this assessment was based on the size of the entrance into an apparent hollow only. No evidence (e.g. chew marks) of past or present use of any hollow by black cockatoos was seen. Additional details on each observed "potential black cockatoo breeding tree" can be found in Appendix D.

Foraging evidence attributed to two species of black cockatoo was observed during the site survey in the form of chewed marri and coastal blackbutt fruits in addition to

chewed banksia cones and pine cones. Marri and coastal blackbutt foraging was attributed to Carnaby's and/or the forest red-tailed black cockatoo while chewed banksia and pine cones was attributed to Carnaby's black cockatoo only.

Potential black cockatoo foraging habitat onsite is primarily represented by marri, jarrah, coastal blackbutt, *Banksia attenuata* and *Banksia menziesii* specimens. Most of the marri, jarrah and coastal blackbutt trees consist of scattered specimens that do not form a continuous canopy so quantifying the extent of this resource by way of area is difficult, though most of the more mature specimens would have been counted as part of the habitat tree assessment (285 live trees). *Banksia attenuata* and *Banksia menziesii* specimens are concentrated in the central eastern section of the study area (in association with some coastal blackbutt and jarrah). This section of the site covers an area of about 8 ha (based on measuring canopy cover from an air photo) though defining the extent is somewhat subjective as the boundary with some adjoining areas is gradational.

No existing roosting trees (trees used at night by black cockatoos to rest) were observed during the survey period.

With respect to native vertebrate fauna, 14 mammals (includes eight bat species), 86 bird, 39 reptile and ten frog species have previously been recorded in the general area, some of which have the potential to occur in or utilise sections of the study area at times.

Of the 149 native animals that are listed as potentially occurring in the area, three are considered to be endangered/vulnerable or in need of special protection under State and/or Federal law. In addition, three migratory species and one DEC priority species may also utilise the area at times.

In summary, two vertebrate fauna species of conservation significance (listed as State or Federal threatened/migratory species or as DEC priority species) were positively identified as utilising the study area for some purpose during the survey period, these being:

- *Calyptorhynchus latirostris* Carnaby`s Black Cockatoo – S1 (*WC Act*), Endangered (*EPBC Act*)
  Foraging evidence attributed to this species found and some of the remnant vegetation within the study area represents foraging habitat for this species. Larger trees (>50cm DBH or >30cm DBH for wandoo) can be considered potential breeding habitat.

- *Calyptorhynchus banksii naso* Forest Red-tailed Black Cockatoo – S1 (*WC Act*), Vulnerable (*EPBC Act*)
  Foraging evidence attributed to this species found and some of the remnant vegetation within the study area represents foraging habitat for this species. Larger trees (>50cm DBH or >30cm DBH for wandoo) can be considered potential breeding habitat.

An additional five species of conservation significance may possibly utilise the study area for some purpose at times but their current status on-site and/or in the general area is, in some cases, difficult to determine because they were not sighted during the survey period, or evidence of use of the study area was not found. These species are listed below:

Note: Habitat for some of these species on-site, while considered possibly suitable, may be marginal in extent/quality and species listed below may only visit the area for short periods, or as rare/uncommon vagrants.

- *Ardea alba* Great Egret – S3 (WC Act), Migratory (*EPBC Act*)
  May occasionally occur in small numbers within seasonally flooded areas during wetter months of the year. Unlikely to breed onsite.

- *Ardea ibis* Cattle Egret – S3 (WC Act), Migratory (*EPBC Act*)
  May very occasionally occur in small numbers within seasonally flooded areas during wetter months of the year. Unlikely to breed onsite.

- *Falco peregrinus Peregrine Falcon - S4 (WC Act)*
  Uncommon so unlikely to be resident in area but study site may form part of larger home range.

- *Merops ornatus* Rainbow Bee-eater – S3 (*WC Act*), Migratory (*EPBC Act*)
  Rainbow bee-eaters are common seasonal visitors to south west and during summer months a small number of individuals of this species are likely to occasionally forage and roost onsite. Sandy ground conditions in some areas may be suitable for construction of breeding burrows.

- *Isoodon obesulus fusciventer* Southern Brown Bandicoot - P5 (DEC Priority species)
  Most of the site is unsuitable for this species to utilise due to absent or sparse groundcover. If present most likely to inhabit sedgeland areas where ground cover is densest.

A number of other species of conservation significance, while possibly present in the general area, are not listed as potential species due to known localised extinction (and no subsequent recruitment from adjoining areas) and/or lack of suitable habitat and/or the presence of feral predators. Details on these species and reasons for their omission are provided in Appendix E and Table 2.

Constraints on any future development within the study area will largely be centred on the presence of habitat used or potentially used by threatened fauna species in particular those listed under the *EPBC Act*, namely the two species of black cockatoo known to frequent the area. The potential impact of the removal or modification of these species habitat will need to be taken into consideration prior to the development proceeding. Stormwater management will also be an important facet of future development as watercourses in the study area drain into Ellen Brook.

A series of other recommendations aimed at mitigating and minimising potential impacts on fauna and fauna habitat in general are provided in Section 10. These should be taken into consideration during future planning and development where considered reasonable and practicable.

The need for a referral to ensure compliance with the *EPBC Act* will need to be reassessed once plans for the development are finalised or have progressed to a stage where potential impacts on listed threatened fauna species or their habitat can be determine.

1. INTRODUCTION

This report details the results of a fauna assessment of Lot 1313 (part) Great Northern Highway, Muchea (the study site). The area is located about 45 kms north east of the Perth central business district and is centred at approximately 31.56686°S and 115.99812°E. The study site has a total area of about 149 hectares (ha) and is mostly cleared of native vegetation (Figures 1 & 2).

2. DEVELOPMENT PROPOSAL

It is understood that the proponents (Westbridge Property Group) are gathering information to support a scheme amendment for the site to allow for future development.

The main aim of the assessment is to provide information on the fauna values of the area to allow for informed decisions to be made on the suitability of the proposed scheme amendment and any likely subsequent developments. It is anticipated that the information presented will be used by regulatory authorities to assess the potential impact of the proposal on fauna and fauna habitats as part of any required approval process.

3. SCOPE OF WORKS

The scope of works was to conduct a level 1 fauna survey as defined by the EPA (EPA 2004). Because some listed threatened species (i.e. several species of black cockatoo) are known to occur in the general area, the scope of the survey work was expanded to include a targeted assessment of the site's significance to these species. The fauna assessment has therefore included:

1. Level 1 Fauna Survey (to EPA standard).

2. Targeted searches for black cockatoo foraging, nesting and roosting habitat.

3. Preparation of a report detailing results.

Note: For the purposes of this report the term black cockatoo is in reference to Carnaby's black cockatoo *Calyptorhynchus latirostris* and the forest red-tailed black cockatoo *Calyptorhynchus banksii naso*.

4. METHODOLOGY

4.1 POTENTIAL FAUNA INVENTORY - DESKTOP STUDY

4.1.1 Database Searches

Searches of the following databases were undertaken to aid in the compilation of a list of vertebrate fauna potentially occurring within the study area:

- DEC's NatureMap Database Search (combined data from DEC, Western Australian Museum, Birds Australia and consultants reports) (DEC 2013): and
- Protected matters search tool (Department of Sustainability, Environment, Water, Population and Communities – DSEWPaC 2013).

It should be noted that these lists are based on observations from a broader area than the study site and therefore may include species that would only ever occur as vagrants in the actual study area due to a lack of suitable habitat or the presence of only marginal habitat. The databases also often include very old records and in some cases the species in question have become locally or regionally extinct.

Information from these sources should therefore be taken as indicative only and local knowledge and information needs also to be taken into consideration when determining what actual species may be present within the specific area under investigation.

4.1.2 Previous Fauna Surveys in the Area

Fauna surveys, assessments and reviews have been undertaken in nearby areas in the past, though not all are publically available and could not be referenced. The most significant of those available have been used as the primary reference material for compiling the potential fauna assemblage for the general area.

Those reports referred to included, but were not limited to:

- Harewood, G. (2007). Fauna Assessment (Level 1). Mining Lease 70/326 (part Swan Loc. 5892), Bullsbrook. Unpublished report for Cardno BSD Pty Ltd. December 2007.
- Harewood, G. (2010). Fauna Assessment (Level 1) and Black Cockatoo Habitat Assessment. Great Northern Gateway, Bullsbrook. Unpublished report for Cardno (WA) Pty Ltd. October 2010.

- Harvey, M.S., Dell, J. How R.A.., & Waldock, J.M. (1997) Ground Fauna of Bushland Remnants on the Ridge Hill Shelf and Pinjarra Plain Landforms, Perth. Report to the Australian Heritage Commission. NEP Grant N95/49. 56 pp.

- How, R.A, Harvey, M.S., Dell J., & Waldock, J.M. (1996) Ground Fauna of Urban Bushland Remnants in Perth. Report to the Australian Heritage Commission. NEP Grant N93/04. 103 pp.

- Maryan, B., Browne-Cooper, R. and Bush B. (2002). Herpertofauna survey of Marilla Road Bushland. Western Australian Naturalist 23. No 3, 197-205.

As with the databases searches some reports refer to species that would not occur in the study area due to a lack of suitable habitat (extent and/or quality) and this fact was taken into consideration when compiling the potential fauna species list for the study area. It should also be noted that the NatureMap database is likely to include some records from previous fauna surveys in the area including some of those listed above.

4.1.3 Existing Publications

The following represent the main publications used to identify and refine the potential fauna species list for the study area:

- Barrett, G., Silcocks, A., Barry, S., Cunningham, R. and Poulter, R. (2003). The New Atlas of Australian Birds. Royal Australasian Ornithologists Union, Victoria.

- Bush, B., Maryan, B., Browne-Cooper, R. & Robinson, D. (2007). Reptiles and Frogs in the Bush: Southwestern Australia. UWA Press, Nedlands.

- Churchill, S. (2008). Australian Bats. Second Edition, Allen & Unwin.

- Johnstone, R.E. and Storr, G.M. (1998). Handbook of Western Australian Birds: Volume 1 – Non-passerines (Emu to Dollarbird). Western Australian Museum, Perth Western Australia.

- Johnstone, R.E. and Storr, G.M. (2004). Handbook of Western Australian Birds: Volume 2 – Passerines (Blue-winged Pitta to Goldfinch). Western Australian Museum, Perth Western Australia.

- Menkhorst, P. and Knight, F. (2011). A Field Guide to the Mammals of Australia. Oxford University Press, Melbourne.

- Storr, G.M., Smith, L.A. and Johnstone R.E. (1983). Lizards of Western Australia II: Dragons and Monitors. WA Museum, Perth.
- Storr, G.M., Smith, L.A. and Johnstone R.E. (1990). Lizards of Western Australia III: Geckos and Pygopods. WA Museum, Perth.
- Storr, G.M., Smith, L.A. and Johnstone R.E. (1999). Lizards of Western Australia I: Skinks. Revised Edition, WA Museum, Perth.
- Storr, G.M., Smith, L.A. and Johnstone R.E. (2002). Snakes of Western Australia. Revised Edition, WA Museum, Perth.
- Tyler M.J. & Doughty P. (2009). Field Guide to Frogs of Western Australia, Fourth Edition, WA Museum, Perth.
- Van Dyck, S. & Strahan, R. Eds (2008) The Mammals of Australia. Third edition. Queensland Museum.
- Wilson, S. and Swan, G. (2010) A Complete Guide to Reptiles of Australia. Reed, New Holland, Sydney.

4.1.4 Fauna of Conservation Significance

The conservation significance of fauna species has been assessed using data from the following sources:

- *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act*). Administered by the Australian Government Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC);
- *Wildlife Conservation Act 1950 (WC Act).* Administered by the Western Australian Department of Environment and Conservation (DEC);
- Red List produced by the Species Survival Commission (SSC) of the World Conservation Union (also known as the IUCN Red List - the acronym derived from its former name of the International Union for Conservation of Nature and Natural Resources). The Red List has no legislative power in Australia but is used as a framework for State and Commonwealth categories and criteria; and the
- DEC Priority Fauna list. A non-legislative list maintained by the DEC for management purposes.

The *EPBC Act* also requires the compilation of a list of migratory species that are recognised under international treaties including the:

- Japan Australia Migratory Bird Agreement 1981 (JAMBA);

- China Australia Migratory Bird Agreement 1998 (CAMBA);
- Republic of Korea-Australia Migratory Bird Agreement 2007 (ROKAMBA); and
- Bonn Convention 1979 (The Convention on the Conservation of Migratory Species of Wild Animals).

(Note - Species listed under JAMBA are also protected under Schedule 3 of the *WC Act*.)

All migratory bird species listed in the annexes to these bilateral agreements are protected in Australia as matters of national environmental significance (MNES) under the *EPBC Act*.

The conservation status of all vertebrate fauna species listed as occurring or possibly occurring in the vicinity of the study area has been assessed using the most recent lists published in accordance with the above-mentioned instruments and is indicated as such in the fauna listings of this report. A full listing of conservation codes are provided in Appendix A.

A number of other species not listed in official lists can also be considered of local or regional conservation significance. These include species that have a restricted range, those that occur in breeding colonies and those at the limit of their range.

While not classified as rare, threatened or vulnerable under any State or Commonwealth legislation, a number of bird species have been listed as of significance on the Swan Coastal portion of the Perth Metropolitan Region (Bush Forever - Government of Western Australia 1998 and 2000). The bird species are often referred to as Bush Forever Decreaser Species. The three categories used for birds within the Bush Forever documents are:

- Habitat specialists with reduced distribution on the Swan Coastal Plain (code Bh)
- Wide ranging Species with reduced population's on the Swan Coastal Plain. (code Bp)
- Extinct in the Perth region (code Be)

The presence of Bush Forever species should be taken into some consideration when determining the fauna values of an area. Bush Forever decreaser species are indicated as such within the species list held in Appendix B.

4.1.5 Invertebrate Fauna

It can be difficult to identify what may be significant invertebrate species (e.g. Short Range Endemics - SREs) as there are uncertainties in determining the range-restrictions of many species due to lack of surveys, lack of taxonomic resolutions within target taxa and problems in identifying certain life stages. Where invertebrates are collected during surveys, a high percentage are likely to be unknown, or for known species there can be limited knowledge or information on their distribution (Harvey 2002).

For this project, the assessment for conservation significant invertebrates has been limited to those listed by the DEC and *EPBC Act* database searches (which rely on distribution records and known habitat preferences). No assessment of the potential for SREs to be present or their potential significance has been made.

4.1.6 Taxonomy and Nomenclature

Taxonomy and nomenclature for fauna species used in this report is generally taken from the DEC's WA Fauna Census Database which is assumed to follow Aplin and Smith (2001) for amphibians and reptiles, How *et al*. (2001) for mammals and Johnstone (2001) for birds.

Common names are taken from the Western Australia Museum (WAM) recognised primary common name listings when specified, though where common names are not provided they have been acquired from other publications. Sources include Van Dyck & Strahan (2008), Bush *et al.* (2007), Wilson and Swan (2010), Bush *et al*. (2002), Tyler *et al*. (2000), Christidis and Boles (2008) and Glauret (1961). Not all common names are generally accepted.

4.2 SITE SURVEYS

Daytime field survey work at the site was carried out by the Author on the 28 January, 2013.

4.2.1 Fauna Habitat Assessment

Vegetation units identified during the flora and vegetation survey, carried out by Emerge Associates (2013), have been used to define broad fauna habitat types across the site. This information has been supplemented with observations made during the fauna assessment site surveys.

The main aim of the habitat assessment was to determine if it was likely that any species of conservation significance would be utilising the areas that maybe

impacted on as a consequence of development at the site. The habitat information obtained was also used to aid in finalising the overall potential fauna list.

As part of the desktop literature review, available information on the habitat requirements of the species of conservation significance listed as possibly occurring in the area was researched. During the field survey the habitats within the study area were assessed and specific elements identified, if present, to determine the likelihood of listed threatened species utilising the area and its significance to them.

4.2.2 Opportunistic Fauna Observations

Opportunistic observations of fauna species was made during all field survey work which involved a series of transects across the site during the day and night while searching microhabitats such as logs, rocks, leaf litter and observations of bird species with binoculars.

4.2.3 Black Cockatoo Habitat Assessment

The black cockatoo habitat assessment included a:

- Habitat tree survey: This involved the identification of all suitable trees species within the study area that have a Diameter at Breast Height (DBH) of over 50cm (irrespective of the presence/absence of suitable hollows. Note: For wandoo, suitable DBH is 30 cm. DSEWPaC (2012) criteria.). The location of each tree identified was recorded with a GPS and details on tree species, number and size of hollows (if any) noted. Trees with hollows were marked with "H" using spray paint.

  Target tree species included marri, coastal blackbutt, jarrah and wandoo or any other suitable *Corymbia/Eucalyptus* species of a suitable size that was present. Peppermints, banksia, sheoak and melaleuca tree species (for example) were not assessed as they typically do not develop hollows that are used by black cockatoos.

  For the purposes of this study a potential cockatoo nest hollow was defined as:

  Generally any tree which is alive or dead that contains one or more visible hollows (cavities within the trunk or branches) suitable for occupation by any of the three black cockatoo species for the purpose of nesting/breeding. Hollows that had an entrance greater than about 12cm in diameter and would allow the entry of a cockatoo (white tailed

or red-tailed) into a suitably orientated and sized branch/trunk, were recorded as a "potential nest hollow".

Identified hollows (if any) were examined using binoculars for evidence of actual use by black cockatoos (e.g. chewing around hollow entrance, scarring and scratch marks on trunks and branches). Trees with possible nest hollows were also scratched and raked with a large stick/pole to flush any sitting birds from hollows and calls of chicks were also listened for.

- Black cockatoo foraging assessment: The location and nature of black cockatoo foraging evidence (e.g. chewed fruits around base of trees) observed during the field survey was recorded.
- Roosting habitat survey: Direct and indirect evidence of black cockatoos roosting within trees on site was noted if observed (e.g. branch clippings, droppings or moulted feathers).

5. SURVEY CONSTRAINTS

No seasonal sampling has been carried out as part of this fauna assessment. The conclusions presented are based upon field data and the environmental monitoring and/or testing carried out over a limited period of time and are therefore merely indicative of the environmental condition of the site at the time of the field assessments. It should also be recognised that site conditions can change with time.

Some fauna species are reported as potentially occurring within the study area based on there being suitable habitat (quality and extent) within the study area or immediately adjacent. With respect to opportunistic observations, the possibility exists that certain species may not have been detected during field investigations due to:

- seasonal inactivity during the field survey;
- species present within micro habitats not surveyed;
- cryptic species able to avoid detection; and
- transient wide-ranging species not present during the survey period.

Lack of observational data on some species should therefore not necessarily be taken as an indication that a species is absent from the site.

The habitat requirements and ecology of many of the species known to occur in the wider area are often not well understood or documented. It can therefore be difficult to exclude species from the potential list based on a lack of a specific habitat or microhabitat within the study area. As a consequence of this limitation the potential fauna list produced is most likely an overestimation of those species that actually utilise the study area for some purpose. Some species may be present in the general area but may only use the study area itself on rare occasions or as vagrants.

In recognition of survey limitations, a precautionary approach has been adopted for this assessment. Any fauna species that would possibly occur within the study area (or immediately adjacent), as identified through ecological databases, publications, discussions with local experts/residents and the habitat knowledge of the Author, has been assumed to potentially occur in the study area.

During the black cockatoo habitat survey trees with hollows were recorded. It should be noted that identifying hollows suitable for fauna species from ground level has limitations. Generally the full characteristics of any hollow seen are not fully evident (e.g. internal dimensions). It is also difficult to locate all hollows within all trees as some are not observable from ground level.

The location of habitat trees was recorded using a handheld GPS. The accuracy of the GPS cannot be guaranteed above a level of about 5 to 10 metres, though it should be noted that in some circumstance the accuracy can be worse or better than this.

6. RESULTS

6.1 POTENTIAL FAUNA INVENTORY - DESKTOP STUDY

A list of expected fauna species likely to occur in the study area was compiled from information obtained during the desktop study and is presented in Appendix B. This listing was refined after information gathered during the site reconnaissance survey was assessed. The raw database search results from NatureMap (DEC 2013) and the Protected Matters Search Tool (DSEWPaC 2013) are contained within Appendix C.

The list of potential fauna takes into consideration that firstly the species in question is not known to be locally extinct and secondly that suitable habitat for each species, as identified during the habitat assessment, is present within the study area, though compiling an accurate list has limitations (see Section 5 above).

6.2 SITE SURVEYS

6.2.1 Fauna Habitat Assessment

The broad scale fauna habitats within the study area are largely based on vegetation structure. The location and extent of the each of the defined units within the study site are shown in Figure 3 with a description of each given below. Additional information of the vegetation units present within the study area can be found in the vegetation and flora report for the site (Emerge Associates 2013).

- Open woodland of *Eucalyptus todtiana, Banksia attenuata* and *Banksia menziesii* over low open shrubland of *Eremaea pauciflora, Xanthorrhoea preissii* over open tussock grassland of **Ehrharta calycina* with *Dasypogon bromeliifolius* on grey sands.

- Tall shrubland of *Melaleuca osullivanii* over sparse rushland of *Dielsia stenostachya* over forbland of **Cotula coronopifolia, Angianthus preissianus* and **Hordeum hystrix* in damp grey/black sands.

- Tall open shrubland of *Melaleuca osullivanii* over open sedgeland of *Juncus pallidus* over closed forbland of **Cotula coronopifolia, *Briza maxima* and **Lotus subbiflorus* in saturated black loams.

- Woodland of *Melaleuca preissiana* over sedgeland of **Juncus acutus* subsp. *acutus* over grassland of **Cynodon dactylon* in saturated black loams.

- Open woodland of *Melaleuca preissiana* over open sedgeland of *Juncus pallidus* over grassland of **Cynodon dactylon* in saturated black loams with free water at the surface.

- Woodland of *Melaleuca preissiana* over mixed pasture grasses.

- Cleared pastures with isolated paddock trees (mainly *Corymbia calophylla, Eucalyptus todtiana, E. wandoo* and *E. marginata* over a range of introduced grasses and weeds.

- Revegetation areas of planted *Eucalypt* and *Melaleuca* species.

- Pine Plantation. A small area of pines (*Pinus radiata ?*) is present near the central section of the eastern boundary of the property (not shown in Figure 3).

- Seasonal creeklines. Two small seasonal creeklines run across the property and ultimately drain into Ellen Brook which is located about 700 m west of the study site.

- Manmade dams – the site contains five man made dams.

Only about 20 ha of the site (~12%) contains continuous native vegetation with all areas showing considerable evidence of historical disturbance such as ongoing livestock grazing, logging, sand mining, clearing for access tracks/firebreaks and frequent fires.

The study area mainly covers a section of the alluvial Pinjarra Plain with the soil profile being dominated by a pebbly silt of the Guildford Formation. The eastern most section of the site is however located over an area of sand formed on a colluvial slope located at the extreme base of the Darling Scarp (Gozzard 1982). Topography at the site is relatively subtle with a gentle east-west slope ranging from a maximum of about 70m AHD to 55 AHD.

Plates 1 to 4 illustrate the nature of vegetation/fauna habitats existing within the study area.

6.2.2 Opportunistic Fauna Observations

Opportunistic fauna observations are listed in Appendix B. A total of 28 native fauna species were observed (or positively identified from foraging evidence, scats, tracks, skeletons or calls) within the study area during the single day time survey. Evidence of four introduced species utilising the area was also seen.

Evidence of two conservation significant fauna species was observed (Carnaby's and the forest red-tailed black cockatoo - foraging evidence - chewed banksia cones, marri and mountain marri fruits and/or pine cones). No evidence of any migratory or DEC priority species using the area was found.

6.2.3 Black Cockatoo Habitat Assessment

The tree assessment identified 404 specimens within the study area that fit DSEWPaC's criteria for black cockatoo breeding habitat (i.e. suitable tree species with a diameter at breast height (DBH) of >50cms or >30cm for wandoo) (Figure 4). Two hundred and fourty two of the trees were marri (*C. calophylla*), 63 wandoo (*Eucalyptus wandoo*), 35 coastal blackbutt (*E. todtiana*), 23 jarrah (*E. marginata*) and nine flooded gum (*E. rudis*). Twenty five of the trees could not be identified to species level as they were dead and had no distinguishing characteristics evident. Seven trees were non-endemic eucalypts of a species unknown to the Author.

Fifty five of the 404 trees were observed to contain hollows of some type with 13 possibly having large enough hollows for black cockatoos to use for nesting though this assessment was based on the size of the entrance into an apparent hollow only. No evidence (e.g. chew marks) of past or present use of any hollow by black cockatoos was seen.

Additional details on each observed "potential black cockatoo breeding tree" can be found in Appendix D.

Foraging evidence attributed to two species of black cockatoo was observed during the site survey in the form of chewed marri and coastal blackbutt fruits in addition to chewed banksia cones and pine cones. Marri and coastal blackbutt foraging was attributed to Carnaby's and/or the forest red-tailed black cockatoo while chewed banksia and pine cones was attributed to Carnaby's black cockatoo only.

The total extent of native vegetation onsite (excluding scattered and small groves of trees) is about 20 ha but the value as foraging habitat varies considerably depending on species composition. Potential black cockatoo foraging habitat onsite is primarily represented by marri, jarrah, coastal blackbutt, *Banksia attenuata* and *Banksia menziesii* specimens. Most of the marri, jarrah and coastal blackbutt trees consist of scattered specimens that do not form a continuous canopy so quantifying the extent of this resource by way of area is difficult, though most of the more mature specimens would have been counted as part of the habitat tree assessment (285 live trees). *Banksia attenuata* and *Banksia menziesii* specimens are concentrated in the central eastern section of the study area (in association with some coastal blackbutt and jarrah). This section of the site covers an area of about 8 ha (based on measuring canopy cover from an air photo) though defining the extent is somewhat subjective as the boundary with some adjoining areas is gradational.

No existing roosting trees (trees used at night by black cockatoos to rest) were observed within the site were observed during the survey period.

6.3 FAUNA INVENTORY – SUMMARY

6.3.1 Vertebrate Fauna

Table 1 summarises the number of fauna species potentially occurring within the study area, based on results from the desktop study and observations made during the field assessment. A complete list of vertebrate fauna possibly inhabiting or frequenting the study area is located in Appendix B.

Not all species listed as potentially occurring within the study area in existing databases and publications (i.e. *EPBC Act* Threatened Fauna and Migratory species lists, DEC's NatureMap database, various reports and publications) are shown in the expected listing in Appendix B. Some species have been excluded from this list based largely on the lack of suitable habitat at the study site and in the general area or known local extinction even if suitable habitat is present.

Table 1: Summary of Potential Fauna Species (as listed in Appendix B)

Group	Total number of potential species	Potential number of specially protected species	Potential number of migratory species	Potential number of priority species	Number of species observed field survey 2013
Fish	0	0	0	0	0
Amphibians	10	0	0	0	0
Reptiles	39	0	0	0	1
Birds	87[1]	3	3	0	27[1]
Non-Volant Mammals	12[6]	0	0	1	4[3]
Volant Mammals (Bats)	8	0	0	0	0
Total	**156[7]**	**3**	**3**	**1**	**32[4]**

Superscript = number of introduced species included in total.

Despite the omission of some species it should be noted that the list provided is still very likely an over estimation of the fauna species utilising the site (either on a regular or infrequent basis) as a result of the precautionary approach adopted for the assessment.

A review of the *EPBC Act* threatened fauna list, DEC's Threatened Fauna Database and Priority List, unpublished reports and scientific publications identified at least 23 specially protected, priority or migratory vertebrate fauna species as potentially occurring in the general vicinity of the study area.

Species that have no potential whatsoever (under normal circumstances) to utilise the study area for any purpose are not listed or discussed, despite appearing in the DEC or *EPBC Act* database searches. Species have been

omitted from the potential list for the site (Appendix B), principally due to lack of suitable habitat on-site (including extent and/or quality) or known local extinction. Based on the habitats present and documented distributions it is considered possible that seven of these species may use the study area for some purpose at times.

In summary, two vertebrate fauna species of conservation significance (listed as State or Federal threatened/migratory species or as DEC priority species) were positively identified as utilising the study area for some purpose during the survey period, these being:

- *Calyptorhynchus latirostris* Carnaby`s Black Cockatoo – S1 (*WC Act*), Endangered (*EPBC Act*)
  Foraging evidence attributed to this species found and some of the remnant vegetation within the study area represents foraging habitat for this species. Larger trees (>50cm DBH or >30cm DBH for wandoo) can be considered potential breeding habitat.

- *Calyptorhynchus banksii naso* Forest Red-tailed Black Cockatoo – S1 (*WC Act*), Vulnerable (*EPBC Act*)
  Foraging evidence attributed to this species found and some of the remnant vegetation within the study area represents foraging habitat for this species. Larger trees (>50cm DBH or >30cm DBH for wandoo) can be considered potential breeding habitat.

An additional five species of conservation significance may possibly utilise the study area for some purpose at times but their current status on-site and/or in the general area is, in some cases, difficult to determine because they were not sighted during the survey period, or evidence of use of the study area was not found. These species are listed below:

Note: Habitat for some of these species on-site, while considered possibly suitable, may be marginal in extent/quality and species listed below may only visit the area for short periods, or as rare/uncommon vagrants.

- *Ardea alba* Great Egret – S3 (WC Act), Migratory (*EPBC Act*)
  May occasionally occur in small numbers within seasonally flooded areas during wetter months of the year. Unlikely to breed onsite.

- *Ardea ibis* Cattle Egret – S3 (WC Act), Migratory (*EPBC Act*)
  May very occasionally occur in small numbers within seasonally flooded areas during wetter months of the year. Unlikely to breed onsite.

- *Falco peregrinus Peregrine Falcon - S4 (WC Act)*
  Uncommon so unlikely to be resident in area but study site may form part of larger home range.

- *Merops ornatus* Rainbow Bee-eater – S3 (*WC Act*), Migratory (*EPBC Act*)
  Rainbow bee-eaters are common seasonal visitors to south west and during summer months a small number of individuals of this species are likely to occasionally forage and roost onsite. Sandy ground conditions in some areas may be suitable for construction of breeding burrows.

- *Isoodon obesulus fusciventer* Southern Brown Bandicoot - P5 (DEC Priority species)
  Most of the site is unsuitable for this species to utilise due to absent or sparse groundcover. If present most likely to inhabit sedgeland areas where ground cover is densest.

A number of other species of conservation significance, while possibly present in the general area, are not listed as potential species due to known localised extinction (and no subsequent recruitment from adjoining areas) and/or lack of suitable habitat and/or the presence of feral predators. Details on conservation significant species and reasons for the omission of some from the potential listing are provided in Appendix E and Table 2.

Thirty two bird species that potentially frequent or occur in the study area are noted as Bush Forever Decreaser Species in the Perth Metropolitan Region (nine species were sighted/identified as having used the study area during the survey). Decreaser species are a significant issue in biodiversity conservation in the Perth section of the coastal plain as there have been marked reductions in range and population levels of many sedentary bird species as a consequence of disturbance and land clearing (Dell & Hyder-Griffiths 2002).

6.3.2 Invertebrate Fauna

Five species of conservation significant invertebrate species appeared in the DEC or *EPBC Act* database searches (DEC 2013, DSEWPaC 2013). None of these species is considered likely to persist within the study area due to an absence of suitable habitat. Additional information on each species can be found in Appendix E.

7. FAUNA VALUES

7.1 CONSERVATION SIGNIFICANCE OF THE STUDY AREA

The local (sub-regional) conservation significance of the study area has been determined by applying site specific criteria such as:

- Fauna species and/or habitat present that is poorly represented in the general study area;
- Fauna habitat within the general study area supporting species of conservation or other significance; and
- Fauna habitat in better condition than other similar locations in general study area.

The majority of the study area has no regional or local conservation value due to the fact that most has been almost totally cleared of native vegetation for the purpose of for livestock grazing. A high percentage of the fauna likely to be found in the study site are common widespread species that are capable of adapting to degraded or highly degraded areas.

The native vegetation that remains on site, while being degraded to varying degrees is nonetheless providing habitat or potentially providing habitat for a small number of conservation significant fauna species. While overall the vegetation is unlikely to have any regional conservation significance given its limited extent and history of disturbance, its use or potential use by these species gives it some local significance and this fact should be taken into consideration during any future development planning proposed for the site.

7.2 VALUE OF THE STUDY AREA AS AN ECOLOGICAL LINKAGE/WILDLIFE CORRIDOR

Corridors of native vegetation can be very important for the dispersal of species in otherwise cleared landscapes. Any areas of remnant vegetation making up part of a linkage is therefore of great value by facilitating the movement of species that cannot utilise cleared/developed land. Linkage with adjacent bushland areas has been identified as a natural attribute of high priority in the assessment of an areas regional significance.

Vegetation within the study area links along an unnamed seasonal creek that passes under the Great Northern Highway and connects to Ellen Brook which further south has been identified as a regional ecological linkage (Tingay & Associates 1998 - see Figure 6 - Government of Western Australia 2000a). The

study area itself does not however provide a continuous linkage to any other areas of significant vegetation in other directions and so overall has limited value as a wildlife corridor between adjoining areas.

8. POTENTIAL IMPACTS AND DEVELOPMENT CONSTRAINTS

8.1 POTENTIAL IMPACTS OF DEVELOPMENT

In general, the most significant potential impacts to fauna of any development include:

- Loss of vegetation/fauna habitat that may be used for foraging, breeding, roosting, or dispersal (includes loss of hollow bearing trees);
- Fragmentation of vegetation/fauna habitat which may restrict the movement of some fauna species;
- Modifications to surface hydrology, siltation of creek lines;
- Changes to fire regimes;
- Pollution (e.g. oil spills);
- Noise/Light/Dust;
- Spread of plant pathogens (e.g. dieback) and weeds;
- Potential increase in the number of predatory introduced species (e.g. cats);
- Death or injury of fauna during clearing and construction; and
- An increase in fauna road kills subsequent to development.

The exact extent of development within the study area is not known at this stage however the possible impact on specific species of conservation significance previously recorded in the general area is provided in Table 2 below. Additional information on specific fauna species is provided in Appendix E.

Table 2: Likelihood of Occurrence and Possible Impacts – Fauna Species of Conservation Significance (continues on following pages).

Common Name	Genus & Species	Conservation Status (See Appendix A for codes)	Habitat Present	Likelihood of Occurrence	Possible Impacts
Bedfordale Trapdoor Spider	*Arbanitis inornatus*	P1	No	Unlikely.	No impact.
Unnamed Bee	*Hylaeus globuliferus*	P3	No/Marginal	Unlikely.	No impact.
Unnamed Bee	*Leioproctus douglasiellus*	S1	No	Unlikely.	No impact.
Unnamed Bee	*Leioproctus contrarius*	P3	No	Unlikely.	No impact.
Graceful Sun Moth	*Synemon gratiosa*	P4 EN	No	Unlikely.	No impact.
Black-striped Minnow	*Galaxiella nigrostriata*	P3	No	Unlikely.	No impact.
Mud Minnow	*Galaxias munda*	S1	No	Unlikely.	No impact.
Western Swamp Tortoise	*Pseudemydura umbrina*	S1 CR	No	Unlikely.	No impact.
Jewelled Ctenotus	*Ctenotus gemmula*	P3	No	Unlikely.	No impact.
Black-striped Snake	*Neelaps calonotos*	P3	No	Unlikely.	No impact.
Southern Carpet Python	*Morelia spilota imbricata*	S4 P4	No/Marginal	Unlikely – most likely locally extinct	No impact.
Malleefowl	*Leipoa ocellata*	S1, VU, Mig	No	Unlikely - species locally extinct.	No Impact.
Great Egret	*Ardea alba*	S3 Mig	Yes	Possible	Loss or modification of some habitat. No significant impact likely
Cattle Egret	*Ardea ibis*	S3 Mig	Yes	Possible	Loss or modification of some habitat. No significant impact likely
Australasian Bittern	*Botaurus poiciloptilus*	S1 EN	No/Marginal	Unlikely.	No significant impact.
Migratory shorebirds/Wetland species	*Various*	S1, S3 or Mig	No/Marginal	Unlikely	No significant impact.
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	S3 Mig	No	Unlikely	No impact.
Peregrine Falcon	*Falco peregrinus*	S4	Yes	Possible	Loss or modification of some habitat. No significant impact likely
Carnaby`s Black Cockatoo	*Calyptorhynchus latirostris*	S1 EN	Yes	Known to occur	Loss of some habitat.

Common Name	Genus & Species	Conservation Status (See Appendix A for codes)	Habitat Present	Likelihood of Occurrence	Possible Impacts
Forest Red-tailed Black Cockatoo	*Calyptorhynchus banksii naso*	S1 VU	Yes	Known to occur	Loss of some habitat.
Fork-tailed Swift	*Apus pacificus*	S3 Mig	Yes	Flyover only	No impact.
Rainbow Bee-eater	*Merops ornatus*	S3 Mig	Yes	Possible	Loss/modification of some habitat. No significant impact likely.
Chuditch	*Dasyurus geoffroii*	S1 VU	Yes/Marginal	Unlikely - species probably locally extinct.	No Impact.
Southern Brush-tailed Phascogale	*Phascogale tapoatafa ssp*	S1	Yes/Marginal	Unlikely - species probably locally extinct.	No Impact.
Southern Brown Bandicoot	*Isoodon obesulus fusciventer*	P5	Yes/Marginal	Possible	Loss/modification of some habitat.
Western Brush Wallaby	*Macropus irma*	P4	No	Unlikely	No impact.
Tammar	*Macropus eugenii derbianus*	P5	No	Unlikely	No impact.
Black-flanked Rock Wallaby	*Petrogale lateralis*	S1 VU	No	Unlikely	No impact.

8.2 POTENTIAL CONSTRAINTS ON DEVELOPMENT

Constraints on development within the study area will largely be centred on the presence of habitat used or potentially used by threatened fauna species in particular those listed under the *EPBC Act*, namely the two species of black cockatoo. The potential impacts on these species and/or their habitat will need to be taken into consideration during the planning process.

While the exact location and extent of vegetation clearing that may be required is unknown, almost any clearing of native vegetation within the study area has the potential to exceed DSEWPaC thresholds for what they consider "likely significant impact" with respect to the loss of black cockatoo habitat (see Section 9). Typically, approval will only be given for developments that are deemed as likely to have a significant impact if offsets for habitat loss are provided. DSEWPaC assess every project separately so there are no standard offset requirements but minimising vegetation loss in the first instance will reduce possible obligations if the project is referred and deemed a controlled action.

Stormwater management will also be an important facet of future development as watercourses in the study area drain into Ellen Brook to eliminate the possibility of downstream pollution affecting other fauna habitats of significance.

9. COMMONWEALTH ENVIRONMENT PROTECTION & BIODIVERSITY CONSERVATION ACT 1999

A number of fauna species known to or potentially present within the study area are listed under the federal *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)*. The objective of the *EPBC Act* is to provide for the protection of the environment, especially those aspects that are of national significance, promote ecologically sustainable development, the conservation of biodiversity and a cooperative approach to the protection and management of the environment.

EPBC Act listed threatened fauna species (or their habitat) identified as being present in the study area were:

- *Calyptorhynchus latirostris* Carnaby's Black Cockatoo – Endangered
- *Calyptorhynchus banksii naso* Forest Red-tailed Black Cockatoo – *Vulnerable*

EPBC Act listed migratory fauna species identified as potentially utilising the study area were:

- *Merops ornatus* Rainbow Bee-eater – Migratory
- *Ardea alba* Great Egret – Migratory
- *Ardea ibis* Cattle Egret – Migratory

The following *EPBC Act* listed threatened/migratory fauna species (or their habitat) were determined during the fauna assessment not to be present in the study area despite appearing in database/literature searches. Their exclusion from the potential species list is primarily justified by an obvious lack of suitable habitat or known local extinction. It is also very unlikely that vegetation at the site represents habitat critical for the recovery of the respective threatened species in the area.

These species will not be discussed further:

- *Synemon gratiosa* Graceful Sun Moth - Endangered
- *Pseudemydura umbrina* Western Swamp Tortoise – Critically Endangered
- *Leipoa ocellata* Malleefowl – Vulnerable
- *Botaurus poiciloptilus* Australasian Bittern – Endangered
- *Ardea alba* Great Egret – Migratory
- *Ardea ibis* Cattle Egret – Migratory
- Various Migratory Shorebirds/Wetland Species - Migratory
- *Haliaeetus leucogaster* White-bellied Sea-Eagle – Migratory
- *Apus pacificus* Fork-tailed Swift – Migratory
- *Dasyurus geoffroii* Chuditch – Vulnerable
- *Petrogale lateralis* Black-flanked Rock Wallaby – Vulnerable

If an action (i.e. the potential need to clear sections of the site) is deemed to have a potential "significant impact" on listed species a referral to the Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) is required to ensure compliance with the *EPBC Act*. Currently, for the species in question, "significant impact" is defined within one or more of the following four documents, these being:

- Department of the Environment, Water, Heritage and the Arts (DEWHA) (2009). Matters of National Environmental Significance. Significant Impact Guidelines 1.1, *EPBC Act 1999*.
- Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) (2012). EPBC Act referral guidelines for three threatened black cockatoo species: Carnaby's cockatoo (endangered) *Calyptorhynchus latirostris*, Baudin's cockatoo (vulnerable) *Calyptorhynchus baudinii*, Forest red-tailed black cockatoo (vulnerable) *Calyptorhynchus banksii naso*.

An assessment of significant impact on federally listed threatened/migratory fauna species and the possible need to refer the project to DSEWPaC using criteria within the abovementioned documents are provided below

9.1 BLACK COCKATOOS

The DSEWPaC document titled "EPBC Act referral guidelines for three threatened black cockatoo species" (DSEWPaC 2012) summarises what scale of actions would be considered likely to have a significant impact on listed endangered and vulnerable south west black cockatoo species.

The following points provide general guidance on what, in DSEWPaC's view, may be at high and low risk of requiring a referral to ensure compliance with the *EPBC Act* as well as providing some guidance on uncertainty.

Actions that have a high risk of significant impacts

- Clearing of any known nesting tree.
- Clearing or degradation of any part of a vegetation community known to contain breeding habitat.
- Clearing of more than 1 ha of quality foraging habitat.
- Clearing or degradation (including pruning the top canopy) of a known night roosting site.
- Creating a gap of greater than 4 km between patches of black cockatoo habitat (breeding, foraging or roosting).

Actions that have and uncertain risk of significant impacts

- Degradation (such as through altered hydrology or fire regimes) of more than 1 ha of foraging habitat. Significance will depend on the level and extent of degradation and the quality of the habitat.
- Clearing or disturbance in areas surrounding black cockatoo habitat that has the potential to degrade habitat through introduction of invasive species, edge effects, hydrological changes, increased human visitation or fire.
- Actions that do not directly affect the listed species but that have the potential for indirect impacts such as increasing competitors for nest hollows.

- Actions with the potential to introduce known plant diseases such as *Phytophthora* spp. to an area where the pathogen was not previously known.

Actions that have a low risk of significant impacts

- Actions that do not affect black cockatoo habitat or individuals.
- Actions whose impacts occur outside the modelled distribution of the three black cockatoos

As detailed in *Section 6.2.3,* 404 trees with a DBH of greater than 50cm (or DBH >30cm in the case of wandoo) were identified within the study area. All these trees, by DSEWPaC's definition of the term, are potential black cockatoo breeding habitat (i.e. DBH >50cm or in the case of wandoo DBH >30cm).

The "clearing or degradation of any part of a vegetation community known to contain breeding habitat" has the potential to be deemed by DSEWPaC as having a "high risk of significant impacts". The study area also contains black cockatoo foraging habitat. The clearing or degradation of more than 1.0ha of this vegetation will also be seen by DSEWPaC as having "high" or "uncertain risk of significant impacts" (DSEWPaC 2012).

The need to commence dialogue or submit a referral to DSEWPaC regarding this project should be assessed against relevant referral guidelines detailed above once planning is finalised or has progressed to a stage where potential impacts on *EPBC Act* listed threatened fauna species or their habitat can be determine.

9.2 LISTED MIGRATORY SPECIES

The DSEWPaC document titled "Matters of National Environmental Significance. Significant Impact Guidelines 1.1, *EPBC Act* 1999 (DEWHA 2009b) summarises what scale of actions would be considered likely to have a significant impact on listed migratory species.

Within this document an action has, will have, or is likely to have a significant impact on migratory species if it does, will, or is likely to:

- substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat of the migratory species; or

- result in invasive species that is harmful to the migratory species becoming established in an area of important habitat of the migratory species; or

- seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of the species.

An area of important habitat is:

- habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species;

- habitat that is of critical importance to the species at particular life-cycle stages;

- habitat utilised by a migratory species which is at the limit of the species range; or

- habitat within an area where the species is declining.

To have a significant impact on a migratory species as defined under the DSEWPaC Significant Impact Guidelines (DEWHA 2009) any proposed development would need to trigger at least one of the abovementioned significant impact criteria thresholds.

It is considered extremely unlikely that any of these thresholds relating to migratory species will be compromised by development at the site at any scale. The habitat within the study area likely to be used by migratory species does not represent “important habitat” and the number of individuals utilising the study area at any time would not, under any circumstances, represent “an ecologically significant proportion of the population” of any of the migratory species considered likely to utilise the study area.

10. RECOMMENDATIONS

The following recommendations are provided for guidance during ongoing project planning, to ensure compliance with relevant state and federal environmental regulations and to reduce the impact on fauna and fauna habitat as much as reasonable and practicable. This listing is not exhaustive and management plans and offsets (if required) will need to be finalised after liaison

with relevant regulatory advisers/authorities (e.g. DEC and DSEWPaC) as required. It is recommended that:

- Development free zones/reserves/buffers should be created around or along existing seasonal creek lines/wetlands with the aim preserving as much of the existing vegetation in these areas as possible. Totally cleared/highly degraded areas in these areas should be priorities for any proposed rehabilitation/revegetation plans formulated as part of the development.

- Revegetation/rehabilitation plans should include the use of local plant species and seed stock. The final selection of suitable species should be carried out after liaison with appropriate experts or local land care groups to ascertain which species are most suitable for the area.

- Where possible retain and protect remnant vegetation on site that does not require clearing. During site works areas requiring clearing should be clearly marked and access to other areas restricted to prevent accidental clearing of areas to be retained. No dead, standing or fallen timber should be removed unnecessarily. Logs (hollow or not) and other debris resulting from land clearing should be used to enhance fauna habitat in untouched and rehabilitated areas if possible.

- A Water Management Plan (WMP) for the site should be formulated for any proposed development at the site. This should cover issues relating to stormwater drainage management, the control of pollution and nutrient levels in stormwater runoff and ensuring the potential impacts to the environment and associated wetlands can be managed.

- Fuel storage facilities required during construction phases should be bunded.

- Trenching required installation of underground services should be kept open for only as long as necessary and suitable escape ramps and bridging provided if the site is to be left unattended for extended periods.

- Whenever possible pipe ends should be sealed to prevent fauna entering.

- The need for a referral will need to be reassessed once plans for the development are finalised or have progressed to a stage where potential impacts on *EPBC Act* listed threatened fauna species or their habitat can be determine.

11. CONCLUSION

The fauna assessment within the study area was undertaken for the purposes of categorising the fauna assemblages and identifying fauna habitats present. A targeted assessment of black cockatoo habitat within the area was also carried out.

With respect to native vertebrate fauna, 14 mammals (includes eight bat species), 86 bird, 39 reptile and ten frog species have previously been recorded in the general area, some of which have the potential to occur in or utilise sections of the study area at times.

Of the 149 native animals that are listed as potentially occurring in the area, three are considered to be endangered/vulnerable or in need of special protection under State and/or Federal law. In addition, three migratory species and one DEC priority species may also utilise the area at times.

Constraints on future development within the study area will largely be centred on the presence of habitat used or potentially used by threatened fauna species in particular those listed under the *EPBC Act*, namely the two species of black cockatoo known to frequent the area. The potential impact of the removal or modification of these species habitat will need to be taken into consideration prior to the development proceeding. Stormwater management will also be an important facet of future development as watercourses in the study area drain into Ellen Brook.

A series of other recommendations aimed at mitigating and minimising potential impacts on fauna and fauna habitat in general are provided in Section 10. These should be taken into consideration during future planning and development where considered reasonable and practicable.

The need for a referral to ensure compliance with the *EPBC Act* will need to be reassessed once plans for the development are finalised or have progressed to a stage where potential impacts on listed threatened fauna species or their habitat can be determine.

12. BIBLIOGRAPHY

(not necessarily cited)

Allen, G.R., Midgley, S.H., Allen, M. (2003). Freshwater Fishes of Australia. Western Australian Museum, Perth, Western Australia.

Aplin, K.P. and Smith, L.A. (2001). Checklist of the frogs and reptiles of Western Australia, Records of the Western Australian Museum Supplement No. 63, 51-74.

Barrett, G., Silcocks, A., Barry, S., Cunningham, R. and Poulter, R. (2003). The New Atlas of Australian Birds. Royal Australasian Ornithologists Union, Victoria.

Beatty S.J., Morgan D.L., Klunzinger, M., & Lymbe, A.J. (2010). Aquatic Macrofauna of Ellen Brook and the Brockman River: Freshwater Water Refuges in a Salinised Catchment.

Bishop, C., Williams, M. Mitchell, D. & Gamblin, T. (2010a). Survey guidelines for the Graceful sun-moth (*Synemon gratiosa*) & site habitat assessments V1.2. DEC, December 2010.

Bishop, C., Williams, M. Mitchell, D. & Gamblin, T. (2010b). Conservation of the Graceful Sun-moth (*Synemon gratiosa*). Findings from the 2010 Graceful Sun-moth surveys and habitat assessments across the Swan, South West and southern Midwest Regions. Interim Report. DEC, August 2010.

Bush, B., Maryan, B., Browne-Cooper, R. & Robinson, D. (2002). Reptiles and Frogs of the Perth Region. UWA Press, Nedlands.

Bush, B., Maryan, B., Browne-Cooper, R. & Robinson, D. (2007). Reptiles and Frogs in the Bush: Southwestern Australia. UWA Press, Nedlands.

Cale, B. (2003). Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) Recovery Plan 2002-2012. CALM, Wanneroo.

CALM (2005). Fauna Note No. 05/2005 Carnaby's Cockatoo, Written by Tamra Chapman, Belinda Cale and Marion Massam. CALM, Wanneroo.

Christidis, l. and Boles, W.E. (1994). The Taxonomy and Species of Birds of Australia and its Territories. RAOU, Monograph 2.

Christidis, L. and Boles, W.E. (2008) Systematics and Taxonomy of Australian Birds. CSIRO Publishing, Melbourne

Cogger, H.G., (2000). Reptiles and Amphibians of Australia. Reed, Sydney.

Dell, J., & Hyder-Griffiths, B. (2002). A Description of the Fauna Values of the Muddy Lakes Area of the South Bunbury to Capel Coastal Corridor. Department of Environmental Protection, Perth.

Department of Conservation and Land Management (1994). Chuditch Recovery Plan 1992-2001, by Peter Orell and Keith Morris for the Chuditch Recovery Team.

Department of Environment and Conservation (2001). Karrak-watch: A summary of information about the Forest red-tailed black cockatoo, http://science.calm.wa.gov.au/articles/2001-10-04/.

Department of Environment and Conservation (2007). Forest Black Cockatoo (Baudin's Cockatoo - *Calyptorhynchus baudinii*) and Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) Recovery Plan. DEC.

Department of Environment and Conservation (2013). NatureMap Database search. "By Circle" 115°59' 52" E, 31°33' 57" S – Study area (plus 20km buffer), 21/01/2013.

Department of the Environment, Water, Heritage and the Arts (DEWHA) (2009). Matters of National Environmental Significance. Significant Impact Guidelines 1.1, EPBC Act 1999.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) (2012). *EPBC Act* referral guidelines for three threatened black cockatoo species: Carnaby's cockatoo (endangered) *Calyptorhynchus latirostris*, Baudin's cockatoo (vulnerable) *Calyptorhynchus baudinii*, Forest red-tailed black cockatoo (vulnerable) *Calyptorhynchus banksii naso*.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC); (2013). *EPBC Act* Protected Matters Report: Point Search - 31.56686, 115.99812 (10 km Buffer) Available from: http://www.environment.gov.au. Report Created 21/01/13 20:01:43.

Emerge Associates (2013). Flora and Vegetation Survey and Wetland Assessment. Lot 1313 (part), Muchea Scheme Amendment. Unpublished report for Westbridge Property Group. January 2013.

Environmental Protection Authority (EPA) (2002). Terrestrial Biological Surveys As An Element of Biodiversity Protection. Position Statement No. 3. EPA, Perth.

Environmental Protection Authority (EPA), (2003a). Level of Assessment for Proposals Affecting Natural Areas Within the System 6 Region and Swan Coastal Plain Portion of the *System 1* Region. Guidance Statement 10.

Environmental Protection Authority (EPA) (2003b). Greater Bunbury Region Scheme – EPA Bulletin 1108. EPA, Perth.

Environmental Protection Authority (EPA) (2004). Guidance for the Assessment of Environmental Factors - Terrestrial fauna surveys for environmental impact assessment in Western Australia. Guidance Statement No 56 EPA, Perth.

Environmental Protection Authority (EPA) and Department of Environment and Conservation (DEC) (2010). Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessments (eds B.M. Hyder, J. Dell and M.A. Cowan), Perth Western Australia.

Glauret, L. (1961). A Handbook of the Lizards of Western Australia. Handbook 6, Western Australian Naturalists Club, Perth.

Government of Western Australia (1998). Perth Bushplan.

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

Government of Western Australia (2000b). Bush Forever Volume 2. Directory of Bush Forever Sites. Department of Environmental Protection Perth, Western Australia.

Gozzard, J.R. (1982). Muchea Sheet 2034 I and part 2134 IV Perth Metropolitan Region, Environmental Geology Series, GSWA

Harvey, M.S., Dell, J. How R.A.., & Waldock, J.M. (1997) Ground Fauna of Bushland Remnants on the Ridge Hill Shelf and Pinjarra Plain Landforms, Perth. Report to the Australian Heritage Commission. NEP Grant N95/49. 56 pp.

How, R.A. and Dell, J. (1994). The Zoogeographical Significance of Urban Bushland Remnants to Reptiles in the Perth Region, Western Australia. Pacific Conservation Biology 1: 132-140.

How, R.A, Harvey, M.S., Dell J., & Waldock, J.M. (1996) Ground Fauna of Urban Bushland Remnants in Perth. Report to the Australian Heritage Commission. NEP Grant N93/04. 103 pp.

How, R., Cooper, N.K. and Bannister, J.L. (2001). Checklist of the mammals of Western Australia, Records of the Western Australian Museum Supplement No. 63, 91-98.

Johnstone, R.E. (2001). Checklist of the birds of Western Australia, Records of the Western Australian Museum Supplement No. 63, 75-90.

Johnstone, R. E. & Kirkby, T. (2008). Distribution, status, social organisation, movements and conservation of Baudin's Cockatoo (*Calyptorhynchus baudinii*) in South-west Western Australia. Records of the WA Museum 25: 107-118 (2008).

Johnstone, R. E. & Kirkby, T. (2011). Carnaby's Cockatoo (*Calyptorhynchus latirostris*), Baudin's 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. Report for the Department of Planning, Western Australia.

Johnstone, R.E. and Storr, G.M. (1998). Handbook of Western Australian Birds: Volume 1 – Non-passerines (Emu to Dollarbird). Western Australian Museum, Perth Western Australia.

Johnstone, R. E. and Storr, G.M. (2004). Handbook of Western Australian Birds: Volume 2 – Passerines (Blue-winged Pitta to Goldfinch). Western Australian Museum, Perth Western Australia.

Keighery, B. J. (1994). Bushland Plant Survey: a Guide to Plant Community Surveys for the Community. Wildflower Society of Western Australia (Inc.) Nedlands, Western Australia.

Maxwell S., Burbidge A.A & Morris K. (1996). The 1996 Action Plan for Australian Marsupials and Monotremes. Wildlife Australia, Canberra.

Menkhorst, P. and Knight, F. (2011). A Field Guide to the Mammals of Australia. Oxford University Press, Melbourne.

Morcombe, M. (2004). Field Guide to Australian Birds. Steve Parish Publishing, Archerfield, Queensland.

Morgan, D.L., Gill, H.S. & Potter, I.C. (1996). Distribution of freshwater fish in the south-western Corner of Australia. Water Resource Technical Series. Water and Rivers Commission Report WRT4 1996.

Morgan, D.L., Beatty, S.J., Klunzinger, M.W, Allen, M.G. and Burnham, Q.E (2011). Field Guide to the Freshwater Fishes, Crayfishes and Mussels of South Western Australia. Published by SERCUL.

Nevill, S (ed) (2005). Guide to the Wildlife of the Perth Region. Simon Nevill Publications, Perth.

Pizzey, G., & Knight, F. (2011). The Field Guide to the Birds of Australia. Harper Collins, Sydney.

Saunders, D. (1980). Food and Movements of the Short-billed Form of the White-tailed Black Cockatoo. Aust. Wildl. Res. 7(1980) pp. 257-269.

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

Simpson, K. and Day, N. (2010). Field Guide to the Birds of Australia. Penguin Books, Ringwood.

Smith, R. A., and Shams, R., (2002). Hydrogeological information for management planning in the Ellen Brook catchment: Western Australia, Water and Rivers Commission, Salinity and Land Use Impacts Series Report No. SLUI 11.

Sorena M. and T. Soderquist (1995). Western Quoll *Dasyurus geoffroyi*. pp 62-64 in Strahan R. (ed). (1995). The Mammals of Australia. Australian Museum / Reed Books.

Soderquist T. (1995). Brush-tailed Phascogale *Phascogale tapoatafa*. pp 104-106 in Strahan R. (ed). (1995). The Mammals of Australia. Australian Museum / Reed Books.

Storr, G.M., Smith, L.A. and Johnstone R.E. (1983). Lizards of Western Australia II: Dragons and Monitors. WA Museum, Perth.

Storr, G.M., Smith, L.A. and Johnstone R.E. (1990). Lizards of Western Australia III: Geckos and Pygopods. WA Museum, Perth.

Storr, G.M., Smith, L.A. and Johnstone R.E. (1999). Lizards of Western Australia I: Skinks. Revised Edition, WA Museum, Perth.

Storr, G.M., Smith, L.A. and Johnstone R.E. (2002). Snakes of Western Australia. Revised Edition, WA Museum, Perth.

Tyler M.J. & Doughty P. (2009). Field Guide to Frogs of Western Australia, Fourth Edition, WA Museum, Perth.

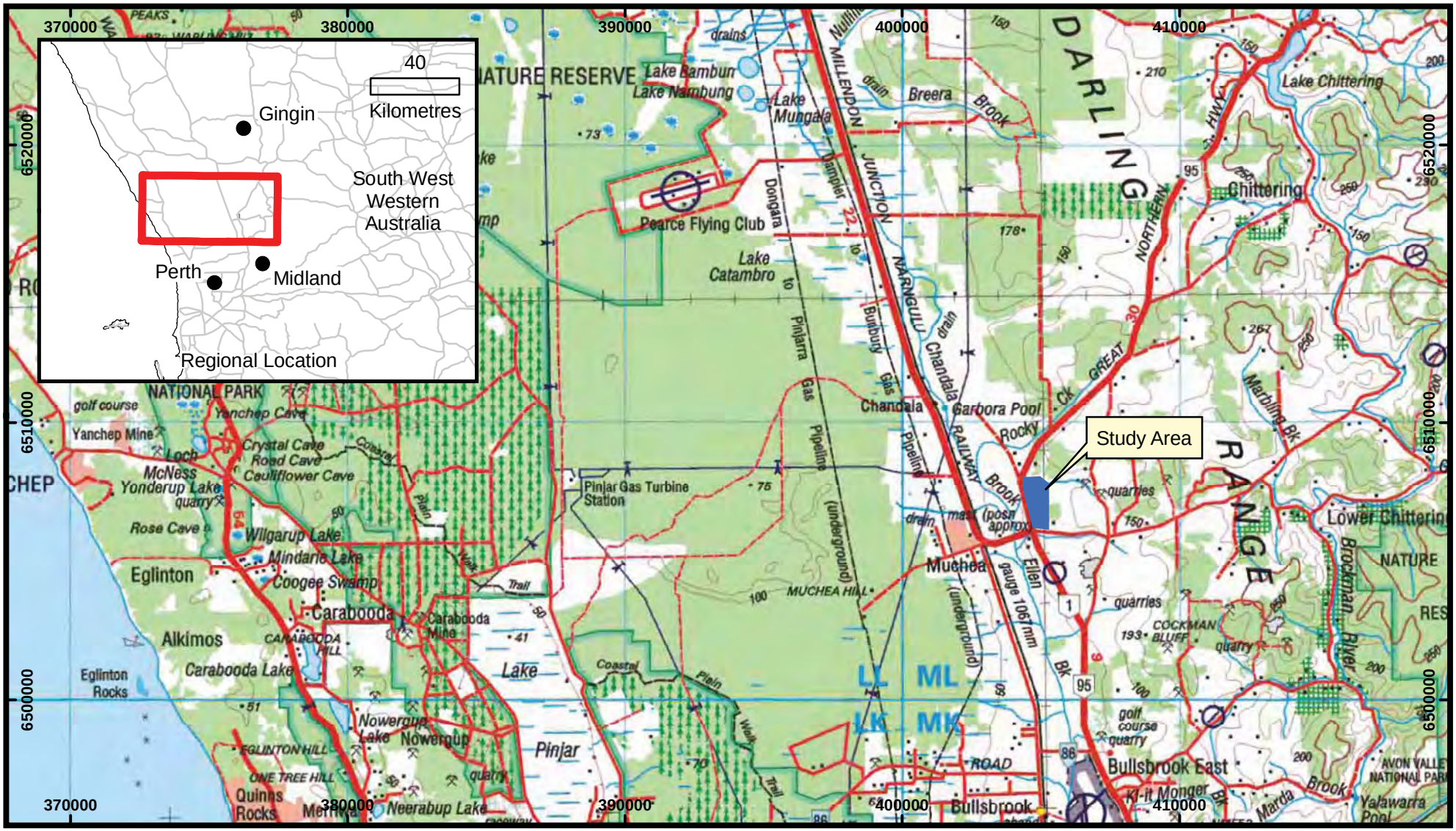
Tyler M.J., Smith L.A. and Johnstone R.E. (2000). Frogs of Western Australia, Revised Edition, WA Museum, Perth.

Thackway, R. and Cresswell, I.D. (1995). An Interim Biogeographic Regionalisation for Australia. Australian Nature Conservation Agency, Canberra.

Van Dyck, S. & Strahan, R. Eds (2008). The Mammals of Australia. Third edition Queensland Museum.

Wilson, S. and Swan, G. (2010). A Complete Guide to Reptiles of Australia. Reed, New Holland, Sydney.

FIGURES



Legend

Study Area (Lot 1313 (pt))

0 2 4 6 8 10

Kilometres

MGA Zone 50

Fauna Assessment

DRAWN:G Harewood

DATE : Mar 2013

SCALE: 1:200,000

LOT 1313 (pt)
Great Northern Highway
Muchea

Study Area and Surrounds

Figure: 1

Legend

Study Area

0 100 200 300 400 500

Meters

MGA Zone 50

Fauna Assessment

DRAWN:G Harewood

DATE : Mar 2013

SCALE: 1:8,500

Lot 1313 (pt)
Great Northern Highway
Muchea

Study Area Air Photo

Figure: 2

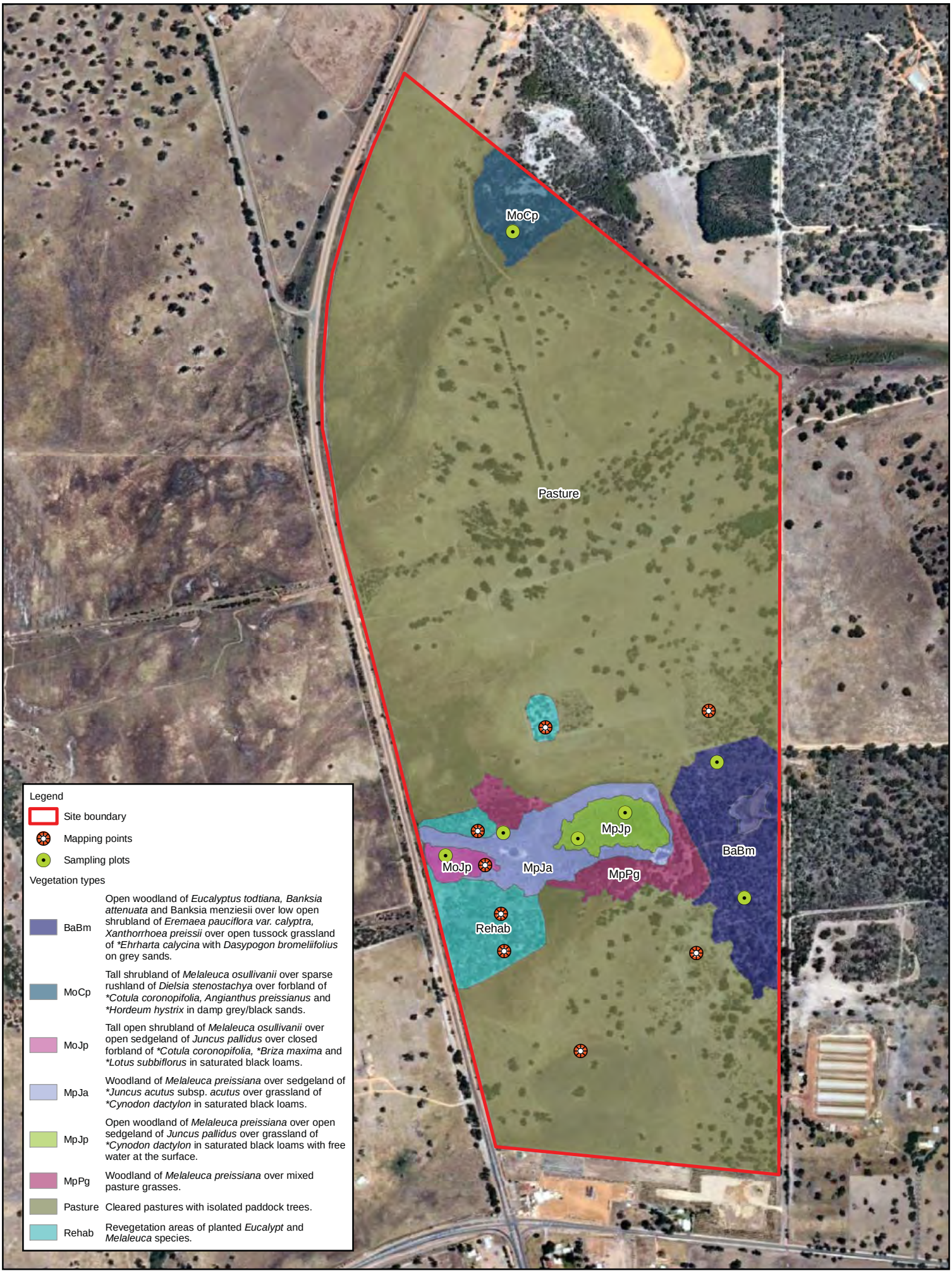


Figure 3: Vegetation Types

Project: Muchea Scheme Amendment - Flora and Vegetation Survey and Wetland Assessment

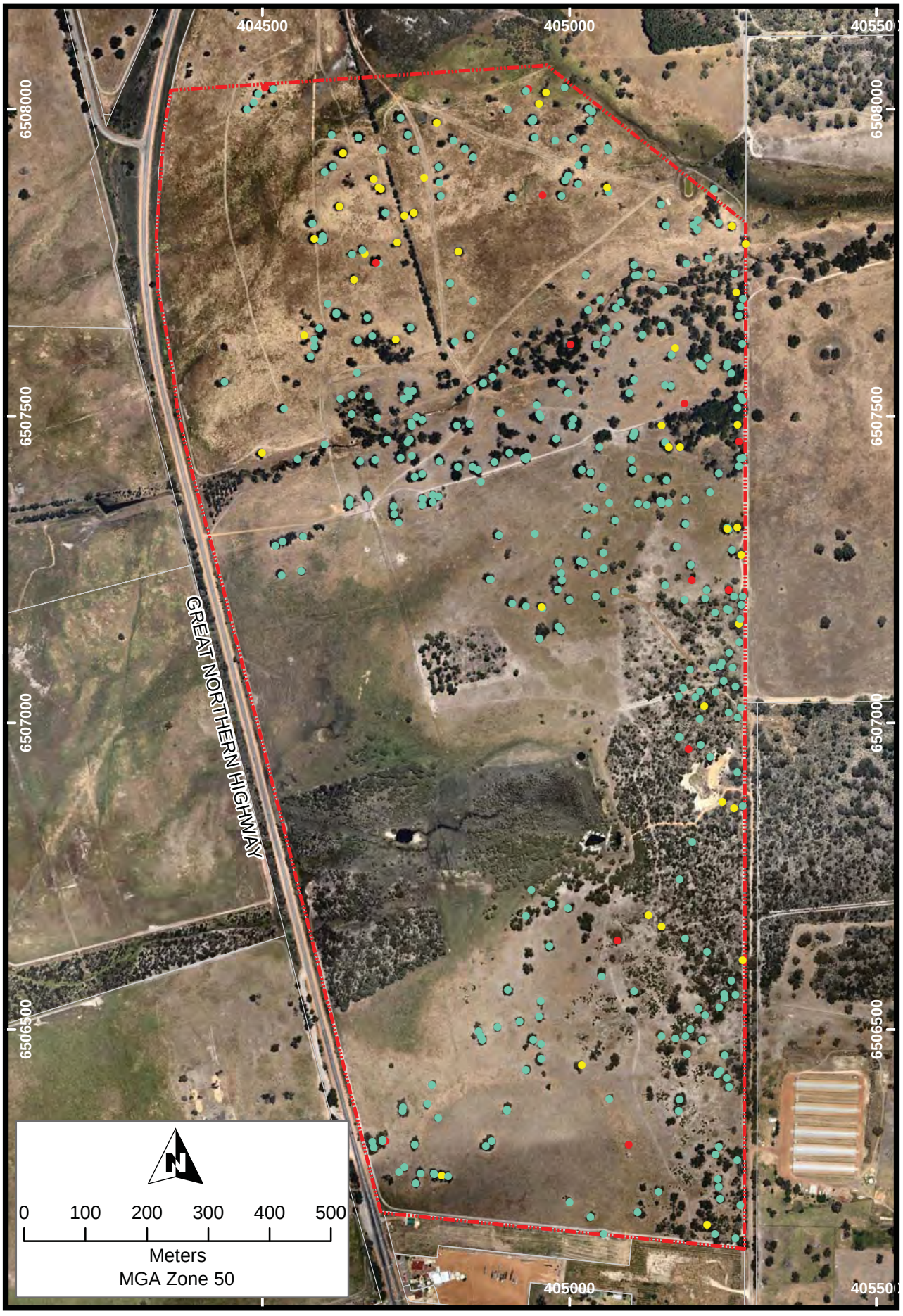
Client: Westbridge Property Group

Plan Number: EP12-052(01)--F23

Drawn:	GRO	Date:	03/01/13
Approved:	DRAFT	Date:	--/--/--
Checked:	DRAFT	Scale:	1:10,000@A4

0 90 180 360 Metres

emerge ASSOCIATES Integrated Science & Design



Legend

- Study Area
- Tree >50cm DBH, no hollows seen
- Tree >50cm DBH, one or more hollows seen
- Tree >50cm DBH, one or more hollows possibly suitable for a Black Cockatoo

Fauna Assessment

DRAWN:G Harewood

DATE : Mar 2013

SCALE: 1:8,660

Lot 1313 (pt)
Great Northern Highway
Muchea

Habitat Trees

Figure: 4

PLATES

Plate 1: Open woodland of *Eucalyptus todtiana, Banksia attenuat*a and *Banksia menziesii* over low open shrubland over open tussock grassland on grey sands.

Plate 2: Woodland of *Melaleuca preissiana* over sedgeland over grassland in saturated black loams.

Plate 3: Revegetation areas of planted Eucalypt and *Melaleuca* species.

Plate 4: Cleared pastures with isolated paddock trees over a range of introduced grasses and weeds.

APPENDIX A

CONSERVATION CATEGORIES

EPBC Act (1999) Threatened Fauna Categories

Category	Code	Description
Extinct	E	There is no reasonable doubt that the last member of the species has died.
*Extinct in the wild	EW	A species (a) is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or (b) has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
*Critically endangered	CE	A species is facing an extremely high risk of extinction in the wild in the immediate future.
*Endangered	EN	A species: (a) is not critically endangered; and (b) is facing a very high risk of extinction in the wild in the near future.
*Vulnerable	VU	A species (a) is not critically endangered or endangered; and (b) is facing a high risk of extinction in the wild in the medium-term future.
Conservation dependent	CD	A species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered
*Migratory	Migratory	(a) all migratory species that are: (i) native species; and (ii) from time to time included in the appendices to the Bonn Convention; and (b) all migratory species from time to time included in annexes established under JAMBA, CAMBA and ROKAMBA; and (c) all native species from time to time identified in a list established under, or an instrument made under, an international agreement approved by the Minister.
Marine	Ma	Species in the list established under s248 of the EPBC Act

Note: Only species in those categories marked with an asterix are matters of national environmental significance under the *EPBC Act*.

Western Australian Wildlife Conservation Act (1950) Threatened Fauna Categories

Category	Code	Description
Schedule 1	S1	Fauna which is rare or likely to become extinct Threatened fauna (Schedule 1) are further ranked by the DEC according to their level of threat using IUCN Red List criteria: **CR: Critically Endangered** - considered to be facing an extremely high risk of extinction in the wild. **EN: Endangered** - considered to be facing a very high risk of extinction in the wild. **VU: Vulnerable** - considered to be facing a high risk of extinction in the wild.
Schedule 2	S2	Fauna which is presumed extinct
Schedule 3	S3	Birds which are subject to an agreement between the governments of Australia and Japan (JAMBA) relating to the protection of migratory birds and birds in danger of extinction
Schedule 4	S4	Fauna that is otherwise in need of special protection

Western Australian DEC Priority Fauna Categories

Category	Code	Description
Priority 1	P1	Taxa that are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Taxa may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes..
Priority 2	P2	Taxa that are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. Taxa may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes.
Priority 3	P3	Taxa that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Taxa may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them.
Priority 4	P4	(a) **Rare**. Taxa that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands. (b) **Near Threatened**. Taxa that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. (c) Taxa that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.
Priority 5	P5	Taxa that are not threatened but are subject to a specific conservation program, the cessation of which would result in the taxa becoming threatened within five years.

IUCN Red List Threatened Species Categories

Category	Code	Description
Extinct	EX	Taxa for which there is no reasonable doubt that the last individual has died.
Extinct in the Wild	EW	Taxa which is known only to survive in cultivation, in captivity or and as a naturalised population well outside its past range and it has not been recorded in known or expected habitat despite exhaustive survey over a time frame appropriate to its life cycle and form.
Critically Endangered	CR	Taxa facing an extremely high risk of extinction in the wild.
Endangered	EN	Taxa facing a very high risk of extinction in the wild.
Vulnerable	VU	Taxa facing a high risk of extinction in the wild.
Near Threatened	NT	Taxa which has been evaluated but does not qualify for CR, EN or VU now but is close to qualifying or likely to qualify in the near future.
Least Concern	LC	Taxa which has been evaluated but does not qualify for CR, EN, VU, or NT but is likely to qualify for NT in the near future.
Data Deficient	DD	Taxa for which there is inadequate information to make a direct or indirect assessment of its risk of extinction based on its distribution and/or population status.

A full list of categories and their meanings are available at:

http://www.iucnredlist.org/technical-documents/categories-and-criteria/2001-categories-criteria

APPENDIX B

FAUNA OBSERVED OR POTENTIALLY IN STUDY AREA

Fauna Observed or Potentially in Study Area

Lot 1313 (Pt) Muchea, W.A.

-31.56686° S, 115.99812° E GDA94

Compiled by Greg Harewood - March 2013

Observed (Sighted/Heard/Signs) = +

Class **Family** *Species*	Common Name	Conservation Status	Jan '13

Amphibians

Myobatrachidae
Ground or Burrowing Frogs

Crinia georgiana	Quacking Frog	LC	
Crinia glauerti	Glauert`s Froglet	LC	
Crinia insignifera	Squelching Froglet	LC	
Geocrinia leai	Lea`s Frog	LC	
Heleioporus eyrei	Moaning Frog	LC	
Limnodynastes dorsalis	Banjo Frog	LC	
Myobatrachus gouldii	Turtle Frog	LC	
Pseudophryne guentheri	Güenther`s Toadlet	LC	

Hylidae
Tree or Water-Holding Frogs

Litoria adelaidensis	Slender Tree Frog	LC	
Litoria moorei	Motorbike Frog	LC	

Reptiles

Gekkonidae
Geckoes

Christinus marmoratus	Marbled Gecko		
Strophurus spinigerus	South-western Spiny-tailed Gecko		

Pygopodidae
Legless Lizards

Aprasia repens	Sand-plain Worm Lizard		
Delma fraseri	Fraser's Delma		
Delma grayii	Side-barred Delma		
Lialis burtonis	Common Snake Lizard		
Pygopus lepidopodus	Southern Scaleyfoot		

WC Act Status - S1 to S4, EPBC Act Status - EN = Endangered, VU = Vulnerable, EX = Extinct, DEC Priority Status - P1 to P5, Int. Agmts - CA = CAMBA, JA = JAMBA, RK = ROKAMBA, Bush Forever Decreaser Species - Bh = habitat specialists, Bp = wide ranging species, Be = extinct in Perth Coastal Plain Region. IUCN Red List Category Definitions LC = Least Concern - see Appendix A and http://www.iucnredlist.org/technical-documents/categories-and-criteria/2001-categories-criteria for others.

Class **Family** *Species*	Common Name	Conservation Status	Jan '13
Agamidae Dragon Lizards			
Pogona minor minor	Western Bearded Dragon		
Rankinia adelaidensis	Western Heath Dragon	Bh	
Varanidae Monitor's or Goanna's			
Varanus gouldii	Gould's Sand Monitor		
Varanus rosenbergi	Heath Monitor	Bp	
Varanus tristis	Black-headed Monitor		
Scincidae Skinks			
Acritoscincus trilineatum	South-western Cool Skink		
Cryptoblepharus buchananii	Buchanan's Snake-eyed Skink		+
Ctenotus australis	Western Limestone Ctenotus		
Ctenotus fallens	West Coast Ctenotus		
Ctenotus impar	South-western Odd-striped Ctenotus	Bh	
Egernia kingii	King's Skink		
Egernia napoleonis	Salmon-bellied Skink		
Hemiergis quadrilineata	Two-toed Earless Skink		
Lerista elegans	West Coast Four-toed Lerista		
Lerista lineopunctulata	Line-spotted Robust Lerista		
Lerista praepedita	Worm Lerista		
Menetia greyii	Dwarf Skink		
Morethia lineoocellata	Western Pale-flecked Morethia		
Morethia obscura	Dusky Morethia		
Tiliqua occipitalis	Western Blue Tongue Lizard		
Tiliqua rugosa rugosa	Western Bobtail		
Typhlopidae Blind Snakes			
Ramphotyphlops australis	Southern Blind Snake		

WC Act Status - S1 to S4, EPBC Act Status - EN = Endangered, VU = Vulnerable, EX = Extinct, DEC Priority Status - P1 to P5, Int. Agmts - CA = CAMBA, JA = JAMBA, RK = ROKAMBA, Bush Forever Decreaser Species - Bh = habitat specialists, Bp = wide ranging species, Be = extinct in Perth Coastal Plain Region. IUCN Red List Category Definitions LC = Least Concern - see Appendix A and http://www.iucnredlist.org/technical-documents/categories-and-criteria/2001-categories-criteria for others.

Class **Family** *Species*	Common Name	Conservation Status	Jan '13
Elapidae Elapid Snakes			
Brachyurophis fasciolata	Narrow-banded Shovel-nosed Snake		
Brachyurophis semifasciata	Southern Shovel-nosed Snake		
Elapognathus coronatus	Crowned Snake	Bp	
Neelaps bimaculatus	Black-naped Snake		
Notechis scutatus	Tiger Snake		
Parasuta gouldii	Gould's Hooded Snake		
Parasuta nigriceps	Black-backed Snake		
Pseudechis australis	Mulga Snake		
Pseudonaja affinis	Dugite		
Simoselaps bertholdi	Jan`s Banded Snake		
Birds			
Casuariidae Emus, Cassowarries			
Dromaius novaehollandiae	Emu	Bp LC	+
Phasianidae Quails, Pheasants			
Coturnix pectoralis	Stubble Quail	LC	
Anatidae Geese, Swans, Ducks			
Anas gracilis	Grey Teal	LC	
Anas platyrhynchos	Mallard		
Anas superciliosa	Pacific Black Duck	LC	+
Chenonetta jubata	Australian Wood Duck	LC	
Tadorna tadornoides	Australian Shelduck	LC	
Ardeidae Herons, Egrets, Bitterns			
Ardea alba	Great Egret	S3 Mig CA JA	
Ardea ibis	Cattle Egret	S3 Mig CA JA	

WC Act Status - S1 to S4, EPBC Act Status - EN = Endangered, VU = Vulnerable, EX = Extinct, DEC Priority Status - P1 to P5, Int. Agmts - CA = CAMBA, JA = JAMBA, RK = ROKAMBA, Bush Forever Decreaser Species - Bh = habitat specialists, Bp = wide ranging species, Be = extinct in Perth Coastal Plain Region. IUCN Red List Category Definitions LC = Least Concern - see Appendix A and http://www.iucnredlist.org/technical-documents/categories-and-criteria/2001-categories-criteria for others.

Class **Family** *Species*	Common Name	Conservation Status	Jan '13
Accipitridae Kites, Goshawks, Eagles, Harriers			
Accipiter cirrocephalus	Collared Sparrowhawk	Bp LC	
Accipiter fasciatus	Brown Goshawk	Bp LC	
Aquila audax	Wedge-tailed Eagle	Bp LC	+
Aquila morphnoides	Little Eagle	Bp	+
Circus approximans	Swamp Harrier	LC	
Elanus caeruleus	Black-shouldered Kite		
Haliastur sphenurus	Whistling Kite	Bp LC	
Hamirostra isura	Square-tailed Kite	Bp	
Falconidae Falcons			
Falco berigora	Brown Falcon	Bp LC	
Falco cenchroides	Australian Kestrel	LC	+
Falco longipennis	Australian Hobby	LC	
Falco peregrinus	Peregrine Falcon	S4 Bp LC	
Turnicidae Button-quails			
Turnix varia	Painted Button-quail	Bp	
Columbidae Pigeons, Doves			
Ocyphaps lophotes	Crested Pigeon	LC	+
Phaps chalcoptera	Common Bronzewing	Bh LC	
Cacatuidae Cockatoos, Corellas			
Cacatua sanguinea	Little Corella	LC	
Calyptorhynchus banksii naso	Forest Red-tailed Black Cockatoo	S1 VU Be VU LC	+
Calyptorhynchus latirostris	Carnaby`s Cockatoo	S1 EN Bp EN A2bcd+3bcd	+
Eolophus roseicapilla	Galah		+

Class **Family** *Species*	Common Name	Conservation Status	Jan '13
Psittacidae Parrots			
Glossopsitta porphyrocephala	Purple-crowned Lorikeet	LC	
Neophema elegans	Elegant Parrot	LC	
Platycercus icterotis icterotis	Western Rosella (Western ssp)	Bp LC	
Platycercus spurius	Red-capped Parrot		+
Platycercus zonarius	Australian Ringneck Parrot		+
Polytelis anthopeplus	Regent Parrot	LC	
Cuculidae Parasitic Cuckoos			
Cacomantis flabelliformis	Fan-tailed Cuckoo	LC	
Chrysococcyx basalis	Horsfield`s Bronze Cuckoo	LC	
Chrysococcyx lucidus	Shining Bronze Cuckoo	LC	
Cuculus pallidus	Pallid Cuckoo	LC	
Strigidae Hawk Owls			
Ninox novaeseelandiae	Boobook Owl	LC	
Tytonidae Barn Owls			
Tyto alba	Barn Owl	LC	
Podargidae Frogmouths			
Podargus strigoides	Tawny Frogmouth	LC	
Aegothelidae Owlet-nightjars			
Aegotheles cristatus	Australian Owlet-nightjar	LC	
Halcyonidae Tree Kingfishers			
Dacelo novaeguineae	Laughing Kookaburra	Introduced	+
Todiramphus sanctus	Sacred Kingfisher	LC	

WC Act Status - S1 to S4, EPBC Act Status - EN = Endangered, VU = Vulnerable, EX = Extinct, DEC Priority Status - P1 to P5, Int. Agmts - CA = CAMBA, JA = JAMBA, RK = ROKAMBA, Bush Forever Decreaser Species - Bh = habitat specialists, Bp = wide ranging species, Be = extinct in Perth Coastal Plain Region. IUCN Red List Category Definitions LC = Least Concern - see Appendix A and http://www.iucnredlist.org/technical-documents/categories-and-criteria/2001-categories-criteria for others.

Class **Family** *Species*	Common Name	Conservation Status	Jan '13
Meropidae Bee-eaters			
Merops ornatus	Rainbow Bee-eater	S3 Mig JA LC	
Maluridae Fairy Wrens, GrassWrens			
Malurus splendens	Splendid Fairy-wren	Bh LC	+
Pardalotidae Pardalotes, Bristlebirds, Scrubwrens, Gerygones, Thornbills			
Acanthiza apicalis	Broad-tailed Thornbill	Bh LC	
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	Bh LC	+
Acanthiza inornata	Western Thornbill	Bh LC	
Gerygone fusca	Western Gerygone	LC	+
Pardalotus punctatus	Spotted Pardalote	LC	
Pardalotus striatus	Striated Pardalote	LC	+
Sericornis frontalis	White-browed Scrubwren	Bh LC	
Smicrornis brevirostris	Weebill	Bh LC	+
Meliphagidae Honeyeaters, Chats			
Acanthorhynchus superciliosus	Western Spinebill	LC	
Anthochaera carunculata	Red Wattlebird	LC	+
Anthochaera lunulata	Western Little Wattlebird	Bp	
Lichenostomus virescens	Singing Honeyeater	LC	
Lichmera indistincta	Brown Honeyeater	LC	
Manorina flavigula	Yellow-throated Miner	Bp LC	
Phylidonyris melanops	Tawny-crowned Honeyeater	Bp LC	
Phylidonyris nigra	White-cheeked Honeyeater	Bp	
Phylidonyris novaehollandiae	New Holland Honeyeater	Bp LC	

Class **Family** *Species*	Common Name	Conservation Status	Jan '13
Petroicidae Australian Robins			
Microeca fascinans	Jacky Winter	LC	
Petroica goodenovii	Red-capped Robin	LC	
Petroica multicolor	Scarlet Robin	Bh LC	+
Neosittidae Sitellas			
Daphoenositta chrysoptera	Varied Sittella	Bh LC	
Pachycephalidae Crested Shrike-tit, Crested Bellbird, Shrike Thrushes, Whistlers			
Colluricincla harmonica	Grey Shrike-thrush	Bh LC	
Pachycephala pectoralis	Golden Whistler	Bh LC	
Pachycephala rufiventris	Rufous Whistler	LC	+
Dicruridae Monarchs, Magpie Lark, Flycatchers, Fantails, Drongo			
Grallina cyanoleuca	Magpie-lark	LC	+
Rhipidura fuliginosa	Grey Fantail	LC	+
Rhipidura leucophrys	Willie Wagtail	LC	+
Campephagidae Cuckoo-shrikes, Trillers			
Coracina novaehollandiae	Black-faced Cuckoo-shrike	LC	
Lalage sueurii	White-winged Triller		
Artamidae Woodswallows, Butcherbirds, Currawongs			
Artamus cinereus	Black-faced Woodswallow	Bp LC	
Artamus cyanopterus	Dusky Woodswallow	Bp LC	
Cracticus tibicen	Australian Magpie		+
Cracticus torquatus	Grey Butcherbird	LC	+
Strepera versicolor	Grey Currawong	Bp LC	
Corvidae Ravens, Crows			
Corvus coronoides	Australian Raven	LC	+

WC Act Status - S1 to S4, EPBC Act Status - EN = Endangered, VU = Vulnerable, EX = Extinct, DEC Priority Status - P1 to P5, Int. Agmts - CA = CAMBA, JA = JAMBA, RK = ROKAMBA, Bush Forever Decreaser Species - Bh = habitat specialists, Bp = wide ranging species, Be = extinct in Perth Coastal Plain Region. IUCN Red List Category Definitions LC = Least Concern - see Appendix A and http://www.iucnredlist.org/technical-documents/categories-and-criteria/2001-categories-criteria for others.

Class **Family** *Species*	Common Name	Conservation Status	Jan '13
Motacillidae Old World Pipits, Wagtails			
Anthus novaeseelandiae	Australian Pipit	LC	+
Hirundinidae Swallows, Martins			
Hirundo neoxena	Welcome Swallow	LC	
Hirundo nigricans	Tree Martin	LC	
Sylviidae Old World Warblers			
Cincloramphus cruralis	Brown Songlark	LC	
Cincloramphus mathewsi	Rufous Songlark	LC	
Zosteropidae White-eyes			
Zosterops lateralis	Grey-breasted White-eye	LC	

Mammals

Tachyglossidae Echidnas			
Tachyglossus aculeatus	Echidna	LC	
Dasyuridae Carnivorous Marsupials			
Antechinus flavipes	Yellow-footed Antechinus, Mardo	Bh LC	
Peramelidae Bandicoots			
Isoodon obesulus fusciventer	Southern Brown Bandicoot	P5	
Burramyidae Pygmy Possums			
Cercartetus concinnus	Western Pygmy-possum	Bh LC	
Tarsipedidae Honey Possum			
Tarsipes rostratus	Honey Possum	Bh LC	
Macropodidae Kangaroos, Wallabies			
Macropus fuliginosus	Western Grey Kangaroo	LC	+

WC Act Status - S1 to S4, EPBC Act Status - EN = Endangered, VU = Vulnerable, EX = Extinct, DEC Priority Status - P1 to P5, Int. Agmts - CA = CAMBA, JA = JAMBA, RK = ROKAMBA, Bush Forever Decreaser Species - Bh = habitat specialists, Bp = wide ranging species, Be = extinct in Perth Coastal Plain Region. IUCN Red List Category Definitions LC = Least Concern - see Appendix A and http://www.iucnredlist.org/technical-documents/categories-and-criteria/2001-categories-criteria for others.

Class **Family** *Species*	Common Name	Conservation Status	Jan '13
Molossidae Freetail Bats			
Mormopterus planiceps	Western Freetail Bat	LC	
Tadarida australis	White-striped Freetail-bat	LC	
Vespertilionidae Ordinary Bats			
Chalinolobus gouldii	Gould`s Wattled Bat	LC	
Chalinolobus morio	Chocolate Wattled Bat	LC	
Nyctophilus geoffroyi	Lesser Long-eared Bat	LC	
Nyctophilus gouldi	Gould`s Long-eared Bat	LC	
Nyctophilus major	Western Long-eared Bat		
Vespadelus regulus	Southern Forest Bat	LC	
Muridae Rats, Mice			
Mus musculus	House Mouse	Introduced	
Rattus rattus	Black Rat	Introduced	
Canidae Dogs, Foxes			
Vulpes vulpes	Red Fox	Introduced	+
Felidae Cats			
Felis catus	Cat	Introduced	
Bovidae Horned Ruminants			
Bos taurus	European Cattle	Introduced	+
Leporidae Rabbits, Hares			
Oryctolagus cuniculus	Rabbit	Introduced	+

WC Act Status - S1 to S4, EPBC Act Status - EN = Endangered, VU = Vulnerable, EX = Extinct, DEC Priority Status - P1 to P5, Int. Agmts - CA = CAMBA, JA = JAMBA, RK = ROKAMBA, Bush Forever Decreaser Species - Bh = habitat specialists, Bp = wide ranging species, Be = extinct in Perth Coastal Plain Region. IUCN Red List Category Definitions LC = Least Concern - see Appendix A and http://www.iucnredlist.org/technical-documents/categories-and-criteria/2001-categories-criteria for others.

APPENDIX C

DEC & EPBC DATABASE SEARCH RESULTS

NatureMap - Invertebrates - Muchea

Created By Greg Harewood on 21/01/2013

Kingdom Animalia
Current Names Only Yes
Core Datasets Only Yes
Species Group Invertebrates
Method 'By Circle'
Centre 115°59' 52" E,31°33' 57" S
Buffer 20km

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
1.	-14000	*Allothereua maculata*			
2.	-14519	*Amblyomma triguttatum*			
3.	-14144	*Aname mainae*			
4.	-13324	*Aname tepperi*			
5.	-14278	*Antichiropus variabilis*			
6.	-13302	*Antichiropus whistleri*			
7.	-13654	*Araneus cyphoxis*			
8.	-14831	*Araneus senicaudatus*			
9.	33903	*Arbanitis inornatus (trapdoor spider)*		P1	
10.	-14175	*Aurecocrypta lugubris*			
11.	-13995	*Austracantha minax*			
12.	-13872	*Backobourkia brounii*			
13.	-13548	*Backobourkia heroine*			
14.	-13328	*Badumna insignis*			
15.	-14764	*Ballarra longipalpus*			
16.	-14146	*Cercophonius granulosus*			
17.	-14150	*Cormocephalus aurantiipes*			
18.	-14371	*Cormocephalus strigosus*			
19.	-14815	*Cormocephalus turneri*			
20.	-13563	*Dingosa serrata*			
21.	-14762	*Eriophora biapicata*			
22.	-14168	*Euoplos inornatus*			
23.	-13909	*Henicops dentatus*			
24.	-14741	*Holconia westralia*			
25.	33977	*Hylaeus globuliferus (bee)*		P3	
26.	-13557	*Idiommata blackwalli*			
27.	-14140	*Isopeda leishmanni*			
28.	33982	*Leioproctus contrarius (bee)*		P3	
29.	33983	*Leioproctus douglasiellus (bee)*		T	
30.	-13593	*Missulena granulosa subsp. granulosa*			
31.	-14517	*Mituliodon tarantulinus*			
32.	-13203	*Ommatoiulus moreletii*			
33.	-13757	*Pedidromus velox*			Y
34.	-14019	*Pholcus phalangioides*			
35.	-13904	*Scolopendra laeta*			
36.	-13193	*Supunna funerea*			
37.	-13178	*Synothele lowei*			Y
38.	-14380	*Synothele taurus*			Y
39.	-13561	*Tasmanicosa leuckartii*			
40.	-13850	*Trichocyclus nullarbor*			
41.	-14745	*Urodacus novaehollandiae*			
42.	-13948	*Venator immansueta*			
43.	-13345	*Venator koyuga*			

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

NatureMap - Fish - Muchea

Created By Greg Harewood on 21/01/2013

Kingdom	Animalia
Current Names Only	Yes
Core Datasets Only	Yes
Species Group	Fish
Method	'By Circle'
Centre	115°59' 52" E,31°33' 57" S
Buffer	20km

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
1.	-15522	*Atherinosoma wallacei*			
2.	-16834	*Bostockia porosa*			
3.	-15405	*Edelia vittata*			
4.	34026	*Galaxiella munda (Western Mud Minnow)*		T	
5.	-18499	*Gambusia sp.*			
6.	-15499	*Pseudogobius olorum*			

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

NatureMap - Frogs - Muchea

Created By Greg Harewood on 21/01/2013

Kingdom Animalia
Current Names Only Yes
Core Datasets Only Yes
Species Group Amphibians
Method 'By Circle'
Centre 115°59' 52" E,31°33' 57" S
Buffer 20km

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
1.	25398	*Crinia georgiana (Quacking Frog)*			
2.	25399	*Crinia glauerti (Clicking Frog)*			
3.	25400	*Crinia insignifera (Squelching Froglet)*			
4.	25401	*Crinia pseudinsignifera (Bleating Froglet)*			
5.	25404	*Geocrinia leai (Ticking Frog)*			
6.	25408	*Heleioporus albopunctatus (Western Spotted Frog)*			
7.	25409	*Heleioporus barycragus (Hooting Frog)*			
8.	25410	*Heleioporus eyrei (Moaning Frog)*			
9.	25411	*Heleioporus inornatus (Whooping Frog)*			
10.	25415	*Limnodynastes dorsalis (Western Banjo Frog)*			
11.	25378	*Litoria adelaidensis (Slender Tree Frog)*			
12.	25388	*Litoria moorei (Motorbike Frog)*			
13.	25426	*Neobatrachus pelobatoides (Humming Frog)*			
14.	25433	*Pseudophryne guentheri (Crawling Toadlet)*			

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

NatureMap - Reptiles - Muchea

Created By Greg Harewood on 21/01/2013

Kingdom Animalia
Current Names Only Yes
Core Datasets Only Yes
Species Group Reptiles
Method 'By Circle'
Centre 115°59' 52" E,31°33' 57" S
Buffer 20km

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
1.	-19786	*Acritoscincus trilineatus*			
2.	25241	*Antaresia stimsoni subsp. stimsoni*			
3.	24990	*Aprasia pulchella*			
4.	24991	*Aprasia repens*			
5.	-19511	*Brachyurophis fasciolatus subsp. fasciolatus*			
6.	-19669	*Brachyurophis semifasciatus*			
7.	25337	*Chelodina oblonga (Oblong Turtle)*			
8.	24918	*Crenadactylus ocellatus subsp. ocellatus*			
9.	30893	*Cryptoblepharus buchananii*			
10.	30899	*Ctenophorus adelaidensis (Southern Heath Dragons)*			
11.	30900	*Ctenophorus adelaidensis subsp. adelaidensis*			
12.	25027	*Ctenotus australis*			
13.	25039	*Ctenotus fallens*			
14.	25040	*Ctenotus gemmula (Jewelled South-west Ctenotus, skink (Swan Coastal Plain pop P3))*			
15.	25047	*Ctenotus impar*			
16.	25766	*Delma fraseri (Fraser's Legless Lizard)*			
17.	24999	*Delma grayii*			
18.	41403	*Diplodactylus calcicolus (South Coast Gecko)*			
19.	24929	*Diplodactylus granariensis subsp. granariensis*			
20.	25251	*Echiopsis curta (Bardick)*			
21.	25100	*Egernia napoleonis*			
22.	25250	*Elapognathus coronatus (Crowned Snake)*			
23.	24959	*Gehyra variegata*			
24.	25115	*Hemiergis initialis subsp. initialis*			
25.	25119	*Hemiergis quadrilineata*			
26.	25128	*Lerista christinae*			
27.	25133	*Lerista elegans*			
28.	25148	*Lerista lineopunctulata*			
29.	25165	*Lerista praepedita*			
30.	25005	*Lialis burtonis*			
31.	-19743	*Lucasium alboguttatum*			
32.	30937	*Lucasium alboguttatus*			
33.	25184	*Menetia greyii*			
34.	25240	*Morelia spilota subsp. imbricata (Carpet Python)*		S	
35.	25191	*Morethia lineoocellata*			
36.	25192	*Morethia obscura*			
37.	25248	*Neelaps bimaculatus (Black-naped Snake)*			
38.	25249	*Neelaps calonotos (Black-striped Snake)*		P3	
39.	30941	*Nephrurus milii (Barking Gecko)*			
40.	25252	*Notechis scutatus (Tiger Snake)*			
41.	25253	*Parasuta gouldii*			
42.	25255	*Parasuta nigriceps*			
43.	25509	*Pletholax gracilis (Keeled Legless Lizard)*			
44.	25007	*Pletholax gracilis subsp. gracilis*			
45.	25510	*Pogona minor*			
46.	24907	*Pogona minor subsp. minor*			
47.	25261	*Pseudechis australis (Mulga Snake)*			
48.	25345	*Pseudemydura umbrina (Western Swamp Turtle, tortoise)*		T	
49.	25259	*Pseudonaja affinis subsp. affinis (Dugite)*			
50.	25008	*Pygopus lepidopodus (Common Scaly Foot)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
51.	25271	*Ramphotyphlops australis*			
52.	25288	*Ramphotyphlops waitii*			
53.	25266	*Simoselaps bertholdi (Jan's Banded Snake)*			
54.	25518	*Strophurus spinigerus*			
55.	24943	*Strophurus spinigerus subsp. inornatus*			
56.	24942	*Strophurus spinigerus subsp. spinigerus*			
57.	25207	*Tiliqua rugosa subsp. rugosa*			

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

NatureMap - Birds - Muchea

Created By Greg Harewood on 21/01/2013

Kingdom Animalia
Current Names Only Yes
Core Datasets Only Yes
Species Group Birds
Method 'By Circle'
Centre 115°59' 52" E,31°33' 57" S
Buffer 20km

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
1.	24559	*Acanthagenys rufogularis (Spiny-cheeked Honeyeater)*			
2.	24260	*Acanthiza apicalis (Broad-tailed Thornbill)*			
3.	24261	*Acanthiza chrysorrhoa (Yellow-rumped Thornbill)*			
4.	24262	*Acanthiza inornata (Western Thornbill)*			
5.	24560	*Acanthorhynchus superciliosus (Western Spinebill)*			
6.	25535	*Accipiter cirrocephalus (Collared Sparrowhawk)*			
7.	25536	*Accipiter fasciatus (Brown Goshawk)*			
8.	25755	*Acrocephalus australis (Australian Reed Warbler)*			
9.	41323	*Actitis hypoleucos (Common Sandpiper)*		IA	
10.	25544	*Aegotheles cristatus (Australian Owlet-nightjar)*			
11.	24310	*Anas castanea (Chestnut Teal)*			
12.	24312	*Anas gracilis (Grey Teal)*			
13.	24315	*Anas rhynchotis (Australasian Shoveler)*			
14.	24316	*Anas superciliosa (Pacific Black Duck)*			
15.	24561	*Anthochaera carunculata (Red Wattlebird)*			
16.	24562	*Anthochaera lunulata (Western Little Wattlebird)*			
17.	24599	*Anthus australis subsp. australis*			
18.	24285	*Aquila audax (Wedge-tailed Eagle)*			
19.	24286	*Aquila morphnoides subsp. morphnoides*			
20.	24341	*Ardea pacifica (White-necked Heron)*			
21.	25566	*Artamus cinereus (Black-faced Woodswallow)*			
22.	24353	*Artamus cyanopterus (Dusky Woodswallow)*			
23.	24318	*Aythya australis (Hardhead)*			
24.	24319	*Biziura lobata (Musk Duck)*			
25.	24345	*Botaurus poiciloptilus (Australasian Bittern)*		T	
26.	25713	*Cacatua galerita (Sulphur-crested Cockatoo)*			
27.	24721	*Cacatua galerita subsp. galerita*	Y		
28.	25714	*Cacatua pastinator (Western Long-billed Corella)*			
29.	25715	*Cacatua roseicapilla (Galah)*			
30.	25716	*Cacatua sanguinea (Little Corella)*			
31.	24729	*Cacatua tenuirostris (Eastern Long-billed Corella)*	Y		
32.	25598	*Cacomantis flabelliformis (Fan-tailed Cuckoo)*			
33.	25717	*Calyptorhynchus banksii (Red-tailed Black-Cockatoo)*			
34.	24734	*Calyptorhynchus latirostris (Carnaby's Cockatoo (short-billed black-cockatoo))*		T	
35.	24321	*Chenonetta jubata (Australian Wood Duck)*			
36.	25601	*Chrysococcyx lucidus (Shining Bronze Cuckoo)*			
37.	24432	*Chrysococcyx lucidus subsp. plagosus*			
38.	24833	*Cincloramphus cruralis (Brown Songlark)*			
39.	24834	*Cincloramphus mathewsi (Rufous Songlark)*			
40.	24288	*Circus approximans (Swamp Harrier)*			
41.	24396	*Climacteris rufa (Rufous Treecreeper)*			
42.	25675	*Colluricincla harmonica (Grey Shrike-thrush)*			
43.	25568	*Coracina novaehollandiae (Black-faced Cuckoo-shrike)*			
44.	24416	*Corvus bennetti (Little Crow)*			
45.	25592	*Corvus coronoides (Australian Raven)*			
46.	24417	*Corvus coronoides subsp. perplexus*			
47.	24671	*Coturnix pectoralis (Stubble Quail)*			
48.	24420	*Cracticus nigrogularis (Pied Butcherbird)*			
49.	25595	*Cracticus tibicen (Australian Magpie)*			
50.	25596	*Cracticus torquatus (Grey Butcherbird)*			
51.	24322	*Cygnus atratus (Black Swan)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
52.	30901	*Dacelo novaeguineae (Laughing Kookaburra)*	Y		
53.	25673	*Daphoenositta chrysoptera (Varied Sittella)*			
54.	25607	*Dicaeum hirundinaceum (Mistletoebird)*			
55.	24470	*Dromaius novaehollandiae (Emu)*			
56.	24290	*Elanus caeruleus subsp. axillaris (Australian Black-shouldered Kite)*			
57.	24567	*Epthianura albifrons (White-fronted Chat)*			
58.	25621	*Falco berigora (Brown Falcon)*			
59.	25622	*Falco cenchroides (Australian Kestrel)*			
60.	25623	*Falco longipennis (Australian Hobby)*			
61.	25624	*Falco peregrinus (Peregrine Falcon)*		S	
62.	25727	*Fulica atra (Eurasian Coot)*			
63.	25729	*Gallinula tenebrosa (Dusky Moorhen)*			
64.	25530	*Gerygone fusca (Western Gerygone)*			
65.	24735	*Glossopsitta porphyrocephala (Purple-crowned Lorikeet)*			
66.	24443	*Grallina cyanoleuca (Magpie-lark)*			
67.	24295	*Haliastur sphenurus (Whistling Kite)*			
68.	25734	*Himantopus himantopus (Black-winged Stilt)*			
69.	24491	*Hirundo neoxena (Welcome Swallow)*			
70.	24492	*Hirundo nigricans subsp. nigricans*			
71.	24577	*Lichenostomus ornatus (Yellow-plumed Honeyeater)*			
72.	24581	*Lichenostomus virescens (Singing Honeyeater)*			
73.	25661	*Lichmera indistincta (Brown Honeyeater)*			
74.	24326	*Malacorhynchus membranaceus (Pink-eared Duck)*			
75.	25651	*Malurus lamberti (Variegated Fairy-wren)*			
76.	25652	*Malurus leucopterus (White-winged Fairy-wren)*			
77.	25654	*Malurus splendens (Splendid Fairy-wren)*			
78.	24583	*Manorina flavigula (Yellow-throated Miner)*			
79.	25758	*Megalurus gramineus (Little Grassbird)*			
80.	25663	*Melithreptus brevirostris (Brown-headed Honeyeater)*			
81.	24736	*Melopsittacus undulatus (Budgerigar)*			
82.	24598	*Merops ornatus (Rainbow Bee-eater)*		IA	
83.	25610	*Myiagra inquieta (Restless Flycatcher)*			
84.	24738	*Neophema elegans (Elegant Parrot)*			
85.	25748	*Ninox novaeseelandiae (Boobook Owl)*			
86.	24820	*Ninox novaeseelandiae subsp. boobook (Boobook Owl)*			
87.	25564	*Nycticorax caledonicus (Rufous Night Heron)*			
88.	24407	*Ocyphaps lophotes (Crested Pigeon)*			
89.	24328	*Oxyura australis (Blue-billed Duck)*			
90.	25679	*Pachycephala pectoralis (Golden Whistler)*			
91.	24623	*Pachycephala pectoralis subsp. fuliginosa*			
92.	25680	*Pachycephala rufiventris (Rufous Whistler)*			
93.	25681	*Pardalotus punctatus (Spotted Pardalote)*			
94.	24626	*Pardalotus punctatus subsp. xanthopyge (Yellow-rumped Pardalote)*			
95.	25682	*Pardalotus striatus (Striated Pardalote)*			
96.	24648	*Pelecanus conspicillatus (Australian Pelican)*			
97.	24659	*Petroica goodenovii (Red-capped Robin)*			
98.	25697	*Phalacrocorax carbo (Great Cormorant)*			
99.	25698	*Phalacrocorax melanoleucos (Little Pied Cormorant)*			
100.	24666	*Phalacrocorax melanoleucos subsp. melanoleucos*			
101.	-15209	*Phalacrocorax sp.*			
102.	24667	*Phalacrocorax sulcirostris (Little Black Cormorant)*			
103.	25699	*Phalacrocorax varius (Pied Cormorant)*			
104.	24409	*Phaps chalcoptera (Common Bronzewing)*			
105.	24595	*Phylidonyris nigra subsp. gouldii*			
106.	24596	*Phylidonyris novaehollandiae (New Holland Honeyeater)*			
107.	24841	*Platalea flavipes (Yellow-billed Spoonbill)*			
108.	25720	*Platycercus icterotis (Western Rosella)*			
109.	24747	*Platycercus spurius (Red-capped Parrot)*			
110.	25721	*Platycercus zonarius (Australian Ringneck)*			
111.	24750	*Platycercus zonarius subsp. semitorquatus (Twenty-eight Parrot)*			
112.	24751	*Platycercus zonarius subsp. zonarius*			
113.	24843	*Plegadis falcinellus (Glossy Ibis)*		IA	
114.	25703	*Podargus strigoides (Tawny Frogmouth)*			
115.	24679	*Podargus strigoides subsp. brachypterus*			
116.	25704	*Podiceps cristatus (Great Crested Grebe)*			
117.	24681	*Poliocephalus poliocephalus (Hoary-headed Grebe)*			
118.	30854	*Polytelis anthopeplus subsp. westralis*			
119.	25731	*Porphyrio porphyrio (Purple Swamphen)*			
120.	25613	*Rhipidura fuliginosa (Grey Fantail)*			
121.	24452	*Rhipidura fuliginosa subsp. preissi*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
122.	25614	*Rhipidura leucophrys (Willie Wagtail)*			
123.	25534	*Sericornis frontalis (White-browed Scrubwren)*			
124.	30948	*Smicrornis brevirostris (Weebill)*			
125.	24645	*Stagonopleura oculata (Red-eared Firetail)*			
126.	25597	*Strepera versicolor (Grey Currawong)*			
127.	25590	*Streptopelia senegalensis (Laughing Turtle-Dove)*	Y		
128.	25705	*Tachybaptus novaehollandiae (Australasian Grebe)*			
129.	24331	*Tadorna tadornoides (Australian Shelduck)*			
130.	24844	*Threskiornis molucca (Australian White Ibis)*			
131.	24845	*Threskiornis spinicollis (Straw-necked Ibis)*			
132.	25549	*Todiramphus sanctus (Sacred Kingfisher)*			
133.	25723	*Trichoglossus haematodus (Rainbow Lorikeet)*			
134.	24851	*Turnix velox (Little Button-quail)*			
135.	24852	*Tyto alba subsp. delicatula (Barn Owl)*			
136.	25765	*Zosterops lateralis (Grey-breasted White-eye)*			

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

NatureMap - Mammals - Muchea

Created By Greg Harewood on 21/01/2013

Kingdom Animalia
Current Names Only Yes
Core Datasets Only Yes
Species Group Mammals
Method 'By Circle'
Centre 115°59' 52" E,31°33' 57" S
Buffer 20km

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
1.	24086	*Cercartetus concinnus (Western Pygmy-possum)*			
2.	24092	*Dasyurus geoffroii (Chuditch, Western Quoll)*		T	
3.	24041	*Felis catus (Cat)*	Y		
4.	24153	*Isoodon obesulus subsp. fusciventer (Quenda, Southern Brown Bandicoot)*		P5	
5.	24131	*Macropus eugenii subsp. derbianus (Tammar Wallaby (WA subsp))*		P5	
6.	24132	*Macropus fuliginosus (Western Grey Kangaroo)*			
7.	24133	*Macropus irma (Western Brush Wallaby)*		P4	
8.	24135	*Macropus robustus subsp. erubescens (Euro)*			
9.	24223	*Mus musculus (House Mouse)*	Y		
10.	24229	*Notomys mitchellii (Mitchell's Hopping-mouse)*			
11.	24195	*Nyctophilus gouldi (Gould's Long-eared Bat)*			
12.	24142	*Petrogale lateralis subsp. lateralis (Black-flanked Rock-wallaby, Black-footed Rock-wallaby)*		T	
13.	24099	*Phascogale tapoatafa subsp. tapoatafa (Southern Brush-tailed Phascogale, Wambenger)*		T	
14.	24230	*Pseudomys albocinereus (Ash-grey Mouse)*			
15.	24245	*Rattus rattus (Black Rat)*	Y		
16.	24207	*Tachyglossus aculeatus (Echidna)*			
17.	24167	*Tarsipes rostratus (Honey Possum)*			
18.	24206	*Vespadelus regulus (Southern Forest Bat)*			
19.	24040	*Vulpes vulpes (Red Fox)*	Y		

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

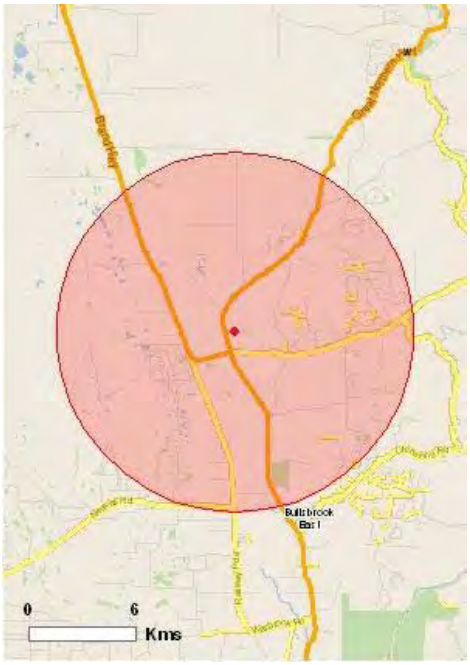
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

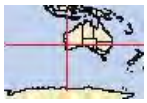
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 21/01/13 20:01:43



Coordinates
Buffer: 10.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Listed Threatened Ecological Communities:	4
Listed Threatened Species:	26
Listed Migratory Species:	9

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate.

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	9
Commonwealth Heritage Places:	1
Listed Marine Species:	6
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

Place on the RNE:	5
State and Territory Reserves:	6
Regional Forest Agreements:	1
Invasive Species:	18
Nationally Important Wetlands:	1
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Corymbia calophylla - Xanthorrhoea preissii woodlands and shrublands of the Swan Coastal Plain	Endangered	Community known to occur within area
Assemblages of plants and invertebrate animals of tumulus (organic mound) springs of the Swan Coastal Plain	Endangered	Community known to occur within area
Claypans of the Swan Coastal Plain	Critically Endangered	Community likely to occur within area
Shrublands and Woodlands on Muchea Limestone of the Swan Coastal Plain	Endangered	Community known to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Calyptorhynchus banksii naso		
Forest Red-tailed Black-Cockatoo [67034]	Vulnerable	Species or species habitat may occur within area
Calyptorhynchus latirostris		
Carnaby's Black-Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Breeding likely to occur within area
Leipoa ocellata		
Malleefowl [934]	Vulnerable	Species or species habitat may occur within area
Rostratula australis		
Australian Painted Snipe [77037]	Vulnerable	Species or species habitat may occur within area
Insects		
Synemon gratiosa		
Graceful Sun Moth [66757]	Endangered	Species or species habitat may occur within area
Mammals		

Name	Status	Type of Presence
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat likely to occur within area
Plants		
Acacia anomala Grass Wattle, Chittering Grass Wattle [8153]	Vulnerable	Species or species habitat likely to occur within area
Andersonia gracilis Slender Andersonia [14470]	Endangered	Species or species habitat likely to occur within area
Centrolepis caespitosa [6393]	Endangered	Species or species habitat likely to occur within area
Chamelaucium sp. Gingin (N.G.Marchant 6) Gingin Wax [64649]	Endangered	Species or species habitat known to occur within area
Conospermum densiflorum subsp. unicephalatum One-headed Smokebush [64871]	Endangered	Species or species habitat may occur within area
Darwinia foetida Muchea Bell [83190]	Critically Endangered	Species or species habitat known to occur within area
Diuris micrantha Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat may occur within area
Diuris purdiei Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat may occur within area
Drakaea elastica Glossy-leaved Hammer-orchid, Praying Virgin [16753]	Endangered	Species or species habitat likely to occur within area
Epiblema grandiflorum var. cyaneum Baby Blue Orchid, Blue Babe-in-the-cradle Orchid, Blue Babe-in-a-cradle [67182]	Endangered	Species or species habitat may occur within area
Eucalyptus balanites Cadda Road Mallee, Cadda Mallee [24264]	Endangered	Species or species habitat may occur within area
Eucalyptus leprophloia Scaly Butt Mallee, Scaly-butt Mallee [56712]	Endangered	Species or species habitat may occur within area
Grevillea althoferorum [64906]	Endangered	Species or species habitat likely to occur within area
Grevillea curviloba subsp. curviloba Curved-leaf Grevillea [64908]	Endangered	Species or species habitat likely to occur within area
Grevillea curviloba subsp. incurva Narrow curved-leaf Grevillea [64909]	Endangered	Species or species habitat known to occur within area
Lepidosperma rostratum Beaked Lepidosperma [14152]	Endangered	Species or species habitat likely to occur within area
Thelymitra manginii K.Dixon & Batty ms. [67443]	Endangered	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Thelymitra stellata		
Star Sun-orchid [7060]	Endangered	Species or species habitat likely to occur within area
Verticordia plumosa var. pleiobotrya		
Narrow-petalled Featherflower [55803]	Endangered	Species or species habitat likely to occur within area
Villarsia calthifolia		
Mountain Villarsia [10886]	Endangered	Species or species habitat likely to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Migratory Terrestrial Species		
Haliaeetus leucogaster		
White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Leipoa ocellata		
Malleefowl [934]	Vulnerable	Species or species habitat may occur within area
Merops ornatus		
Rainbow Bee-eater [670]		Species or species habitat may occur within area
Migratory Wetlands Species		
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato)		
Painted Snipe [889]	Vulnerable*	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -
Defence - MUCHEA ARMAMENT RANGE
Defence - PEARCE - AP15 WATER TREATMENT PLANT
Defence - PEARCE - AP19 HF RECEIVER STATION BULLSBROOK
Defence - PEARCE - AP2 OBSTRUCTION BEACON NO.2
Defence - PEARCE - AP4 AERIAL FARM
Defence - PEARCE - AP6 OBSTRUCTION BEACON NO.3

Name
Defence - PEARCE - AP8 BORE SITES
Defence - PEARCE - RAAF BASE

Commonwealth Heritage Places [Resource Information]

Name	State	Status
Natural		
Muchea / Pearce Air Weapons Range	WA	Indicative Place

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Haliaeetus leucogaster		
White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Merops ornatus		
Rainbow Bee-eater [670]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato)		
Painted Snipe [889]	Vulnerable*	Species or species habitat may occur within area

Extra Information

Places on the RNE [Resource Information]

Note that not all Indigenous sites may be listed.

Name	State	Status
Natural		
Bullsbrook Nature Reserves	WA	Indicative Place
Muchea / Pearce Air Weapons Range	WA	Indicative Place
Pearce Aerodrome & Adjacent Bushland	WA	Indicative Place
Lake Chandala Area	WA	Registered
Yeal - Gnangara Area	WA	Registered

State and Territory Reserves [Resource Information]

Name	State
Barracca	WA
Bullsbrook	WA
Chandala	WA
Unnamed WA2336	WA
Unnamed WA44622	WA
Unnamed WA46564	WA

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included.

Name	State
South West WA RFA	Western Australia

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Mammals		
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Brachiaria mutica Para Grass [5879]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat may occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area

Nationally Important Wetlands [Resource Information]

Name	State
Chandala Swamp	WA

Coordinates

-31.56686 115.99812

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Department of Environment, Climate Change and Water, New South Wales
-Department of Sustainability and Environment, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment and Natural Resources, South Australia
-Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts
-Environmental and Resource Management, Queensland
-Department of Environment and Conservation, Western Australia
-Department of the Environment, Climate Change, Energy and Water
-Birds Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-SA Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Atherton and Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
-State Forests of NSW
-Geoscience Australia
-CSIRO
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

Department of Sustainability, Environment, Water, Population and Communities
GPO Box 787
Canberra ACT 2601 Australia
+61 2 6274 1111

APPENDIX D

HABITAT TREE DETAILS

Habitat Details
Datum: GDA94

Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	Number of Hollows	Hollow Type 1	Hollow Size 1 (cm)	Hollow Type 2	Hollow Size 2 (cm)	Hollow Type 3	Hollow Size 3 (cm)	Hollow Type 4	Hollow Size 4 (cm)	Hollow Type 5	Hollow Size 5 (cm)	Occupancy	Chew Marks	Potential Cockatoo Nest Hollow	Comments
wpt004	50J	404722	6506269	Marri	5-10	0											No Signs	No Signs	No	
wpt005	50J	404731	6506277	Marri	15-20	0											No Signs	No Signs	No	
wpt006	50J	404749	6506251	Marri	15-20	0											No Signs	No Signs	No	
wpt007	50J	404757	6506267	Marri	15-20	0											No Signs	No Signs	No	
wpt008	50J	404779	6506266	Marri	15-20	0											No Signs	No Signs	No	
wpt009	50J	404780	6506265	Marri	15-20	0											No Signs	No Signs	No	
wpt010	50J	404792	6506263	Marri	15-20	2	Fissure	5-12	Knot Hole	5-12							No Signs	No Signs	No	
wpt011	50J	404802	6506262	Marri	15-20	0											No Signs	No Signs	No	
wpt012	50J	404748	6506313	Marri	15-20	0											No Signs	No Signs	No	
wpt013	50J	404700	6506320	Marri	15-20	1	Knot Hole	20+									No Signs	No Signs	Yes	Depth of hollow unknown
wpt014	50J	404696	6506319	Marri	15-20	0											No Signs	No Signs	No	
wpt015	50J	404696	6506322	Marri	15-20	0											No Signs	No Signs	No	
wpt016	50J	404681	6506309	Marri	15-20	0											No Signs	No Signs	No	
wpt017	50J	404679	6506318	Marri	15-20	0											No Signs	No Signs	No	
wpt018	50J	404728	6506368	Marri	15-20	0											No Signs	No Signs	No	
wpt019	50J	404729	6506375	Marri	15-20	0											No Signs	No Signs	No	
wpt020	50J	404768	6506380	Marri	20+	0											No Signs	No Signs	No	
wpt021	50J	404776	6506411	Marri	20+	0											No Signs	No Signs	No	
wpt022	50J	404786	6506357	Marri	20+	0											No Signs	No Signs	No	
wpt023	50J	404864	6506311	Marri	20+	0											No Signs	No Signs	No	
wpt024	50J	404873	6506319	Marri	15-20	0											No Signs	No Signs	No	
wpt025	50J	404898	6506368	Marri	15-20	0											No Signs	No Signs	No	
wpt026	50J	404898	6506371	Marri	15-20	0											No Signs	No Signs	No	
wpt027	50J	404929	6506435	Marri	20+	0											No Signs	No Signs	No	
wpt028	50J	404858	6506484	Marri	20+	0											No Signs	No Signs	No	
wpt029	50J	404856	6506490	Marri	20+	0											No Signs	No Signs	No	
wpt030	50J	404852	6506499	Marri	20+	0											No Signs	No Signs	No	
wpt031	50J	404883	6506505	Marri	20+	0											No Signs	No Signs	No	
wpt032	50J	404919	6506514	Marri	20+	0											No Signs	No Signs	No	
wpt033	50J	404900	6506566	Marri	20+	0											No Signs	No Signs	No	
wpt034	50J	404953	6506547	Marri	20+	0											No Signs	No Signs	No	
wpt035	50J	404950	6506522	Marri	20+	0											No Signs	No Signs	No	
wpt036	50J	404941	6506484	Marri	20+	0											No Signs	No Signs	No	
wpt037	50J	404954	6506478	Marri	20+	0											No Signs	No Signs	No	
wpt038	50J	404954	6506454	Marri	20+	0											No Signs	No Signs	No	
wpt039	50J	405020	6506444	Marri	20+	3	Knot Hole	<5	Branch	5-12	Branch	5-12					Bees	No Signs	No	
wpt040	50J	405065	6506389	Marri	15-20	0											No Signs	No Signs	No	
wpt041	50J	405096	6506314	Dead Unknown	20+	5+	Branch	5-12	Branch	12-20	Branch	20+	Branch	5-12	Branch	12-20	No Signs	No Signs	Yes	Depth of hollow unknown
wpt042	50J	405000	6506220	Marri	15-20	0											No Signs	No Signs	No	
wpt043	50J	405034	6506195	Marri	15-20	0											No Signs	No Signs	No	
wpt044	50J	405056	6506168	Marri	15-20	0											No Signs	No Signs	No	
wpt045	50J	405111	6506204	Marri	15-20	0											No Signs	No Signs	No	
wpt046	50J	405145	6506237	Marri	15-20	0											No Signs	No Signs	No	
wpt047	50J	405224	6506183	Dead Marri	20+	5+	Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	No Signs	No Signs	No	
wpt048	50J	405237	6506168	Dead Marri	20+	0											No Signs	No Signs	No	
wpt049	50J	405270	6506161	Marri	15-20	0											No Signs	No Signs	No	
wpt050	50J	405278	6506215	Marri	20+	0											No Signs	No Signs	No	
wpt051	50J	405245	6506226	Marri	20+	0											No Signs	No Signs	No	
wpt052	50J	405243	6506245	Marri	15-20	0											No Signs	No Signs	No	

Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	Number of Hollows	Hollow Type 1	Hollow Size 1 (cm)	Hollow Type 2	Hollow Size 2 (cm)	Hollow Type 3	Hollow Size 3 (cm)	Hollow Type 4	Hollow Size 4 (cm)	Hollow Type 5	Hollow Size 5 (cm)	Occupancy	Chew Marks	Potential Cockatoo Nest Hollow	Comments
wpt053	50J	405242	6506257	Marri	20+	0											No Signs	No Signs	No	
wpt054	50J	405273	6506289	Marri	20+	0											No Signs	No Signs	No	
wpt055	50J	405238	6506298	Marri	20+	0											No Signs	No Signs	No	
wpt056	50J	405243	6506310	Marri	15-20	0											No Signs	No Signs	No	
wpt057	50J	405178	6506368	Marri	15-20	0											No Signs	No Signs	No	
wpt058	50J	405179	6506387	Marri	15-20	0											No Signs	No Signs	No	
wpt059	50J	405260	6506408	Jarrah	15-20	0											No Signs	No Signs	No	
wpt060	50J	405256	6506423	Jarrah	15-20	0											No Signs	No Signs	No	
wpt061	50J	405246	6506434	Marri	15-20	0											No Signs	No Signs	No	
wpt062	50J	405241	6506428	Jarrah	15-20	0											No Signs	No Signs	No	
wpt063	50J	405253	6506459	Marri	15-20	0											No Signs	No Signs	No	
wpt064	50J	405216	6506484	Marri	20+	0											No Signs	No Signs	No	
wpt065	50J	405192	6506462	Jarrah	20+	0											No Signs	No Signs	No	
wpt066	50J	405173	6506486	Jarrah	20+	0											No Signs	No Signs	No	
wpt067	50J	405150	6506490	Jarrah	15-20	0											No Signs	No Signs	No	
wpt068	50J	405189	6506490	Marri	20+	0											No Signs	No Signs	No	
wpt069	50J	405197	6506502	Jarrah	15-20	0											No Signs	No Signs	No	
wpt070	50J	405210	6506535	Marri	20+	0											No Signs	No Signs	No	
wpt071	50J	405221	6506525	Marri	20+	0											No Signs	No Signs	No	
wpt072	50J	405244	6506537	Coastal Blackbutt	10-15	0											No Signs	No Signs	No	
wpt073	50J	405253	6506552	Coastal Blackbutt	10-15	0											No Signs	No Signs	No	
wpt074	50J	405252	6506559	Coastal Blackbutt	10-15	0											No Signs	No Signs	No	
wpt075	50J	405270	6506558	Marri	15-20	0											No Signs	No Signs	No	
wpt076	50J	405264	6506581	Marri	15-20	0											No Signs	No Signs	No	
wpt077	50J	405282	6506615	Jarrah	15-20	5+	Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	No Signs	No Signs	No	
wpt078	50J	405224	6506628	Marri	20+	0											No Signs	No Signs	No	
wpt079	50J	405188	6506650	Jarrah	15-20	0											No Signs	No Signs	No	
wpt080	50J	405150	6506669	Dead Unknown	15-20	5+	Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	No Signs	No Signs	No	
wpt081	50J	405129	6506688	Dead Unknown	15-20	5+	Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	No Signs	No Signs	No	
wpt082	50J	405078	6506646	Jarrah	20+	1	Knot Hole	20+									No Signs	No Signs	Yes	Depth of hollow unknown
wpt083	50J	405105	6506563	Marri	20+	0											No Signs	No Signs	No	
wpt084	50J	405052	6506588	Marri	15-20	0											No Signs	No Signs	No	
wpt085	50J	404967	6506637	Marri	15-20	0											No Signs	No Signs	No	
wpt086	50J	404929	6506686	Dead Unknown	20+	0											No Signs	No Signs	No	
wpt087	50J	404938	6506729	Dead Unknown	20+	0											No Signs	No Signs	No	
wpt088	50J	404970	6506706	Marri	15-20	0											No Signs	No Signs	No	
wpt089	50J	404997	6506699	Marri	15-20	0											No Signs	No Signs	No	
wpt090	50J	405179	6506746	Marri	15-20	0											No Signs	No Signs	No	
wpt091	50J	405200	6506807	Coastal Blackbutt	15-20	0											No Signs	No Signs	No	
wpt092	50J	405249	6506872	Dead Unknown	15-20	5+	Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	No Signs	No Signs	No	
wpt093	50J	405268	6506862	Dead Jarrah	15-20	2	Branch	5-12	Branch	5-12							No Signs	No Signs	No	
wpt094	50J	405282	6506866	Jarrah	15-20	0											No Signs	No Signs	No	
wpt095	50J	405273	6506921	Jarrah	15-20	0											No Signs	No Signs	No	
wpt096	50J	405229	6506946	Marri	20+	0											No Signs	No Signs	No	
wpt097	50J	405214	6506965	Marri	20+	0											No Signs	No Signs	No	
wpt098	50J	405194	6506958	Marri	20+	1	Spout Trunk	20+									No Signs	No Signs	Yes	Depth of hollow unknown
wpt099	50J	405180	6506978	Coastal Blackbutt	15-20	0											No Signs	No Signs	No	
wpt100	50J	405178	6506978	Coastal Blackbutt	15-20	0											No Signs	No Signs	No	
wpt101	50J	405212	6507008	Coastal Blackbutt	15-20	0											No Signs	No Signs	No	
wpt102	50J	405259	6507018	Coastal Blackbutt	15-20	0											No Signs	No Signs	No	
wpt103	50J	405274	6507010	Coastal Blackbutt	15-20	0											No Signs	No Signs	No	
wpt104	50J	405279	6507026	Coastal Blackbutt	15-20	0											No Signs	No Signs	No	
wpt105	50J	405238	6507051	Coastal Blackbutt	15-20	0											No Signs	No Signs	No	

Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	Number of Hollows	Hollow Type 1	Hollow Size 1 (cm)	Hollow Type 2	Hollow Size 2 (cm)	Hollow Type 3	Hollow Size 3 (cm)	Hollow Type 4	Hollow Size 4 (cm)	Hollow Type 5	Hollow Size 5 (cm)	Occupancy	Chew Marks	Potential Cockatoo Nest Hollow	Comments
wpt106	50J	405213	6507053	Marri	20+	0											No Signs	No Signs	No	
wpt107	50J	405220	6507028	Coastal Blackbutt	15-20	3	Branch	5-12	Branch	5-12	Branch	5-12					No Signs	No Signs	No	
wpt108	50J	405205	6507043	Coastal Blackbutt	15-20	0											No Signs	No Signs	No	
wpt109	50J	405178	6507044	Marri	15-20	0											No Signs	No Signs	No	
wpt110	50J	405185	6507058	Coastal Blackbutt	10-15	0											No Signs	No Signs	No	
wpt111	50J	405196	6507088	Coastal Blackbutt	10-15	0											No Signs	No Signs	No	
wpt112	50J	405234	6507092	Jarrah	20+	0											No Signs	No Signs	No	
wpt113	50J	405246	6507093	Jarrah	20+	0											No Signs	No Signs	No	
wpt114	50J	405248	6507099	Jarrah	20+	0											No Signs	No Signs	No	
wpt115	50J	405266	6507091	Jarrah	20+	0											No Signs	No Signs	No	
wpt116	50J	405251	6507070	Marri	20+	0											No Signs	No Signs	No	
wpt117	50J	405270	6507061	Marri	20+	0											No Signs	No Signs	No	
wpt118	50J	405260	6507115	Jarrah	20+	0											No Signs	No Signs	No	
wpt119	50J	405277	6507133	Jarrah	20+	0											No Signs	No Signs	No	
wpt120	50J	405276	6507162	Dead Unknown	20+	1	Branch	5-12									No Signs	No Signs	No	
wpt121	50J	405278	6507171	Jarrah	20+	0											No Signs	No Signs	No	
wpt122	50J	405259	6507186	Coastal Blackbutt	10-15	0											No Signs	No Signs	No	
wpt123	50J	405280	6507193	Marri	20+	0											No Signs	No Signs	No	
wpt124	50J	405282	6507207	Marri	20+	0											No Signs	No Signs	No	
wpt125	50J	405268	6507207	Coastal Blackbutt	10-15	0											No Signs	No Signs	No	
wpt126	50J	405259	6507217	Dead Unknown	10-15	1	Spout Trunk	20+									No Signs	No Signs	Yes	Depth of hollow unknown
wpt127	50J	405280	6507275	Marri	20+	1	Knot Hole	5-12									Bees	No Signs	No	
wpt128	50J	405265	6507283	Marri	20+	0											No Signs	No Signs	No	
wpt129	50J	405259	6507316	Marri	20+	0											No Signs	No Signs	No	
wpt130	50J	405257	6507320	Marri	20+	0											No Signs	No Signs	No	
wpt131	50J	405257	6507318	Dead Unknown	10-15	5+	Spout Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	No Signs	No Signs	No	
wpt132	50J	405273	6507320	Dead Unknown	20+	5+	Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	No Signs	No Signs	No	
wpt133	50J	405229	6507377	Marri	20+	0											No Signs	No Signs	No	
wpt134	50J	405243	6507408	Marri	20+	0											No Signs	No Signs	No	
wpt135	50J	405276	6507420	Marri	20+	0											No Signs	No Signs	No	
wpt136	50J	405278	6507432	Jarrah	20+	0											No Signs	No Signs	No	
wpt137	50J	405282	6507433	Jarrah	20+	0											No Signs	No Signs	No	
wpt138	50J	405276	6507460	Marri	15-20	2	Knot Hole	5-12	Spout Trunk	20+							No Signs	No Signs	Yes	Depth of hollow unknown
wpt139	50J	405274	6507487	Jarrah	20+	5+	Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	No Signs	No Signs	No	
wpt140	50J	405273	6507515	Marri	15-20	0											No Signs	No Signs	No	
wpt141	50J	405282	6507527	Marri	15-20	0											No Signs	No Signs	No	
wpt142	50J	405279	6507533	Marri	15-20	0											No Signs	No Signs	No	
wpt143	50J	405264	6507571	Marri	15-20	0											No Signs	No Signs	No	
wpt144	50J	405256	6507583	Marri	15-20	0											No Signs	No Signs	No	
wpt145	50J	405258	6507587	Marri	15-20	0											No Signs	No Signs	No	
wpt146	50J	405281	6507619	Marri	15-20	0											No Signs	No Signs	No	
wpt147	50J	405276	6507665	Marri	15-20	0											No Signs	No Signs	No	
wpt148	50J	405278	6507680	Marri	15-20	0											No Signs	No Signs	No	
wpt149	50J	405283	6507692	Marri	15-20	0											No Signs	No Signs	No	
wpt150	50J	405272	6507702	Dead Unknown	15-20	5+	Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	No Signs	No Signs	No	
wpt151	50J	405269	6507734	Marri	15-20	0											No Signs	No Signs	No	
wpt152	50J	405287	6507782	Wandoo	15-20	1	Branch	5-12									No Signs	No Signs	No	
wpt153	50J	405265	6507810	Wandoo	15-20	1	Spout Branch	5-12									No Signs	No Signs	No	
wpt154	50J	405243	6507817	Wandoo	20+	0											No Signs	No Signs	No	
wpt155	50J	405209	6507821	Wandoo	20+	0											No Signs	No Signs	No	
wpt156	50J	405202	6507813	Wandoo	20+	0											No Signs	No Signs	No	
wpt157	50J	405208	6507805	Wandoo	20+	0											No Signs	No Signs	No	
wpt158	50J	405226	6507758	Wandoo	20+	0											No Signs	No Signs	No	

Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	Number of Hollows	Hollow Type 1	Hollow Size 1 (cm)	Hollow Type 2	Hollow Size 2 (cm)	Hollow Type 3	Hollow Size 3 (cm)	Hollow Type 4	Hollow Size 4 (cm)	Hollow Type 5	Hollow Size 5 (cm)	Occupancy	Chew Marks	Potential Cockatoo Nest Hollow	Comments
wpt159	50J	405190	6507750	Marri	15-20	0											No Signs	No Signs	No	
wpt160	50J	405157	6507812	Marri	15-20	0											No Signs	No Signs	No	
wpt161	50J	405149	6507846	Marri	15-20	0											No Signs	No Signs	No	
wpt162	50J	405235	6507872	Wandoo	20+	0											No Signs	No Signs	No	
wpt163	50J	405064	6507867	Wandoo	20+	0											No Signs	No Signs	No	
wpt164	50J	405061	6507874	Wandoo	15-20	1	Knot Hole	5-12									No Signs	No Signs	No	
wpt165	50J	405063	6507934	Wandoo	20+	0											No Signs	No Signs	No	
wpt166	50J	405062	6507938	Wandoo	20+	0											No Signs	No Signs	No	
wpt167	50J	405037	6507998	Wandoo	20+	0											No Signs	No Signs	No	
wpt168	50J	405031	6508002	Wandoo	20+	0											No Signs	No Signs	No	
wpt169	50J	405033	6507983	Wandoo	20+	0											No Signs	No Signs	No	
wpt170	50J	405006	6507953	Wandoo	20+	0											No Signs	No Signs	No	
wpt171	50J	405027	6507937	Marri	15-20	0											No Signs	No Signs	No	
wpt172	50J	405015	6507911	Wandoo	20+	0											No Signs	No Signs	No	
wpt173	50J	405014	6507880	Wandoo	20+	0											No Signs	No Signs	No	
wpt174	50J	404993	6507885	Wandoo	20+	0											No Signs	No Signs	No	
wpt175	50J	404998	6507893	Wandoo	20+	0											No Signs	No Signs	No	
wpt176	50J	404987	6507860	Marri	15-20	0											No Signs	No Signs	No	
wpt177	50J	404956	6507861	Dead Unknown	20+	5+	Spout Trunk	20+	Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	Bees	No Signs	Yes	Depth of hollow unknown
wpt178	50J	404907	6507858	Wandoo	20+	0											No Signs	No Signs	No	
wpt179	50J	404977	6507950	Marri	15-20	0											No Signs	No Signs	No	
wpt180	50J	404944	6507955	Wandoo	20+	0											No Signs	No Signs	No	
wpt181	50J	404938	6507983	Wandoo	20+	0											No Signs	No Signs	No	
wpt182	50J	404941	6507983	Wandoo	20+	0											No Signs	No Signs	No	
wpt183	50J	404941	6507985	Wandoo	20+	0											No Signs	No Signs	No	
wpt184	50J	404950	6508010	Wandoo	15-20	1	Knot Hole	5-12									No Signs	No Signs	No	
wpt185	50J	404962	6508028	Wandoo	15-20	1	Branch	5-12									No Signs	No Signs	No	
wpt186	50J	404992	6508037	Wandoo	15-20	0											No Signs	No Signs	No	
wpt187	50J	404933	6508034	Wandoo	15-20	1	Spout Branch	5-12	Spout Branch	12-20							No Signs	No Signs	Yes	Depth of hollow unknown
wpt188	50J	404929	6508031	Wandoo	15-20	0											No Signs	No Signs	No	
wpt189	50J	404900	6508001	Marri	20+	0											No Signs	No Signs	No	
wpt190	50J	404843	6507923	Marri	15-20	0											No Signs	No Signs	No	
wpt191	50J	404829	6507937	Marri	15-20	0											No Signs	No Signs	No	
wpt192	50J	404811	6507950	Marri	20+	0											No Signs	No Signs	No	
wpt193	50J	404784	6507979	Wandoo	20+	2	Branch	5-12	Branch	5-12							No Signs	No Signs	No	
wpt194	50J	404725	6507988	Marri	20+	0											No Signs	No Signs	No	
wpt195	50J	404517	6508035	Marri	15-20	0											No Signs	No Signs	No	
wpt196	50J	404504	6508036	Marri	15-20	1	Spout Trunk	20+									No Signs	No Signs	Yes	Depth of hollow unknown
wpt197	50J	404493	6508026	Marri	15-20	0											No Signs	No Signs	No	
wpt198	50J	404486	6508012	Marri	15-20	0											No Signs	No Signs	No	
wpt199	50J	404475	6508001	Marri	20+	0											No Signs	No Signs	No	
wpt200	50J	404613	6507959	Wandoo	15-20	0											No Signs	No Signs	No	
wpt201	50J	404631	6507930	Wandoo	20+	2	Branch	5-12	Branch	5-12							No Signs	No Signs	No	
wpt202	50J	404656	6507955	Wandoo	15-20	0											No Signs	No Signs	No	
wpt203	50J	404615	6507908	Wandoo	20+	0											No Signs	No Signs	No	
wpt204	50J	404601	6507899	Marri	20+	0											No Signs	No Signs	No	
wpt205	50J	404681	6507888	Wandoo	20+	5+	Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	No Signs	No Signs	No	
wpt206	50J	404689	6507873	Wandoo	15-20	5+	Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	No Signs	No Signs	No	
wpt207	50J	404693	6507872	Wandoo	20+	5+	Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	No Signs	No Signs	No	
wpt208	50J	404700	6507833	Marri	20+	0											No Signs	No Signs	No	
wpt209	50J	404719	6507784	Wandoo	20+	2	Spout Branch	5-12	Branch	5-12							No Signs	No Signs	No	
wpt210	50J	404690	6507749	Marri	20+	0											No Signs	No Signs	No	
wpt211	50J	404685	6507751	Wandoo	20+	5+	Knot Hole	12-20	Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	No Signs	No Signs	Yes	Depth of hollow unknown

Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	Number of Hollows	Hollow Type 1	Hollow Size 1 (cm)	Hollow Type 2	Hollow Size 2 (cm)	Hollow Type 3	Hollow Size 3 (cm)	Hollow Type 4	Hollow Size 4 (cm)	Hollow Type 5	Hollow Size 5 (cm)	Occupancy	Chew Marks	Potential Cockatoo Nest Hollow	Comments
wpt212	50J	404741	6507646	Wandoo	15-20	0											No Signs	No Signs	No	
wpt213	50J	404717	6507626	Wandoo	20+	5+	Knot Hole	5-12	Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	Bees	No Signs	No	
wpt214	50J	404671	6507661	Wandoo	20+	0											No Signs	No Signs	No	
wpt215	50J	404679	6507631	Wandoo	20+	0											No Signs	No Signs	No	
wpt216	50J	404655	6507625	Wandoo	15-20	0											No Signs	No Signs	No	
wpt217	50J	404654	6507572	Dead Unknown	20+	0											No Signs	No Signs	No	
wpt218	50J	404535	6507514	Flooded Gum	10-15	0											No Signs	No Signs	No	
wpt219	50J	404499	6507441	Flooded Gum	10-15	5+	Knot Hole	5-12	Knot Hole	5-12	Branch	5-12	Branch	5-12	Branch	5-12	No Signs	No Signs	No	
wpt220	50J	404438	6507557	Flooded Gum	10-15	0											No Signs	No Signs	No	
wpt221	50J	404578	6507599	Wandoo	15-20	0											No Signs	No Signs	No	
wpt222	50J	404584	6507615	Wandoo	15-20	0											No Signs	No Signs	No	
wpt223	50J	404584	6507626	Wandoo	15-20	0											No Signs	No Signs	No	
wpt224	50J	404568	6507633	Wandoo	20+	5+	Knot Hole	5-12	Knot Hole	5-12	Branch	5-12	Branch	5-12	Branch	5-12	No Signs	No Signs	No	
wpt225	50J	404592	6507644	Wandoo	15-20	0											No Signs	No Signs	No	
wpt226	50J	404620	6507667	Wandoo	20+	0											No Signs	No Signs	No	
wpt227	50J	404620	6507669	Wandoo	20+	0											No Signs	No Signs	No	
wpt228	50J	404606	6507685	Dead Unknown	20+	0											No Signs	No Signs	No	
wpt229	50J	404649	6507723	Marri	20+	5+	Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	No Signs	No Signs	No	
wpt230	50J	404666	6507766	Dead Marri	10-15	1	Knot Hole	<5									No Signs	No Signs	No	
wpt231	50J	404663	6507772	Marri	15-20	0											No Signs	No Signs	No	
wpt232	50J	404646	6507765	Marri	15-20	0											No Signs	No Signs	No	
wpt233	50J	404599	6507789	Marri	15-20	0											No Signs	No Signs	No	
wpt234	50J	404595	6507786	Marri	15-20	0											No Signs	No Signs	No	
wpt235	50J	404598	6507794	Marri	15-20	0											No Signs	No Signs	No	
wpt236	50J	404584	6507790	Marri	15-20	1	Knot Hole	5-12									No Signs	No Signs	No	
wpt237	50J	404581	6507815	Wandoo	15-20	0											No Signs	No Signs	No	
wpt238	50J	404625	6507843	Wandoo	20+	2	Spout Branch	5-12	Spout Branch	5-12							No Signs	No Signs	No	
wpt239	50J	404696	6507935	Wandoo	15-20	0											No Signs	No Signs	No	
wpt240	50J	404737	6507960	Wandoo	20+	0											No Signs	No Signs	No	
wpt241	50J	404749	6507936	Wandoo	20+	0											No Signs	No Signs	No	
wpt242	50J	404787	6507907	Wandoo	20+	0											No Signs	No Signs	No	
wpt243	50J	404788	6507882	Wandoo	20+	0											No Signs	No Signs	No	
wpt244	50J	404790	6507859	Wandoo	20+	0											No Signs	No Signs	No	
wpt245	50J	404763	6507890	Dead Unknown	10-15	5+	Branch	5-12	Branch	12-20	Branch	5-12	Branch	12-20	Branch	5-12	No Signs	No Signs	No	
wpt246	50J	404746	6507832	Wandoo	15-20	5+	Knot Hole	5-12	Knot Hole	5-12	Branch	5-12	Branch	5-12	Branch	5-12	No Signs	No Signs	No	
wpt247	50J	404731	6507828	Wandoo	15-20	5+	Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	No Signs	No Signs	No	
wpt248	50J	404819	6507769	Wandoo	15-20	2	Knot Hole	5-12	Knot Hole	5-12							No Signs	No Signs	No	
wpt249	50J	404806	6507718	Dead Marri	15-20	0											No Signs	No Signs	No	
wpt250	50J	404843	6507689	Marri	15-20	0											No Signs	No Signs	No	
wpt251	50J	404838	6507633	Marri	15-20	0											No Signs	No Signs	No	
wpt252	50J	404813	6507623	Marri	20+	0											No Signs	No Signs	No	
wpt253	50J	404672	6507534	Marri	20+	0											No Signs	No Signs	No	
wpt254	50J	404646	6507535	Dead Marri	20+	0											No Signs	No Signs	No	
wpt255	50J	404627	6507529	Marri	20+	0											No Signs	No Signs	No	
wpt256	50J	404687	6507499	Dead Marri	20+	0											No Signs	No Signs	No	
wpt257	50J	404730	6507529	Dead Marri	20+	0											No Signs	No Signs	No	
wpt258	50J	404645	6507505	Marri	20+	0											No Signs	No Signs	No	
wpt259	50J	404738	6507533	Marri	20+	0											No Signs	No Signs	No	
wpt260	50J	404736	6507542	Marri	20+	0											No Signs	No Signs	No	
wpt261	50J	404745	6507542	Marri	20+	0											No Signs	No Signs	No	
wpt262	50J	405027	6507732	Marri	15-20	0											No Signs	No Signs	No	
wpt263	50J	405105	6507748	Marri	15-20	0											No Signs	No Signs	No	
wpt264	50J	405112	6507732	Marri	15-20	0											No Signs	No Signs	No	

Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	Number of Hollows	Hollow Type 1	Hollow Size 1 (cm)	Hollow Type 2	Hollow Size 2 (cm)	Hollow Type 3	Hollow Size 3 (cm)	Hollow Type 4	Hollow Size 4 (cm)	Hollow Type 5	Hollow Size 5 (cm)	Occupancy	Chew Marks	Potential Cockatoo Nest Hollow	Comments
wpt265	50J	405107	6507730	Marri	15-20	0											No Signs	No Signs	No	
wpt266	50J	405134	6507733	Marri	15-20	0											No Signs	No Signs	No	
wpt267	50J	405153	6507706	Dead Marri	20+	0											No Signs	No Signs	No	
wpt268	50J	405084	6507686	Marri	15-20	0											No Signs	No Signs	No	
wpt269	50J	405076	6507678	Marri	15-20	0											No Signs	No Signs	No	
wpt270	50J	405050	6507690	Dead Marri	20+	0											No Signs	No Signs	No	
wpt271	50J	405030	6507674	Marri	20+	0											No Signs	No Signs	No	
wpt272	50J	405002	6507618	Dead Marri	10-15	1	Spout Trunk	20+									No Signs	No Signs	Yes	Depth of hollow unknown
wpt273	50J	404910	6507607	Marri	20+	0											No Signs	No Signs	No	
wpt274	50J	404890	6507578	Dead Marri	20+	0											No Signs	No Signs	No	
wpt275	50J	404875	6507565	Dead Marri	15-20	0											No Signs	No Signs	No	
wpt276	50J	404859	6507555	Marri	15-20	0											No Signs	No Signs	No	
wpt277	50J	404838	6507543	Marri	20+	0											No Signs	No Signs	No	
wpt278	50J	404751	6507500	Marri	20+	0											No Signs	No Signs	No	
wpt279	50J	404760	6507495	Marri	20+	0											No Signs	No Signs	No	
wpt280	50J	404742	6507490	Marri	20+	0											No Signs	No Signs	No	
wpt281	50J	404743	6507485	Marri	20+	0											No Signs	No Signs	No	
wpt282	50J	404703	6507463	Marri	15-20	0											No Signs	No Signs	No	
wpt283	50J	404601	6507455	Marri	15-20	0											No Signs	No Signs	No	
wpt284	50J	404557	6507431	Marri	20+	0											No Signs	No Signs	No	
wpt285	50J	404642	6507364	Unknown Euc	20+	0											No Signs	No Signs	No	
wpt286	50J	404641	6507356	Unknown Euc	20+	0											No Signs	No Signs	No	
wpt287	50J	404521	6507290	Flooded Gum	10-15	0											No Signs	No Signs	No	
wpt288	50J	404533	6507297	Flooded Gum	10-15	0											No Signs	No Signs	No	
wpt289	50J	404566	6507305	Flooded Gum	10-15	0											No Signs	No Signs	No	
wpt290	50J	404563	6507248	Flooded Gum	10-15	0											No Signs	No Signs	No	
wpt291	50J	404531	6507242	Flooded Gum	10-15	0											No Signs	No Signs	No	
wpt292	50J	404672	6507368	Marri	20+	0											No Signs	No Signs	No	
wpt293	50J	404671	6507373	Marri	20+	0											No Signs	No Signs	No	
wpt294	50J	404659	6507428	Marri	20+	0											No Signs	No Signs	No	
wpt295	50J	404683	6507430	Marri	20+	0											No Signs	No Signs	No	
wpt296	50J	404725	6507434	Marri	20+	0											No Signs	No Signs	No	
wpt297	50J	404736	6507458	Marri	20+	0											No Signs	No Signs	No	
wpt298	50J	404740	6507463	Marri	20+	0											No Signs	No Signs	No	
wpt299	50J	404743	6507437	Marri	20+	0											No Signs	No Signs	No	
wpt300	50J	404760	6507407	Marri	20+	0											No Signs	No Signs	No	
wpt301	50J	404748	6507402	Flooded Gum	15-20	0											No Signs	No Signs	No	
wpt302	50J	404788	6507428	Marri	20+	0											No Signs	No Signs	No	
wpt303	50J	404818	6507418	Marri	20+	0											No Signs	No Signs	No	
wpt304	50J	404842	6507418	Marri	20+	0											No Signs	No Signs	No	
wpt305	50J	404851	6507413	Marri	20+	0											No Signs	No Signs	No	
wpt306	50J	404817	6507486	Dead Marri	15-20	0											No Signs	No Signs	No	
wpt307	50J	404837	6507489	Marri	15-20	0											No Signs	No Signs	No	
wpt308	50J	404878	6507426	Marri	20+	0											No Signs	No Signs	No	
wpt309	50J	404902	6507442	Marri	20+	0											No Signs	No Signs	No	
wpt310	50J	404926	6507434	Marri	20+	0											No Signs	No Signs	No	
wpt311	50J	404929	6507431	Marri	20+	0											No Signs	No Signs	No	
wpt312	50J	404931	6507436	Marri	20+	0											No Signs	No Signs	No	
wpt313	50J	404888	6507507	Marri	20+	0											No Signs	No Signs	No	
wpt314	50J	404947	6507519	Marri	20+	0											No Signs	No Signs	No	
wpt315	50J	404950	6507504	Marri	20+	0											No Signs	No Signs	No	
wpt316	50J	404953	6507500	Marri	20+	0											No Signs	No Signs	No	
wpt317	50J	404978	6507464	Marri	20+	0											No Signs	No Signs	No	

Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	Number of Hollows	Hollow Type 1	Hollow Size 1 (cm)	Hollow Type 2	Hollow Size 2 (cm)	Hollow Type 3	Hollow Size 3 (cm)	Hollow Type 4	Hollow Size 4 (cm)	Hollow Type 5	Hollow Size 5 (cm)	Occupancy	Chew Marks	Potential Cockatoo Nest Hollow	Comments
wpt318	50J	405004	6507486	Marri	20+	0											No Signs	No Signs	No	
wpt319	50J	405006	6507496	Marri	20+	0											No Signs	No Signs	No	
wpt320	50J	404998	6507539	Marri	20+	0											No Signs	No Signs	No	
wpt321	50J	404987	6507554	Marri	20+	0											No Signs	No Signs	No	
wpt322	50J	405044	6507618	Marri	20+	0											No Signs	No Signs	No	
wpt323	50J	405059	6507626	Marri	20+	0											No Signs	No Signs	No	
wpt324	50J	405059	6507644	Dead Unknown	20+	0											No Signs	No Signs	No	
wpt325	50J	405058	6507623	Marri	15-20	0											No Signs	No Signs	No	
wpt326	50J	405078	6507647	Dead Unknown	20+	0											No Signs	No Signs	No	
wpt327	50J	405119	6507634	Dead Unknown	20+	0											No Signs	No Signs	No	
wpt328	50J	405150	6507649	Dead Unknown	20+	0											No Signs	No Signs	No	
wpt329	50J	405172	6507612	Dead Unknown	20+	1	Branch	5-12									No Signs	No Signs	No	
wpt330	50J	405166	6507601	Marri	15-20	0											No Signs	No Signs	No	
wpt331	50J	405105	6507561	Marri	15-20	0											No Signs	No Signs	No	
wpt332	50J	405097	6507539	Marri	20+	0											No Signs	No Signs	No	
wpt333	50J	405156	6507551	Marri	15-20	0											No Signs	No Signs	No	
wpt334	50J	405165	6507550	Marri	15-20	0											No Signs	No Signs	No	
wpt335	50J	405212	6507586	Marri	15-20	0											No Signs	No Signs	No	
wpt336	50J	405217	6507583	Marri	15-20	0											No Signs	No Signs	No	
wpt337	50J	405225	6507596	Marri	15-20	0											No Signs	No Signs	No	
wpt338	50J	405187	6507521	Dead Unknown	15-20	2	Knot Hole	20+	Spout Trunk	20+							No Signs	No Signs	Yes	Depth of hollow unknown
wpt339	50J	405049	6507450	Marri	15-20	0											No Signs	No Signs	No	
wpt340	50J	405020	6507413	Marri	20+	0											No Signs	No Signs	No	
wpt341	50J	405034	6507409	Marri	20+	0											No Signs	No Signs	No	
wpt342	50J	405054	6507385	Marri	20+	0											No Signs	No Signs	No	
wpt343	50J	405029	6507352	Marri	20+	0											No Signs	No Signs	No	
wpt344	50J	405040	6507348	Coastal Blackbutt	10-15	0											No Signs	No Signs	No	
wpt345	50J	405065	6507360	Coastal Blackbutt	10-15	0											No Signs	No Signs	No	
wpt346	50J	405074	6507331	Coastal Blackbutt	10-15	0											No Signs	No Signs	No	
wpt347	50J	405112	6507359	Coastal Blackbutt	10-15	0											No Signs	No Signs	No	
wpt348	50J	405126	6507357	Coastal Blackbutt	10-15	0											No Signs	No Signs	No	
wpt349	50J	405150	6507358	Coastal Blackbutt	10-15	0											No Signs	No Signs	No	
wpt350	50J	405162	6507360	Coastal Blackbutt	10-15	0											No Signs	No Signs	No	
wpt351	50J	405149	6507363	Marri	20+	0											No Signs	No Signs	No	
wpt352	50J	405148	6507363	Marri	20+	0											No Signs	No Signs	No	
wpt353	50J	405158	6507397	Marri	20+	0											No Signs	No Signs	No	
wpt354	50J	405128	6507399	Coastal Blackbutt	10-15	0											No Signs	No Signs	No	
wpt355	50J	405103	6507413	Marri	20+	0											No Signs	No Signs	No	
wpt356	50J	405101	6507429	Marri	20+	0											No Signs	No Signs	No	
wpt357	50J	405104	6507468	Marri	20+	0											No Signs	No Signs	No	
wpt358	50J	405105	6507473	Marri	20+	0											No Signs	No Signs	No	
wpt359	50J	405106	6507474	Marri	20+	0											No Signs	No Signs	No	
wpt360	50J	405150	6507486	Dead Unknown	20+	5+	Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	No Signs	No Signs	No	
wpt361	50J	405156	6507458	Marri	15-20	0											No Signs	No Signs	No	
wpt362	50J	405180	6507450	Dead Unknown	20+	5+	Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	Branch	5-12	No Signs	No Signs	No	
wpt363	50J	405162	6507450	Marri	20+	2	Branch	5-12	Branch	5-12							No Signs	No Signs	No	
wpt364	50J	405189	6507364	Marri	20+	0											No Signs	No Signs	No	
wpt365	50J	405189	6507325	Marri	20+	0											No Signs	No Signs	No	
wpt366	50J	405175	6507289	Coastal Blackbutt	10-15	0											No Signs	No Signs	No	
wpt367	50J	405198	6507258	Marri	10-15	0											No Signs	No Signs	No	
wpt368	50J	405199	6507234	Dead Marri	5-10	1	Spout Trunk	20+									No Signs	No Signs	Yes	Depth of hollow unknown
wpt369	50J	405223	6507217	Coastal Blackbutt	10-15	0											No Signs	No Signs	No	
wpt370	50J	405221	6507203	Coastal Blackbutt	10-15	0											No Signs	No Signs	No	

Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	Number of Hollows	Hollow Type 1	Hollow Size 1 (cm)	Hollow Type 2	Hollow Size 2 (cm)	Hollow Type 3	Hollow Size 3 (cm)	Hollow Type 4	Hollow Size 4 (cm)	Hollow Type 5	Hollow Size 5 (cm)	Occupancy	Chew Marks	Potential Cockatoo Nest Hollow	Comments
wpt371	50J	405237	6507181	Coastal Blackbutt	10-15	0											No Signs	No Signs	No	
wpt372	50J	405256	6507187	Coastal Blackbutt	10-15	0											No Signs	No Signs	No	
wpt373	50J	405187	6507201	Marri	20+	0											No Signs	No Signs	No	
wpt374	50J	405156	6507226	Coastal Blackbutt	10-15	0											No Signs	No Signs	No	
wpt375	50J	405074	6507216	Coastal Blackbutt	10-15	0											No Signs	No Signs	No	
wpt376	50J	405043	6507208	Marri	15-20	0											No Signs	No Signs	No	
wpt377	50J	405040	6507244	Coastal Blackbutt	10-15	0											No Signs	No Signs	No	
wpt378	50J	405056	6507253	Coastal Blackbutt	10-15	0											No Signs	No Signs	No	
wpt379	50J	405055	6507278	Coastal Blackbutt	10-15	0											No Signs	No Signs	No	
wpt380	50J	405028	6507307	Marri	20+	0											No Signs	No Signs	No	
wpt381	50J	405017	6507264	Marri	20+	0											No Signs	No Signs	No	
wpt382	50J	405023	6507263	Marri	20+	0											No Signs	No Signs	No	
wpt383	50J	404944	6507310	Dead Unknown	20+	0											No Signs	No Signs	No	
wpt384	50J	404982	6507263	Marri	20+	0											No Signs	No Signs	No	
wpt385	50J	404986	6507245	Marri	20+	0											No Signs	No Signs	No	
wpt386	50J	404988	6507233	Marri	20+	0											No Signs	No Signs	No	
wpt387	50J	404981	6507219	Marri	20+	0											No Signs	No Signs	No	
wpt388	50J	405000	6507202	Marri	20+	0											No Signs	No Signs	No	
wpt389	50J	404982	6507158	Marri	20+	0											No Signs	No Signs	No	
wpt390	50J	404986	6507152	Marri	20+	0											No Signs	No Signs	No	
wpt391	50J	404951	6507139	Marri	20+	0											No Signs	No Signs	No	
wpt392	50J	404956	6507188	Marri	20+	0											No Signs	No Signs	No	
wpt393	50J	404955	6507190	Marri	20+	2	Branch	5-12	Branch	5-12							No Signs	No Signs	No	
wpt394	50J	404929	6507191	Marri	20+	0											No Signs	No Signs	No	
wpt395	50J	404907	6507196	Marri	20+	0											No Signs	No Signs	No	
wpt396	50J	404872	6507235	Marri	15-20	0											No Signs	No Signs	No	
wpt397	50J	404870	6507235	Marri	15-20	0											No Signs	No Signs	No	
wpt398	50J	404885	6507307	Marri	15-20	0											No Signs	No Signs	No	
wpt399	50J	404856	6507394	Dead Unknown	15-20	0											No Signs	No Signs	No	
wpt400	50J	404777	6507361	Unknown Euc	15-20	0											No Signs	No Signs	No	
wpt401	50J	404721	6507327	Marri	15-20	0											No Signs	No Signs	No	
wpt402	50J	404715	6507341	Marri	20+	0											No Signs	No Signs	No	
wpt403	50J	404713	6507354	Marri	20+	0											No Signs	No Signs	No	
wpt404	50J	404761	6507367	Unknown Euc	15-20	0											No Signs	No Signs	No	
wpt405	50J	404777	6507372	Unknown Euc	15-20	0											No Signs	No Signs	No	
wpt406	50J	404787	6507370	Unknown Euc	15-20	0											No Signs	No Signs	No	
wpt407	50J	404760	6507356	Unknown Euc	15-20	0											No Signs	No Signs	No	

APPENDIX E

SIGNIFICANT SPECIES PROFILES

Bedfordale Trapdoor Spider *Arbanitis inornatus*

Status and Distribution: Listed as Priority 1 by the DEC. Distribution is not documented.

Habitat: Habitat requirements poorly documented. Appears to require woodlands or forests in good condition to persist.

Likely presence in study area: Given the highly degraded nature of most of the study area it is very unlikely that a population of this species persists on site.

Potential impact of development: No impact on this species or its preferred habitat is considered likely to occur.

Unnamed Bee *Hylaeus globuliferus*

Status and Distribution: Listed as Priority 3 by the DEC. Small number of scattered records from north of Perth to near Esperance (DEC 2013).

Habitat: This species of native bee appears to favour flowers of *Adenanthos cygnorum*, though some records of it feeding on *Banksia attenuata*.

Likely presence in study area: The vast majority of the study area has been totally cleared of native vegetation and is unsuitable as habitat for this species. Those areas with vegetation are degraded and do not contain this bees favoured plant species *Adenanthos cygnorum,* considered necessary for a population of this species to persist. Closest DEC record is ~20km west on the coastal l plain in 1996.

Potential impact of proposed development: No impact on this species will occur as it is unlikely to occur.

Unnamed Bee *Leioproctus douglasiellus*

Status and Distribution: Listed as Scheduled 1 under the *WC Act (1950)*. It is known only from specimens collected at Pearce and Forrestdale Lake.

Habitat: This species of native bee appears to be dependent on the flowers of *Goodenia filiformis*.

Likely presence in study area: The vast majority of the study area has been totally cleared of native vegetation and is unsuitable as habitat for this species. Those areas with vegetation are degraded and do not contain the necessary plant species for a population of this species to persist.

Potential impact of proposed development: No impact on this species will occur.

Unnamed Bee *Leioproctus contrarius*

Status and Distribution: Listed as Priority 3 by the DEC. Surveys have shown that it is more widespread than previously thought, though the DEC database search only lists old sightings from the "Bullsbrook area" and "Bullsbrook" in the 1950's (DEC 2013).

Habitat: This species of native bee is apparently dependent on flowers of *Goodeniaceae* and possibly *Lechenaultia stenosepala*.

Likely presence in study area: The vast majority of the study area has been totally cleared of native vegetation and is unsuitable as habitat for this species. Those areas with vegetation are degraded and do not contain the necessary plant species for a population of this species to persist.

Potential impact of proposed development: No impact on this species will occur.

Graceful Sun Moth *Synemon gratiosa*

Status and Distribution: Listed as Priority 4 by the DEC and as Endangered under the *EPBC Act (1999)*. It is also ranked as 'Endangered' under IUCN (2001) criteria.

The GSM was, up until a few years ago thought to be confined to a small number of bush reserves in the northern suburbs of Perth. Targeted survey work since that time by a number of consultants and the DEC have now extended the known range of the species north to Leeman and south as far as Binningup (Bishop *et al.* 2010b).

Survey work carried out in 2010 expanded the previously document area of occupancy of the GSM from 18km^2 to 43 km^2 and the extent of occurrence from 230km^2 to 2,015km^2. The area of occupancy is potentially a conservative estimate at this stage and if habitat anticipated to be occupied by GSM is included, the area of occupancy may be as high as 119 km^2 (Bishop *et al.* 2010b). Additional surveys have been carried out in 2011 north and south of the known range and these may also expand the species range (results no as yet published).

The conservation status of the graceful sun-moth was change at a state level in 2012 from Schedule 1 to Priority 4 as a consequence of the additional information illustrating the species much greater range and abundance.

Habitat: The graceful sun-moth is currently only known from two general vegetation types:

- Banksia woodland/woolly bush on deep sands, in the northern suburbs of Perth on the Swan Coastal Plain. In these sites the GSM breeds on *Lomandra hermaphrodita*, which often occurs in low numbers.

- Open areas of herbland, heathland and shrubland on Quindalup soils (sand and limestone) close to the coast where it breeds on *Lomandra maritima*, which is often present in reasonable numbers and may even be a dominant understorey herb. Sites on limestone may have both *Lomandra* species present.

The presence of *Lomandra* species therefore provides a good indication of prospective habitat, however, sufficient numbers and densities of these plants are thought to be necessary to sustain a viable breeding colony of Graceful Sun-Moths.

Likely presence in study area: It is unlikely that any of the vegetation units present at the site represent habitat suitable for this species to utilise given the lack *Lomandra* in suitable densities in addition to them being fragmented and degraded. Based on these observations and the lack of records from the immediate area it is considered unlikely that this species is present.

Potential impact of development: It is considered unlikely that any impact on this species or its preferred habitat will occur as a consequence of any development taking place at the site.

Black-striped Minnow *Galaxiella nigrostriata*

Status and Distribution: This species is classified as Priority 3 by the DEC. Allen *et al*. (2003) states that this species is common but restricted to wetlands within 100km of the coast in south Western Australia between Albany and Augusta with isolated populations known at Kemerton and near Ellenbrook. In the Muchea/Bullsbrook area it is known only from Melaleuca Park (15km south west of study site) and Lake Chandala (9 km north) (Beatty *et al.* 2010).

Habitat: Permanent or ephemeral pools, roadside ditches and small creeks in sandy, thickly vegetated wetland areas. Water is usually darkly tannin stained and acidic (pH 4.6 – 6.5) (Allen *et al.* 2003). Where present, the Black-striped Jollytail is widespread when water levels are high, but relies on a few summer refuge sites, where it survives in deep, cool pools and, when these dry out, retreats to water contained in the burrows of freshwater crayfish (Bamford 2002).

Likely presence in study area: No evidence of this species was observed during the field reconnaissance survey and the wetlands/dams within the study area appear to be too small and degraded to support a population of this species. Based on these observations and the lack of any historical records from the site it is considered unlikely to occur.

Potential impact of development: No impact on this species is considered likely.

Mud Minnow *Galaxias munda*

Status and Distribution: Listed as Scheduled 1 under the *WC Act (1950)*. Morgan *et al.* (1996) found during their survey of south west rivers that this species was "rare throughout most of its distribution, but occasionally abundant in the headwaters and tributaries of rivers and in a number of shallow pools connected to streams". In contrast Allen *et al.* (2003) states that this species is common in coastal drainages of south-western Australia between Albany and Margaret River, with an isolated population known from Gingin. Previously more widespread within the Ellen Brook catchment but now apparently confined to Lennard Brook, 21km north of the study site (Beatty *et al.* 2010).

Habitat: Typically found in small flowing streams near submerged vegetation, occasionally in still water of ponds, swamps and roadside drains. Water is usually darkly tannin stained and acidic (pH 3.0 – 6.0) (Allen *et al.* 2003).

Likely presence in study area: No evidence of this species was observed during the field reconnaissance survey and the wetlands/dams within the study area appear to be too small and degraded to support a population of this species. Based on these observations and the lack of any historical records from the site it is considered unlikely to occur.

Potential impact of development: No impact on this species is considered likely.

Western Swamp Tortoise *Pseudemydura umbrina*

Status and Distribution: Listed as Scheduled 1 under the *WC Act (1950)* and as Critically Endangered under the *EPBC Act (1999).* Confined to a small number of sites near Bullsbrook.

Habitat: Clay based ephemeral swamps (Bush *et al.* 2002).

Likely presence in study area: There is no suitable habitat for this species within the study site and it is considered very unlikely to occur.

Potential impact of development: No direct impact on this species is anticipated. However, given the fact that the degraded creek lines within the study site flow into Ellen Brook which then flows into habitat of one of only two known populations of this species (Ellen Brook Wildlife Sanctuary) stormwater management to eliminate the possibility of downstream pollution will need to be taken into consideration during planning to ensure no indirect impacts occur.

Jewelled Ctenotus *Ctenotus gemmula*

Status and Distribution: Listed as Priority 3 by DEC. In the west at Cataby and from Wanneroo south to Medina. In the southern interior and along the south coast from Rocky Gully inland to Lake Magenta and east to Toolina Cove (Storr *et al*. 1999).

Habitat: Prefers pale sandplains supporting either *Banksia* or mallee with heath. Seeks shelter beneath leaf litter, in abandoned stick-ant nest and burrows at the base of trees and shrubs (Bush *et al*. 2002).

Likely presence in study area: The study site contains a small area of banksia woodland on grey sands however observations made in the field suggest it is unlikely to support a population of this species given its history of disturbance and limited extent.

Potential impact of development: No impact on this species or its preferred habitat is considered likely.

Black-striped Snake *Neelaps calonotos*

Status and Distribution: Listed as Priority 3 by DEC. Found in the lower west coast from Lancelin to Mandurah. It is locally abundant but is under threat due to land clearing (Storr *et al*. 1999).

Habitat: This species of snake favours sandy soils supporting heath and banksia/eucalypt woodland (Nevill 2005).

Likely presence in study area: The study site contains a small area of banksia woodland on grey sands however observations made in the field suggest it is unlikely to support a population of this species given its history of disturbance and limited extent.

Potential impact of development: No impact on this species or its preferred habitat is considered likely.

Southern Carpet Python *Morelia spilota imbricata*

Status and Distribution: The south western population is classified as Priority 4 by the DEC and is also listed in Schedule 4 under the *WC Act*. This subspecies has wide distribution within the south west but is uncommon. Occurs north to Geraldton and Yalgoo and east to Pinjin, Kalgoorlie, Fraser Range and Eyre (Storr *et al.* 2002).

Habitat: This species has been recorded from semi-arid coastal and inland habitats, Banksia woodland, Eucalypt woodlands, and grasslands. Most often found utilising hollow logs in addition the burrows of other animals for shelter. Often arboreal and will also use tree hollows for refuge.

Likely presence in study area: The degraded and fragmented nature of native vegetation in and surrounding the study site would make it very difficult for a population of this species to persist in the area and therefore it is considered very unlikely to be present.

Potential impact of development: No impact on this species or its preferred habitat is considered likely.

Malleefowl *Leipoa ocellata*

Status and Distribution: This species is listed as Schedule 1 under the WC *Act* and as Vulnerable and Migratory under the *EPBC Act (1999)*. Originally common, but now generally rare to uncommon and patchily distributed.

Current distribution mainly southern arid and semi-arid zones, north to Shark Bay, Jingemarra, Colga Downs and Yeelirrie, east to Earnest Giles Range, Yeo Lake, lower Ponton Creek and to Eucla and west and south to Cockleshell Gully, the Wongan Hills, Stirling Range, Beaufort Inlet, Hatters Hill, Mt Ragged and Point Malcolm (Johnstone and Storr 1998).

Habitat: Mainly scrubs and thickets of mallee *Eucalyptus* spp., boree *Melaleuca lanceolata* and bowgada *Acacia linophylla*, also dense litter forming shrublands.

Likely presence in study area: This species is regionally extinct and would never, under normal circumstances occur anywhere on the Swan Coastal Plain.

Potential impact of development: No impact on this species will occur as it is unlikely to be present.

Australasian Bittern *Botaurus poiciloptilus*

Status and Distribution: Classified as Schedule 1 under the *WC Act* and as Endangered under the *EPBC Act*. The species is uncommon to rare (Morcombe 2004), but locally common in wetter parts of south west (Johnstone and Storr 1998). Occurs north to Moora and east to Mt Arid (Johnstone and Storr 1998).

Habitat: Freshwater wetlands, occasionally estuarine; prefers heavy vegetation (Morcombe 2003) such as beds of tall dense *Typha*, *Baumea* and sedges in freshwater swamps (Johnstone and Storr 1998).

Likely presence in study area: This species may occasionally utilise areas of densest sedgelands as temporary refuge however observations made in the field suggest that vegetation remaining at the site is unlikely to represent significant habitat for this species

given its limited extent and history of disturbance. Not listed as a potential species as frequency of occurrence would be very low and only temporary.

Potential impact of development: No significant impact on this species or its preferred habitat is considered likely.

Great Egret *Ardea alba*

Status and Distribution: This species of egret is listed as Schedule 3 under the *WC Act* and as migratory under the *EPBC Act* and under international agreements to which Australia is a signatory. The Great Egret is common and very widespread in any suitable permanent or temporary habitat (Morcombe, 2003).

Species or species habitat listed as likely to occur in general area within EPBC database search.

Habitat: Wetlands, flooded pasture, dams, estuarine mudflats, mangroves and reefs (Morcombe 2003).

Likely presence in study area: May utilise sedgelands, paperbark woodlands, creek lines, waterlogged paddocks and the manmade drains/dams for foraging at times. Potential for breeding though habitat suitable for this purpose appears marginal.

Potential impact of development: Loss or modification of some marginal habitat. No significant impact likely.

Cattle Egret *Ardea ibis*

Status and Distribution: This species of egret is listed as Schedule 3 under the *WC Act* and as migratory under the *EPBC Act* and under international agreements to which Australia is a signatory. The Cattle Egret is common in the north sections of its range but is an irregular visitor to the better watered parts of the state (Johnstone and Storr 1998). The population is expanding (Morcombe 2003).

Species or species habitat listed as likely to occur in general area within EPBC database search.

Habitat: Moist pastures with tall grasses, shallow open wetlands and margins, mudflats (Morcombe 2003).

Likely presence in study area: May utilise sedgelands, paperbark woodlands, creek lines, waterlogged paddocks and the manmade drains/dams for foraging at times. Potential for breeding though habitat suitable for this purpose appears marginal.

Potential impact of development: Loss or modification of some marginal habitat. No significant impact likely.

Migratory Shorebirds/Wetland Species

A number of migratory shorebirds/wetland species are listed as potentially occurring in the general area. Specific species are not discussed.

Status and Distribution: Migratory shorebirds are listed under the *EPBC Act 1999* and under international agreements to which Australia is a signatory. All species are either widespread summer migrants to Australia or residents. State and Federal conservation status varies between species.

Habitat: Varies between species but includes beaches and permanent/temporary wetlands varying from billabongs, swamps, lakes, floodplains, sewerage farms, saltwork ponds, estuaries, lagoons, mudflats sandbars, pastures, airfields, sports fields and lawns.

Likely presence in study area: Some species may, in small numbers, utilise sedgelands, creek lines, waterlogged paddocks and the manmade drains/dams for foraging or refuge at times. No potential for breeding. None have been listed as a potential species as frequency of occurrence would be very low and only temporary.

Potential impact of development: No significant impact on any of these species is considered likely.

White-bellied Sea Eagle *Haliaeetus leucogaster*

Status and Distribution: This species is listed as Schedule 3 under the *WC Act* and as migratory under the *EPBC Act* and under international agreements to which Australia is a signatory. White-bellied sea eagles are moderately common to common on Kimberley and Pilbara islands, coasts and estuaries, on Bernier, Dorre and Dirk Hartog Is., in Houtman Abrolhos and in the Archipelago of the Recherche; rare to uncommon elsewhere (Johnstone and Storr 1998). Also found in New Guinea, Indonesia, China, southeast Asia and India. Scarce near major coastal cities (Morcombe 2003).

Species or species habitat listed as likely to occur in general area within EPBC database search.

Habitat: They nest and forage usually near the coast over islands, reefs, headlands, beaches, bays, estuaries, mangroves, but will also live near seasonally flooded inland swamps, lagoons and floodplains, often far inland on large pools of major rivers. Established pairs usually sedentary, immatures dispersive (Morcombe 2003). White-

bellied Sea-Eagles build a large stick nest, which is used for many seasons in succession.

Likely presence in study area: No suitable habitat within study site.

Potential impact of development: No impact on this species will occur.

Peregrine Falcon *Falco perigrinus*

Status and Distribution: This species is listed as Schedule 4 under the *WC Act*. Individuals of this species are uncommon/rare but wide ranging across Australia. Moderately common at higher levels of the Stirling Range, uncommon in hilly, north west Kimberley, Hamersley and Darling Ranges; rare or scarce elsewhere (Johnstone and Storr 1998).

Habitat: Diverse from rainforest to arid shrublands, from coastal heath to alpine (Morcombe 2003). Mainly about cliffs along coasts, rivers and ranges and about wooded watercourses and lakes (Johnstone and Storr 1998). The species utilises the ledges, cliff faces and large hollows/broken spouts of trees for nesting. It will also occasionally use the abandoned nests of other birds of prey.

Likely presence in study area: The species potentially utilises some sections of the study area as part of a much larger home range. Probability of this species breeding with the study site is low.

Potential impact of development: Loss or modification of some habitat. However, no significant impact on this species is considered likely

Fork-tailed Swift *Apus pacificus*

Status and Distribution: The Fork-tailed Swift is listed as Schedule 3 under the *WC Act* an as migratory under the *EPBC Act* and under international agreements to which Australia is a signatory. This species breeds in Siberia and the Himalayas and migrates to Australia in October, returning to the breeding grounds by May or June (Morcombe 2003).

Habitat: Low to very high airspace over varied habitat from rainforest to semi desert (Morcombe 2003).

Likely presence in study area: It is potentially an occasional summer visitor to the study area but is entirely aerial and largely independent of terrestrial habitats. Not listed as a potential species as frequency of occurrence would be very low and then only for very brief periods of time.

Potential impact of development: No impact on this species is anticipated.

Rainbow Bee-eater *Merops ornatus*

Status and Distribution: This species is listed as Schedule 3 under the *WC Act* and as migratory under the *EPBC Act* and under international agreements to which Australia is a signatory. The Rainbow Bee-eater is a common summer migrant to southern Australia but in the north they are resident (Morcombe 2003).

Habitat: Open Country, of woodlands, open forest, semi arid scrub, grasslands, clearings in heavier forest, farmlands (Morcombe 2003). Breeds underground in areas of suitable soft soil firm enough to support tunnel building.

Likely presence in study area: Common seasonal visitor to south west. May foraging and roost in the study area at times. Possibly breeds in some sections of the study area where ground conditions permit (e.g. sand quarry) though population levels would not be significant as it usually breeds in pairs, rarely in small colonies (Johnstone and Storr 1998).

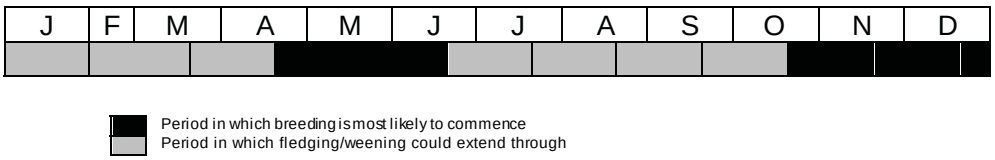
Potential impact of development: Despite the potential for breeding no significant impact on this species is anticipated as individuals' present onsite at any one time are unlikely to represent a substantial proportion of the population. It can be expected to continue to utilise the area, as it does now, despite any future development.

Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso*

Status and Distribution: Listed as Scheduled 1 under the *WC Act* and as Vulnerable under the *EPBC Act*. Found in the humid and subhumid south west, mainly hilly interior, north to Gingin and east to Mt Helena, Christmas Tree Well, North Bannister, Mt Saddleback, Rock Gully and the upper King River (Johnstone and Storr 1998).

Habitat: Eucalypt forests, feeds on Marri, Jarrah, Blackbutt, Karri, Sheoak and Snottygobble. The Forest Red-tailed Black Cockatoo nests in the large hollows of Marri, Jarrah and Karri (Johnstone and Kirkby 1999). In Marri, the nest hollows of the Forest Red-tailed Black Cockatoo range from 8-14m above ground, the entrance is 12 – 41cm in diameter and the depth is one to five metres (Johnstone and Storr 1998).

Breeding commences in winter/spring. There are few records of breeding in the Forest Red-tailed Black Cockatoo (Johnstone and Storr 1998), but eggs are laid in October and November (Johnstone 1997; Johnstone and Storr 1998). Recent data however indicates that breeding in all months of the year occurs with peaks in spring and autumn–winter (Ron Johnstone pers comms). Incubation period 29 – 31 days. Young fledge at 8 to 9 weeks (Simpson and Day 2004).



Likely presence in study area: Foraging evidence attributed to this species found (chewed marri and coastal blackbutt fruits). All areas of remnant native vegetation within the study area containing marri, jarrah or coastal blackbutt represents potential foraging habitat for this species. Larger trees (>50cm DBH) can be considered potential breeding habitat. This species may also roost on site on occasions though no roost trees observed.

Potential impact of development: Loss of foraging, breeding and roosting opportunities.

Carnaby's Black- Cockatoo *Calyptorhynchus latirostris*

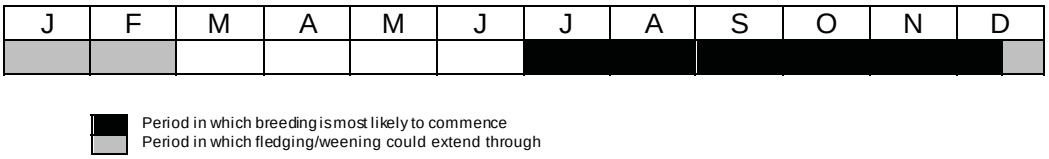
Status and Distribution: Carnaby's Black Cockatoo is listed as Scheduled 1 under the *WC Act* and as Endangered under the *EPBC Act*. Confined to the south-west of Western Australia, north to the lower Murchison River and east to Nabawa, Wilroy, Waddi Forest, Nugadong, Manmanning, Durokoppin, Noongar (Moorine Rock), Lake Cronin, Ravensthorpe Range, head of Oldfield River, 20 km ESE of Condingup and Cape Arid; also casual on Rottnest Island (Johnstone and Storr 1998).

Habitat: Forests, woodlands, heathlands, farms; feeds on Banksia, Hakeas and Marri. Carnaby's Cockatoo has specific nesting site requirements. Nests are mostly in smoothed-barked eucalypts with the nest hollows ranging from 2.5 to 12m above the ground, an entrance from 23-30cm diameter and a depth of 0.1-2.5m (Johnstone and Storr, 1998).

Breeding occurs in winter/spring mainly in eastern forest and wheatbelt where they can find mature hollow bearing trees to nest in (Morcombe, 2003). Judging from breeding records in the Storr – Johnstone Bird Data Bank, this species is currently expanding its breeding range westward and south into the Jarrah – Marri forests of the Darling Scarp and into the Tuart forests of the Swan Coastal Plain including Yanchep, Lake Clifton and near Bunbury and possibly also in the Lancelin region. Carnaby's Black Cockatoo have also been known to breed close to the town of Mandurah, as well as at Dawesville, Lake Clifton and Baldivis (pers. comm., Ron Johnstone, WA Museum) and there are small resident populations on the southern Swan Coastal Plain near Mandurah, Lake Clifton and near Bunbury. At each of these sites the birds forage in remnant vegetation and adjacent pine plantations (Johnstone 2008).

Carnaby's Black-Cockatoo lays eggs from July or August to October or November, with most clutches being laid in August and September (Saunders 1986). Most of the

breeding is in September through to December (Ron Johnstone pers comms). Birds in inland regions may begin laying up to three weeks earlier than those in coastal areas (Saunders 1977). The female incubates the eggs over a period of 28-29 days. The young depart the nest 10–12 weeks after hatching (Saunders 1977; Smith & Saunders 1986).



Likely presence in study area: Foraging evidence attributed to this species found (chewed banksia, marri, coastal blackbutt fruits and pine cones). All areas of remnant native vegetation within the study area containing banksia, marri, jarrah, coastal blackbutt and areas of planted pines represents potential foraging habitat for this species. Larger trees (>50cm DBH) can be considered potential breeding habitat. This species may also roost on site on occasions though no roost trees observed.

Potential impact of development: Loss of foraging, breeding and roosting opportunities.

Chuditch *Dasyurus geoffroii*

Status and Distribution: Listed as Scheduled 1 under the *WC Act* and as Vulnerable under the *EPBC Act.* Formerly occurred over nearly 70 per cent of Australia. The Chuditch now has a patchy distribution throughout the Jarrah forest and mixed Karri/Marri/Jarrah forest of southwest Western Australia. Also occurs in very low numbers in the Midwest, Wheatbelt and South Coast Regions with records from Moora to the north, Yellowdine to the east and south to Hopetoun.

Habitat: Chuditch are known to have occupied a wide range of habitats from woodlands, dry sclerophyll (leafy) forests, riparian vegetation, beaches and deserts. Riparian vegetation appears to support higher densities of Chuditch, possibly because food supply is better or more reliable and better cover is offered by dense vegetation. Chuditch appear to utilise native vegetation along road sides in the wheatbelt (CALM 1994). The estimated home range of a male Chuditch is over 15 km^2 whilst that for females is 3-4 km^2 (Sorena and Soderquist 1995).

Likely presence in study area: The degraded and fragmented nature of native vegetation in and surrounding the study site would make it very difficult for a population of this species to persist in the area and therefore it is considered very unlikely to be present. Transient individuals may occur on very rare occasions.

Potential impact of development: No impact on this species or its preferred habitat is considered likely.

Southern Brush-tailed Phascogale *Phascogale tapoatafa tapoatafa*

Status and Distribution: Listed as Scheduled 1 under the *WC Act (1950)*. Present distribution is believed to have been reduced to approximately 50 per cent of its former range. Now known from Perth and south to Albany, west of Albany Highway. Occurs at low densities in the northern Jarrah forest. Highest densities occur in the Perup/Kingston area, Collie River valley, and near Margaret River and Busselton (DEC information pamphlet). Records are less common from wetter forests.

Habitat: This subspecies has been observed in dry sclerophyll forests and open woodlands that contain hollow-bearing trees but a sparse ground cover. A nocturnal carnivore relying on tree hollows as nest sites. The home range for a female Brush-tailed Phascogale is estimated at between 20 and 70 ha, whilst that for males is given as twice that of females. In addition, they tend to utilise a large number (approximately 20) of different nest sites throughout their range (Soderquist, 1995).

Likely presence in study area: The current status of this species in general area is difficult to determine but the degraded and fragmented nature of native vegetation in and surrounding the study site would make it very difficult for a population of this species to persist in the area and therefore it is considered very unlikely to be present. Not listed as a potential species.

Potential impact of development: No impact on this species is anticipated as it is unlikely to be present.

Southern Brown Bandicoot *Isoodon obesulus fusciventer*

Status and Distribution: Listed as Priority 5 by DEC. Widely distributed in the south west from near Cervantes north of Perth to east of Esperance, patchy distribution through the Jarrah and Karri forest and on the Swan Coastal Plain, and inland as far as Hyden. Has been translocated to Julimar State Forest, Hills Forest Mundaring, Tutanning Nature Reserve, Boyagin Nature Reserve, Dongolocking Nature Reserve, Leschenault Conservation Park, and Karakamia and Paruna Sanctuaries (DEC information pamphlet) and Nambung National Park (DEC pers. coms.)

Habitat: Dense scrubby, often swampy, vegetation with dense cover up to one metre high, often feeds in adjacent forest and woodland that is burnt on a regular basis and in areas of pasture and cropland lying close to dense cover. Populations inhabiting Jarrah and Wandoo forests are usually associated with watercourses. Quendas can thrive in more open habitat subject to exotic predator control (DEC information pamphlet).

Likely presence in study area: Most of the study site is unsuitable for this species to persist due to a lack of dense groundcover but it may occur at locations where native vegetation provides sufficient cover such as in the wetland areas that contain dense segdeland.

Potential impact of development: Loss of some potential habitat. Some possibility that individuals maybe killed or injured during clearing operations.

Western Brush Wallaby *Macropus irma*

Status and Distribution: Listed as Priority 4 by DEC. The Western Brush Wallaby is distributed across the south-west of Western Australia from north of Kalbarri to Cape Arid (DEC information pamphlet).

Habitat: The species optimum habitat is open forest or woodland, particularly favouring open, seasonally wet flats with low grasses and open scrubby thickets. It is also found in some areas of mallee and heathland, and is uncommon in karri forest (DEC information pamphlet).

Likely presence in study area: Bushland within and surrounding the study area is too small and fragmented to support a population of this species.

Potential impact of development: No impact on this species is anticipated as it is unlikely to be present.

Tammar *Macropus eugenii derbianus*

Status and Distribution: Listed as Priority 5 by DEC. Formerly widespread in SW WA and Eyre Peninsula SA, now reduced to tiny populations on the mainland and some offshore islands. Re-introduce in recent times to several national parks and sanctuaries along the Avon Valley including Walyunga National Park

Habitat: Inhabits dense coastal heath and scrub and some dry sclerophyll forest with dense patches of cover.

Likely presence in study area: No suitable habitat and locally extinct on coastal plain. Not listed in this report as a potential species.

Potential impact of development: No impact on this species is anticipated.

Black-flanked Rock Wallaby *Petrogale lateralis*

Status and Distribution: Listed as Scheduled 1 under the *WC Act* and as Vulnerable under the *EPBC Act*. Widely scattered populations in ranges of central and west

Australia including some offshore islands. Re-introduced to Walyunga and Avon National Parks.

Habitat: Granite outcrops, sandstone cliffs and scree slopes in ranges with hummock grassland and occasional fig trees and low shrubs, caves, and coastal limestone cliffs. Timid, never venturing far from rock shelter. Mostly nocturnal, but basks in sun during cooler months. Shelters in crevices and caves, feeds on grasses and forbs.

Likely presence in study area: No suitable habitat on the coastal plain. Not listed in this report as a potential species.

Potential impact of development: No impact on this species is anticipated as it is unlikely to be present.