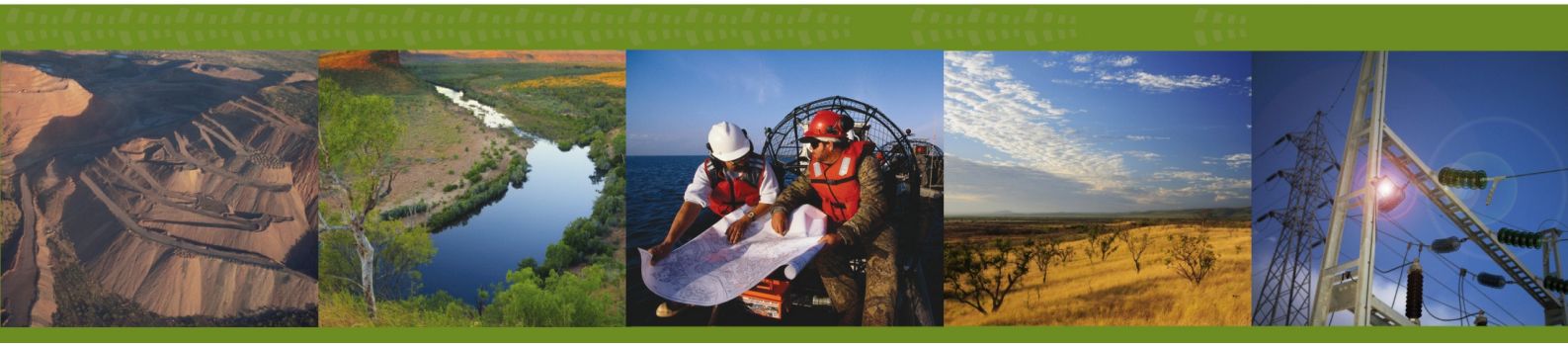
Appendices



Karnup Sand Mining Project

Environmental Investigations

Prepared for
Urban Resources
by Strategen

June 2015

STRATEGEN
environmental consultants

Karnup Sand Mining Project

Environmental Investigations

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June 2015

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Client: Urban Resources

Report Version	Revision No.	Purpose	Strategen author/reviewer	Submitted to Client	
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1. Introduction

1.1 Background

Urban Resources Pty Ltd proposes to operate the Karnup Sand Mining Project located between Stakehill Road and the Kwinana Freeway in Karnup, approximately 48 km south of Perth, Western Australia (the Project; Figure 1). The Project involves the mining of 1 553 800 m^3 of sand from the Project area. The Project area is defined as the portion of M70/1262 that is west of the Kwinana Freeway boundary, as outlined by Figure 1. Urban Resources will rehabilitate the landscape post mining to a form suitable for the future land parks and recreation use as proposed by LandCorp.

The proposed mining area occurs within Mining Tenement M70/1262 comprising remnant native woodland vegetation, historical pine plantations and natural regeneration in areas which were previously cleared. Wetland areas which occur within M70/1262 do not fall into the proposed mining area and therefore will not be impacted by the Project.

The proposed mining will require clearing of native vegetation which could contain species of, or habitat for conservation significant flora as well as Threatened species of black cockatoos. A flora, vegetation and black cockatoo habitat assessment was deemed necessary to determine the environmental values of the potential clearing area.

1.2 Scope

Strategen was commissioned to undertake a flora and vegetation assessment and black cockatoo habitat assessment by Urban Resources within the western portion of M70/1262 in May 2015 (the Survey area; Figure 4).

Wetland areas were not included within the area surveyed as they will not be impacted by the proposed mining.

1.3 Legislative context

This assessment has been conducted with reference to the following Australian and Western Australian legislation:

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) – Australian Government
- *Wildlife Conservation Act 1950* (WC Act) – State
- *Environmental Protection Act 1986* (EP Act) – State
- *Biosecurity and Agriculture Management Act 2007* (BAM Act) – State.

1.3.1 Conservation significant flora and ecological communities

Threatened species are listed under the EPBC Act at the Australian Government level and under the WC Act at the State level (Appendix 4). Priority species are listed by the Department of Parks and Wildlife (Parks and Wildlife) and include species of 'significant conservation value' (Appendix 4).

Threatened Ecological Communities (TECs) are listed under both the EPBC Act and EP Act (Appendix 4). Priority Ecological Communities (PECs) are listed by Parks and Wildlife and include species of significant conservation value (Appendix 4).

1.3.2 Environmentally Sensitive Areas

Environmentally Sensitive Areas (ESAs) are protected under the EP Act, and include the following:

- World Heritage areas
- areas included on the National Estate Register
- defined wetlands and associated buffers
- vegetation within 50 m of a listed threatened species
- TECs.

1.3.3 Protection of native vegetation

Native vegetation is defined under the EP Act as "indigenous aquatic or terrestrial vegetation, and includes dead vegetation unless that dead vegetation is of a class declared by regulation to be excluded from this definition but does not include vegetation in a plantation".

This definition of native vegetation does not include vegetation that was intentionally sown, planted or propagated unless wither of the following apply:

(a) the vegetation was sown, planted or propagated as required under the EP Act or another written law

(b) the vegetation is of a class declared by regulation to be included in this definition.

Native vegetation can only be cleared with a clearing permit, unless for some circumstances where exemptions apply pursuant to the EP Act and the Environmental Protection (Clearing of Native Vegetation) Regulations 2004 (the Regulations). Clearing permits issued pursuant to the Regulations may be issued as area permits or purpose permits. Exemptions for clearing under Regulation 5 of the Regulations do not apply within ESAs.

1.3.4 Introduced species

The BAM Act provides for management and control of listed organisms, including introduced flora species (weeds). Species listed as declared pests under the BAM Act are classified under three categories:

1. C1 Exclusion: Pests assigned under this category are not established in Western Australia, and control measures are to be taken to prevent them entering and establishing in the State.
2. C2 Eradication: Pests assigned under this category are present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still a possibility.
3. C3 Management: Pests assigned under this category are established in Western Australia, but it is feasible, or desirable, to manage them in order to limit their damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area that is currently free of that pest.

Under the BAM Act, land managers are required to manage populations of declared pests as outlined under the relevant category.

1.3.5 Regulatory guidance

The flora and vegetation survey component of this investigation has been designed to address the recommendations of the EPA as described in the following guidance:

- EPA Position Statement No. 2 *Environmental Protection of Native Vegetation in Western Australia* (EPA 2000)
- EPA Position Statement No. 3 *Terrestrial Biological Surveys as an Element of Biodiversity Protection* (EPA 2002)
- EPA Position Statement No. 10 *Level of Assessment for Proposals Affecting Natural Areas Within the System 6 Region and Swan Coastal Plain Portion of the System 1 Region* (EPA 2006)
- EPA Guidance Statement No. 51 *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004).

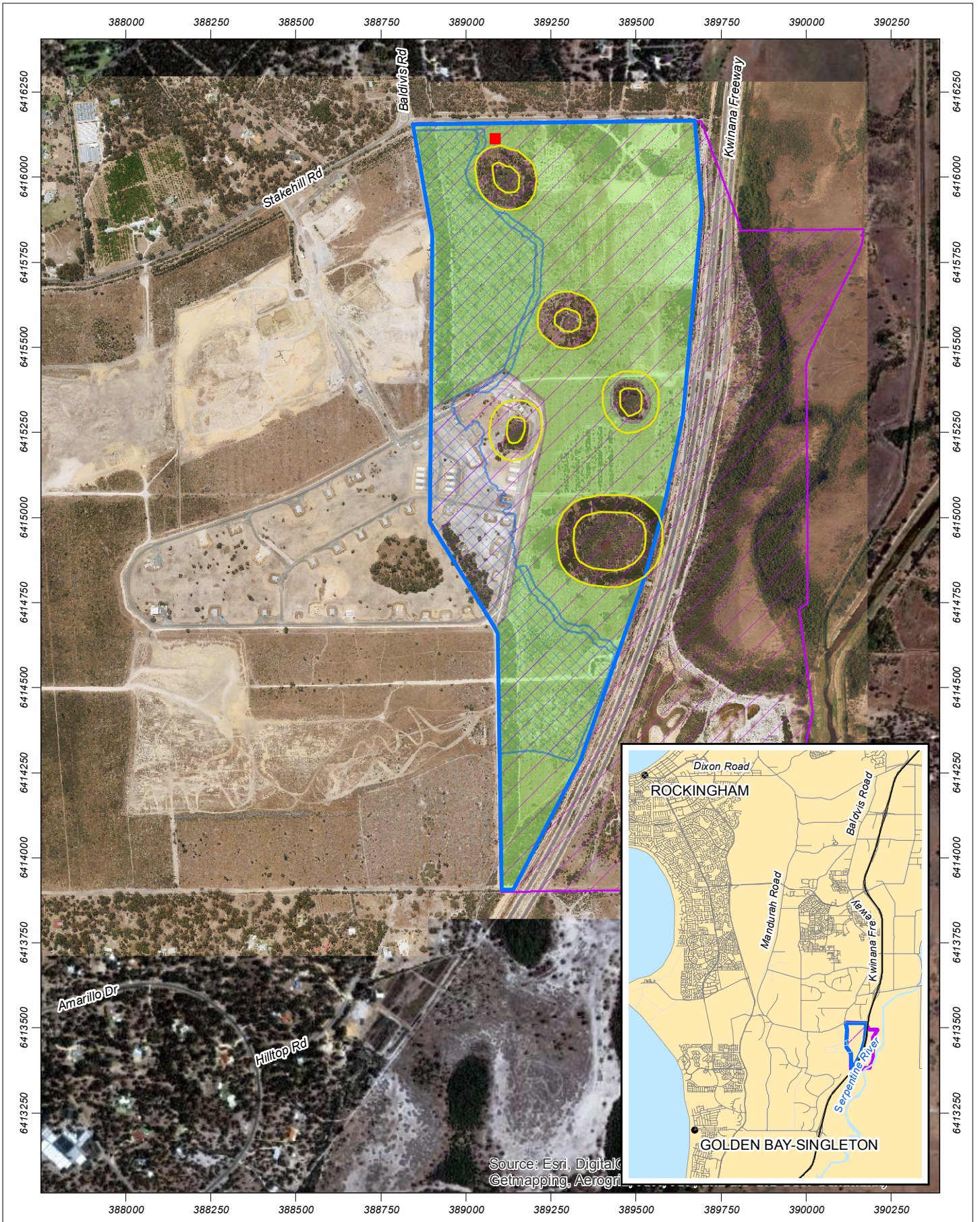

Figure 1: Regional location of the Project

Scale 1:15,000 at A4

0 100 200 300 400 500 m

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 23/06/2015
Author: JCrute
Source: Aerial image: Landgate, flown 11/2014. Aerial image background: ESRI approx. 2010.

Legend

- Site compound boundary
- 50m wetland buffer
- Project area
- Mining area
- Tenement M70/1262
- Survey area

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1.4 Environmental setting

1.4.1 Soils and topography

The Survey area is located within the Swan Coastal Plain 2 (SWA2 – Swan Coastal Plain subregion) of Western Australia (Mitchell et al. 2002). The Swan Coastal Plain comprises five major geomorphological systems that lie parallel to the coast, namely (from west to east) the Quindalup Dunes, Spearwood Dunes, Bassendean Dunes, Pinjarra Plain and Ridge Hill Shelf (Churchward & McArthur 1980; Gibson et al. 1994). Each major system is composed of further subdivisions in the form of detailed geomorphological units (Churchward & McArthur 1980; Semeniuk 1990; Gibson et al.1994). Beard (1990) describes the Swan Coastal Plain as a low-lying coastal plain, often swampy, with sandhills also containing dissected country rising to the duricrusted Dandaragan plateau on Mesozoic, mainly sandy, yellow soils. The Survey area itself is situated predominately on Bassendean sand.

1.4.2 Climate

The Karnup locality experiences a Mediterranean climate characterised by mild, wet winters and warm to hot, dry summers. The nearest Bureau of Meteorology (BoM) weather station at Medina Research Station (Station No. 9194) provides average monthly climate statistics for the Karnup locality (Figure 2). Average annual rainfall recorded at Medina since 1983 is 752.5 mm (BoM 2015). Rainfall may occur at any time of year; however, most occurs in winter in association with cold fronts from the southwest. Highest temperatures occur between December and March, with average monthly maximums ranging from 28.2℃ in December to 31.5℃ in February (BoM 2015). Lowest temperatures occur between June and September, with average monthly minimums ranging from 8.2℃ in July and August to 9.2℃ in September (BoM 2015).

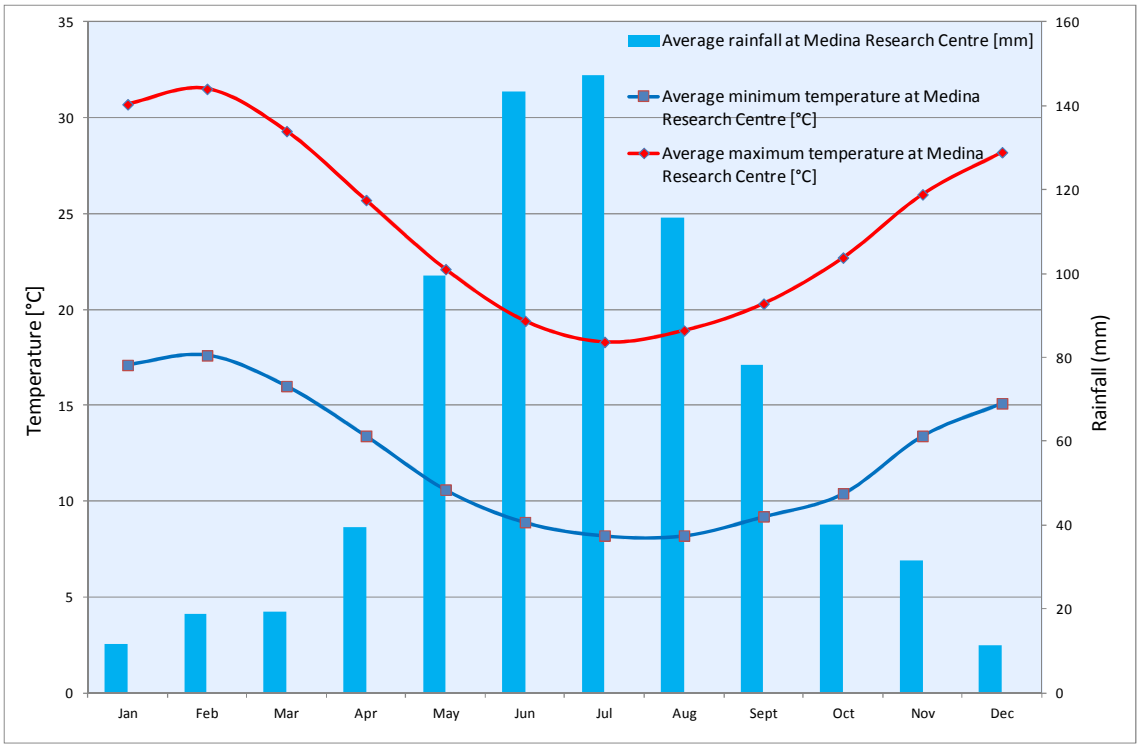

Figure 2: Mean monthly climatic data (temperature and rainfall) for Medina Research Centre

1.4.3 Regional vegetation

Vegetation occurring within the region was initially mapped at a broad scale (1:1 000 000) by Beard during the 1970s. This dataset has formed the basis of several regional mapping systems, including physiographic regions defined by Beard (1981); System 6 Vegetation Complex mapping undertaken by Heddle et al. (1980); the biogeographical region dataset (Interim Biogeographic Regionalisation for Australia, IBRA) for Western Australia (DotE 2015a).

IBRA subregion

The Survey area occurs within the Swan Coastal Plain 2 IBRA subregion which is dominated by *Banksia* or Tuart on sandy soils, *Casuarina obesa* on outwash plains and paperbark (*Melaleuca*) in swampy areas (Mitchell et al. 2002).

Beard (1990) Botanical Subdistrict

The Survey area occurs within the Drummond Botanical Subdistrict which is characterised by low *Banksia* woodlands on leached sands; *Melaleuca* swamps on poorly-drained depressions; and *Eucalyptus gomphocephala* (Tuart), *Eucalyptus marginata* (Jarrah) and *Corymbia calophylla* (Marri) woodlands on less leached soils (Beard 1990).

System 6 mapping

System 6 mapping refers to vegetation mapping undertaken at a Vegetation Complex scale by Heddle *et al.* (1980). This is the primary source of information used to calculate potential impacts of proposals to clear native vegetation on the Swan Coastal Plain. The Survey area occurs at the interface between the Serpentine River and Karrakatta vegetation complexes. These complexes can be described as:

- Serpentine River – closed scrub of *Melaleuca* spp. and fringing woodland of *Eucalyptus rudis* and *M. rhaphiophylla* along streams
- Karrakatta – predominantly open forest of *Eucalyptus gomphocephala – E. marginata – C. calophylla* and woodland of *E. marginata – Banksia* spp.

2. Objectives

The general aim of this survey was to undertake an environmental investigation of the Survey area. The objectives were to:

- conduct a desktop survey for Threatened and Priority flora which have been identified as being present in or around the Survey area
- collect and identify the vascular plant species present within the Survey area
- search areas of suitable habitat for Threatened and/or Priority flora
- define and map the native vegetation communities present within the Survey area
- provide recommendations on the local and regional significance of the vegetation communities
- identify habitat for Threatened species of black cockatoos within the Survey area
- prepare a report summarising the findings.

3. Methods

3.1 Desktop Assessment

A desktop assessment was conducted using Florabase, Parks and Wildlife, and Department of the Environment (DotE) databases to identify the possible occurrence of TECs, PECs, Threatened and Priority flora, and conservation significant fauna species potentially occurring within the Survey area. Reports that document regional flora, vegetation and fauna within the surrounds of the Survey area were also reviewed prior to the field assessment.

A database search request was also submitted to the Threatened Communities Branch of Parks and Wildlife to identify any potential TECs or PECs within 5 km of the Survey area.

3.2 Field assessment

3.2.1 Flora and vegetation

Assessment of flora and vegetation within the Survey area was undertaken by an experienced ecologist from Strategen and senior ecologist from Mattiske Consulting on 1 May 2015 (Table 1). Five vegetation mapping sites were surveyed and the entire site was traversed on foot to record changes in vegetation structure and type (Appendix 1; Appendix 2). The field survey was conducted according to standards set out in Guidance Statement 51 (EPA 2004).

Table 1: Personnel

Name	Project involvement	Flora collection permit
Mr. D. Panickar Strategen (Experienced Ecologist)	Planning, fieldwork, data interpretation and report preparation	SL010993
Mr. J. Cargill Mattiske Consulting (Senior Ecologist)	Fieldwork and plant identification	SL011297

Site selection for vegetation mapping was based on differences in structure and species composition of the communities present within the Survey area. Vegetation mapping sites were determined from aerial photographs and opportunistic sites were selected in the field where a change in vegetation structure or composition was observed.

Flora and vegetation was described and sampled systematically at each survey site and additional opportunistic collecting was undertaken wherever previously unrecorded plants were observed. At each site the following floristic and environmental parameters were noted:

- GPS location
- topography
- soil type and colour
- outcropping rocks and their type
- percentage cover and average height of each vegetation stratum
- presence of significant trees.

For each vascular plant species, the average height and percent cover (both live and dead material) were recorded.

All plant specimens collected during the field surveys were dried and fumigated in accordance with the requirements of the Western Australian Herbarium. The plant species were identified through comparisons with pressed specimens housed at the Western Australian Herbarium where necessary. Nomenclature of the species recorded is in accordance with Western Australian Herbarium (1998-).

3.2.2 Black cockatoo habitat assessment

Desktop assessments identified the potential presence of all three species of Threatened species of black cockatoos (Forest Red-tailed Black-Cockatoos [FRTBC], Baudin's Black-Cockatoos [BBC] and Carnaby's Black-Cockatoos [CBC]) within the Survey area. A foraging and significant tree assessment was undertaken simultaneously with the flora and vegetation assessment to quantify the value of the Survey area as potential habitat for black cockatoos.

Foraging assessment

The Survey area was traversed on foot to record any flora species with the potential to provide a food source for black cockatoos. Data from this assessment were combined with vegetation mapping units defined during the flora and vegetation assessment. Vegetation units were then assigned a foraging value based on the presence and quantity of potential food species and any evidence of foraging by black cockatoos.

Significant tree assessment

Significant trees are defined as trees of suitable species with a diameter at breast height (DBH) greater than 500 mm (> 300 mm for salmon gum and wandoo) (DSEWPaC [now DotE] 2012). Tree species which are considered to be potential breeding or roosting trees are outlined in Table 2. Trees with a DBH greater than 500 mm (or >300 mm for salmon gum and wandoo) are large enough to potentially contain hollows suitable for nesting black cockatoos, or have the potential to develop suitable hollows over the next 50 years. Trees of this size may also be large enough to provide roosting habitat (i.e. trees which provide a roost or rest area for the birds). The locations of such trees within the Survey area were recorded using a Global Positioning System (GPS) device. In addition to the location and DBH, the species of each tree was also recorded.

Table 2: Black cockatoo potential breeding tree species (Groom 2011, DSEWPaC 2012)

Scientific name	Common name	Breeding	Roosting
Corymbia calophylla	Marri	Yes	Yes
Corymbia maculata	Spotted Gum		Yes
Eucalyptus accedens	Powderbark	Yes	
Eucalyptus camaldulensis	River Red Gum		Yes
Eucalyptus citriodora	Lemon Scented Gum		Yes
Eucalyptus diversicolor	Karri	Yes	
Eucalyptus globulus	Tasmania Blue Gum		Yes
Eucalyptus gomphocephala	Tuart	Yes	Yes
Eucalyptus grandis	Flooded Gum, Rose Gum		Yes
Eucalyptus longicornis	Red Morrell	Yes	
Eucalyptus loxophleba	York Gum	Yes	
Eucalyptus marginata	Jarrah	Yes	Yes
Eucalyptus megacarpa	Bullich	Yes	Yes
Eucalyptus occidentalis	Swamp Yate	Yes	
Eucalyptus patens	Blackbutt	Yes	Yes
Eucalyptus robusta	Swamp Mahogany		Yes
Eucalyptus rudis	Flooded Gum	Yes	Yes
Eucalyptus salmonophloia	Salmon Gum	Yes	
Eucalyptus salubris	Gimlet	Yes	
Eucalyptus wandoo	Wandoo	Yes	Yes
Pinus pinaster	Pinaster, Maritime Pine		Yes
Pinus radiata	Monterey, Radiata Pine		Yes

3.3 Data analysis and vegetation mapping

Due to the degraded nature and uniform distribution of vegetation within the Survey area, quadrat data were grouped into a species by site matrix to delineate individual vegetation types (VTs) present within the Survey area. Aerial photography interpretation and field notes taken during the survey were then used to develop VT mapping polygon boundaries over the Survey area. These polygon boundaries were then digitised using Geographic Information System (GIS) software.

VT descriptions (though floristic in origin) have been adapted from the National Vegetation Information System (NVIS) Australian Vegetation Attribute Manual Version 6.0 (ESCAVI 2003), a system of describing structural vegetation units (based on dominant taxa). This model follows nationally-agreed guidelines to describe and represent vegetation types, so that comparable and consistent data is produced nation-wide. For the purposes of this report, a VT is considered equivalent to a NVIS sub-association as described in ESCAVI (2003).

Vegetation condition was recorded at all quadrats, and also opportunistically within the Survey area during the field assessment where required. Vegetation condition was described using the vegetation condition scale for the South West Botanical Province (Keighery 1994). Vegetation condition polygon boundaries were developed using this information in conjunction with aerial photography interpretation, and were digitised as for vegetation type mapping polygon boundaries.

3.4 Flora and vegetation assessment limitations and constraints

Table 3 displays the evaluation of the flora and vegetation assessment against a range of potential limitations that may have an effect on that assessment. Based on this evaluation, the assessment has not been subject to constraints that would affect the thoroughness of the assessment and the conclusions reached.

Table 3: Flora and vegetation assessment potential limitations and constraints

Potential limitation	Impact on assessment	Comment
Sources of information and availability of contextual information (i.e. pre-existing background versus new material).	**Not a constraint.**	The study has been undertaken in the Drummond Botanical Subdistrict on the Swan Coastal Plain which has been well studied and documented with ample literature available (Beard 1990).
Scope (i.e. what life forms, etc., were sampled).	**Not a constraint.**	Due to the degraded nature and uniform distribution of vegetation within the Survey area, most life forms are likely to have been sampled adequately during the time of the survey.
Proportion of flora collected and identified (based on sampling, timing and intensity).	**Not a constraint.**	The proportion of flora surveyed was adequate. The entire site was traversed and all species observed were recorded in accordance with a Level 1 survey.
Completeness and further work which might be needed (i.e. was the relevant survey area fully surveyed).	**Not a constraint**	The information collected during the survey was sufficient to assess the vegetation that was present during the time of the survey.
Mapping reliability.	**Not a constraint.**	Aerial photography of a suitable scale was used to map the Survey area. Sites were chosen from these aerials to reflect changes in community structure. Opportunistic sites were also used if differences were observed during on ground reconnaissance. Vegetation types were assigned to each site based on topography, soil type, presence/absence and percent foliage cover of vegetation.
Timing, weather, season, cycle.	**May be a constraint.**	Flora and vegetation surveys are normally conducted following winter rainfall in the South-West Province, ideally during spring (EPA 2004). The field assessment was conducted in May and as such, some annual herb and forb species may not have been recorded during the assessment.
Disturbances (fire flood, accidental human intervention, etc.).	**Not a constraint.**	The Survey area and regional surrounds have been subject to disturbance over a significant period of time. Given the wide range of this disturbance, this is not considered to be a limitation within the Survey area.
Intensity (in retrospect, was the intensity adequate).	**Not a constraint.**	The entire site was traversed on foot and differences in vegetation structure were recorded appropriately.
Resources (i.e. were there adequate resources to complete the survey to the required standard).	**Not a constraint.**	The available resources were adequate to complete the survey.
Access problems (i.e. ability to access survey area).	**Not a constraint.**	Existing tracks enabled adequate access to survey the vegetation within the Survey area. Where access was not available by car, the area was easily traversed by foot.
Experience levels (e.g. degree of expertise in plant identification to taxon level).	**Not a constraint.**	All survey personnel have the appropriate training in sampling and identifying the flora of the region.

4. Results

4.1 Desktop assessment results

4.1.1 Flora and vegetation

A total of 108 native vascular plant taxa from 40 plant families have the potential to occur within the vicinity of the Survey area (Parks and Wildlife 2007-). The majority of taxa were from within the *Cyperaceae* (15 taxa), *Myrtaceae* (9 taxa) and *Fabaceae* (8 taxa) families (Appendix 3).

Threatened and Priority Ecological Communities

A TEC is defined under the EP Act as an ecological community listed, designated or declared under a written law or a law of the Australian Government as Threatened, Endangered or Vulnerable. There are four State categories of TECs (DEC 2010)[1]:

- presumed totally destroyed (PD)
- critically endangered (CR)
- endangered (EN)
- vulnerable (VU).

A description of each of these TEC categories is presented in Appendix 4. TECs are gazetted as such (Parks and Wildlife 2014a) and some Western Australian TECs are listed as Threatened under the EPBC Act.

Under the EPBC Act, a person must not undertake an action that has or will have a significant impact on a listed TEC without approval from the Australian Government Minister for the Environment, unless those actions are not prohibited under the EPBC Act. A description of each of these categories of TECs is presented in Appendix 4. The current EPBC Act list of TECs can be located on the DotE (2015b) website.

Ecological communities identified as threatened, but not listed as TECs, are classified as Priority Ecological Communities (PECs). These communities are under threat, but there is insufficient information available concerning their distribution to make a proper evaluation of their conservation status. Parks and Wildlife categorises PECs according to their conservation priority, using five categories, P1 (highest conservation significance) to P5 (lowest conservation significance), to denote the conservation priority status of such ecological communities. Appendix 4 defines PECs (DEC 2010). A list of current PECs can be viewed at the Parks and Wildlife (2014b) website.

No TECs or PECs were identified as having the potential to occur within the Survey area (Figure 3). The closest PEC identified in proximity to the Survey area was SCP 25 (Southern *Eucalyptus gomphocephala – Agonis flexuosa* woodlands) which had a buffer of approximately 1.3 km from the Survey area.

[1] The Department of Environment and Conservation is still listed as the author of all TEC and PEC databases and have been referred to as such in this document instead of the Department of Parks and Wildlife (Parks and Wildlife).

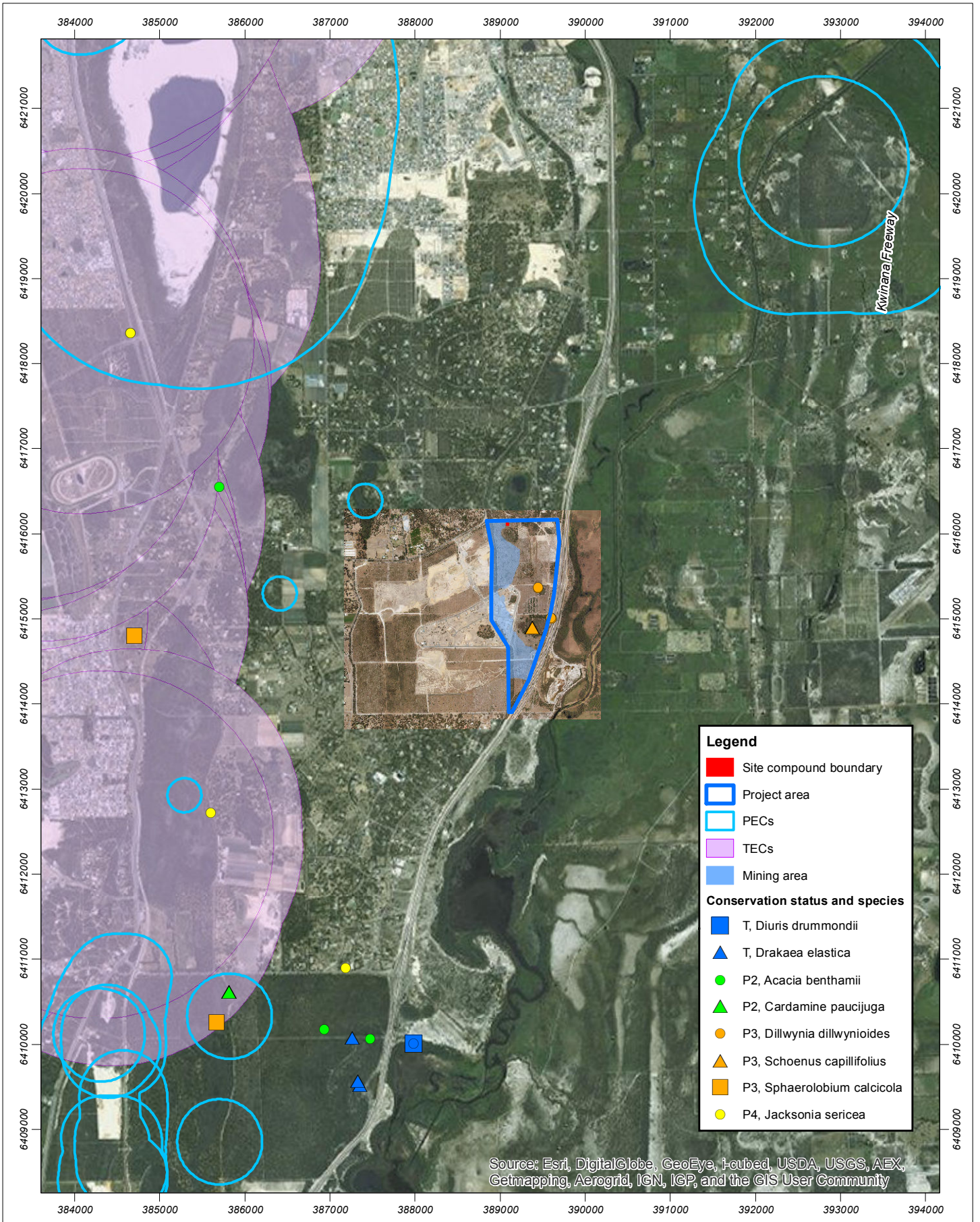

Figure 3: Location of Threatened and Priority Flora, TECs and PECs

Scale 1:60,000 at A4

0 0.5 1 1.5 2 km

N

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 23/06/2015
Author: JCrute
Source: Aerial image: Landgate, flown 11/2014. Background aerial image: : ESRI online, approx. 2010. TEC/PEC & Flora: DPAW 2015.

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Threatened and Priority flora

A desktop survey for Threatened and Priority flora that may potentially occur within the Survey area was undertaken using NatureMap (Parks and Wildlife 2007-), the Western Australian Herbarium (Western Australian Herbarium 1998-), and the DotE Protected Matters Search Tool (DotE 2015c).

Flora within Western Australia that is considered to be under threat may be classed as either Threatened flora or Priority flora. Where flora has been gazetted as Threatened flora under the WC Act, the taking of such flora without the written consent of the Minister is an offence. The WC Act defines "to take" flora as to gather, pluck, cut, pull up, destroy, dig up, remove or injure the flora or to cause or permit the same to be done by any means.

Priority flora are considered to be species which are potentially under threat, but for which there is insufficient information available concerning their distribution and/or populations to make a proper evaluation of their conservation status. Parks and Wildlife categorises Priority flora according to their conservation priority using five categories, P1 (highest conservation significance) to P5 (lowest conservation significance), to denote the conservation priority status of such species. Priority flora species are regularly reviewed and may have their priority status changed when more information on the species becomes available. Appendix 4 defines levels of Threatened and Priority flora (Western Australian Herbarium 1998-).

At the national level, the EPBC Act lists Threatened species as extinct, extinct in the wild, critically endangered, endangered, vulnerable, or conservation dependent. Appendix 4 defines each of these categories of Threatened species. The EPBC Act prohibits an action that has or will have a significant impact on a listed Threatened species without approval from the Australian Government Minister for the Environment. The current EPBC Act list of Threatened flora may be found on the DotE (2015d) website.

Table 4 shows the Threatened and Priority flora potentially occurring within the Survey area. The desktop assessment identified ten Threatened flora and three Priority flora species that have the potential to occur within the area. Of these, based on specific habitat requirements, three Threatened flora species (*Caladenia huegelii, Drakaea elastica* and *Drakaea micrantha*) and four Priority flora species (*Cardamine paucijuga, Sphaerolobium calcicola, Dillwynia dillwynioides* and *Jacksonia sericea*) were considered to have the potential to occur. Figure 3 shows occurrences of *Dillwynia dillwynioides* and *Schoenus capillifolius* within wetlands in proximity to the Survey area (Bennett 2006). As the proposed mining will not occur within wetland areas, these occurrences will not be impacted by the Proposal.

Table 4: Threatened and Priority flora potentially occurring within the Survey area

Species	Conservation status		Description	Potential to occur
	EPBC Act	WC Act		
Andersonia gracilis	**Threatened** - Endangered	Threatened	A slender shrub to 50 cm tall with few, spreading branches. Flowers are pink to pale mauve. Habitat for this species occurs within seasonally damp, black sandy clay flats near swamps (Western Australian Herbarium 1998-, DotE 2015e).	**Unlikely –** Preferred soil type/habitat does not occur within the Survey area– wetland areas will not be impacted by the proposed mining.
Caladenia huegelii	**Threatened** – Endangered	Threatened	A slender orchid from 30 to 50 cm tall. One or two striking flowers characterised by a greenish-cream lower petal with a maroon tip. Other petals are cream with red or pink suffusions. Habitat for this species occurs within well-drained, deep sandy soils in low mixed Banksia, Allocasuarina and Jarrah woodlands (Western Australian Herbarium 1998-, DotE 2015e).	**Possible –** Preferred soil type/habitat occurs within the Survey area.
Centrolepis caespitosa	**Threatened** – Endangered	Priority 4	A diminutive, densely tufted, glabrous annual herb. Flowers are red/brown and are singular. Habitat for this species is relatively unknown. Brown et al. (1998) identified that this species occurs within winter-wet claypans dominated by low shrubs and sedges.	**Unlikely –** Preferred soil type/habitat does not occur within the Survey area– wetland areas will not be impacted by the proposed mining. It is worth noting that Parks and Wildlife have removed this species from its Threatened flora listing and is now classed as Priority 4.
Darwinia foetida	**Threatened** – Critically Endangered	Threatened	An erect, spreading shrub to 70 cm tall. Green flowers, visible from October to November. Habitat for this species occurs within wet/winter-damp clay under Myrtaceous shrubland (DotE 2015e).	**Highly unlikely –** Preferred habitat does not occur within the Survey area as wetland areas will not be impacted by the proposed mining. Additionally, both Western Australian Herbarium (1998-) and DotE (2015e) list this species' distribution to be highly restricted within the Muchea area (approximately 70 km north of Perth).
Diuris drummondii	**Threatened** – Vulnerable	Threatened	A perennial orchid to 105 cm tall. Often forms dense colonies with individuals displaying between three and eight widely spaced yellow flowers. Habitat for this species occurs in low-lying depressions in peaty and sandy clay swamps (DotE 2015e).	**Unlikely –** Preferred soil type/habitat does not occur within the Survey area– wetland areas will not be impacted by the proposed mining.
Diuris micrantha	**Threatened** – Vulnerable	Threatened	A slender orchid to 60 cm tall. Yellow flowers with reddish-brown markings measuring 1.3 cm across. Habitat for this species occurs within clay-loam substrates in winter-wet depressions or swamps (DotE 2015e).	**Unlikely –** Preferred soil type/habitat does not occur within the Survey area– wetland areas will not be impacted by the proposed mining.
Diuris purdiei	**Threatened** – Endangered	Threatened	A slender orchid to 45 cm tall. Unusually flattened flowers, marked with brown blotches on their under surface. Habitat for this species occurs in areas subject to winter inundation within dense heath with scattered Myrtaceous trees (DotE 2015e).	**Unlikely –** Preferred soil type/habitat does not occur within the Survey area – wetland areas will not be impacted by the proposed mining.
Drakaea elastica	**Threatened** – Endangered	Threatened	A slender orchid to 30 cm tall with a prostrate, round to heart shaped leaf. Singular, bright green, glossy flower. Habitat for this species is within bare patches of white sand over dark sandy loams on damp areas (DotE 2015e).	**Possible –** Preferred soil type/habitat occurs within the Survey area.

Species	Conservation status		Description	Potential to occur
	EPBC Act	WC Act		
Drakaea micrantha	**Threatened** – Vulnerable	Threatened	A tuberous, terrestrial orchid to 30 cm tall. Silvery-grey heart shaped leaf with prominent green veins. Red and yellow singular flower. Habitat for this species occurs within cleared, open sandy patches (Brown et al. 1998).	**Possible –** Preferred soil type/habitat occurs within the Survey area.
Lepidosperma rostratum	**Threatened** – Endangered	Threatened	A rhizomatous sedge to 30 cm in diameter. Stems are circular in cross section and flowers are spike-like and up to 4 cm long. Habitat for this species occurs in sandy soils among low heath comprised of *Banksia telmatiaea* and *Calothamnus hirsutus* in winter-wet swamps.	**Unlikely –** Preferred soil type/habitat does not occur within the Survey area – wetland areas will not be impacted by the proposed mining.
Synaphea stenoloba	**Threatened** – Endangered	Threatened	A caespitose shrub to 45 cm tall. Yellow flowers visible from August to October. Habitat for this species occurs within loamy soils in low lying areas that are seasonally inundated (DotE 2015e).	**Unlikely –** Preferred soil type/habitat does not occur within the Survey area – wetland areas will not be impacted by the proposed mining.
Acacia benthamii	Not listed	Priority 2	A shrub to 1 m tall. Flowers are yellow and visible from August to September (Western Australian Herbarium 1998-). Habitat for this species is typically on limestone breakaways.	**Unlikely –** Preferred soil type/habitat does not occur within the Survey area.
Cardamine paucijuga	Not listed	Priority 2	A slender, erect annual herb to 0.4 m tall. Flowers are white and visible from September to October (Western Australian Herbarium 1998-). Habitat for this species occurs in a broad range of settings.	**Possible –** Preferred soil type/habitat could occur within the Survey area.
Sphaerolobium calcicola	Not listed	Priority 3	A slender, multi-stemmed, scandent or erect shrub to 1.5 m tall. Flowers are orange-red and visible in June or from September to November (Western Australian Herbarium 1998-). Habitat for this species occurs in a broad range of settings.	**Possible –** Preferred soil type/habitat could occur within the Survey area.
Dillwynia dillwynioides	Not listed	Priority 3	A decumbent or erect, slender shrub to 1.2 m tall. Flowers are red and yellow/orange and visible in August to December (Western Australian Herbarium 1998-). Habitat for this species is in winter-wet depressions and sandy soils.	**Possible –** Preferred soil type/habitat occurs within the Survey area.
Schoenus capillifolius	Not listed	Priority 3	A semi-aquatic, tufted, annual grass-like herb to 5 cm tall. Flowers are green and visible from October to November (Western Australian Herbarium 1998-). Habitat for this species is in brown mud in claypans.	**Unlikely –** Preferred soil type/habitat does not occur within the Survey area – wetland areas will not be impacted by the proposed mining.
Stylidium longitubum	Not listed	Priority 3	An erect annual herb to 12 cm tall. Flowers are pink and visible from October to December (Western Australian Herbarium 1998-). Habitat for this species occurs in sandy clay in seasonal wetlands.	**Unlikely –** Preferred soil type/habitat does not occur within the Survey area – wetland areas will not be impacted by the proposed mining.
Jacksonia sericea	Not listed	Priority 4	A Low spreading shrub to 0.6 m tall. Flowers are orange and visible from December to February (Western Australian Herbarium 1998-). Habitat for this species occurs in calcareous and sandy soils.	**Possible –** Preferred soil type/habitat occurs within the Survey area.

4.1.2 Black cockatoo habitat

All three species of Threatened black cockatoos occurring in Western Australia were identified as having the potential to occur within the Survey area based on a desktop survey for Threatened fauna (DotE 2015c; Appendix 3). Table 5 displays the current conservation status for the three identified species within the Survey area. Desktop surveys also identified the presence of Jarrah-*Banksia* woodland within the Survey area which may provide both foraging and breeding habitat for black cockatoos.

Table 5: Threatened species of black cockatoos potentially occurring within the Survey area

Species		Conservation status	
Common name	Scientific name	EPBC Act	WC Act
Carnaby's Black-Cockatoo	*Calyptorhynchus latirostris*	Endangered	Threatened
Baudin's Black-Cockatoo	*Calyptorhynchus baudinii*	Vulnerable	Threatened
Forest Red-tailed Black Cockatoo	*Calyptorhynchus banksii* naso	Vulnerable	Threatened

Foraging and breeding habits of black cockatoos

Carnaby's Black-Cockatoos feed on the seeds, nuts and flowers, of a variety of native and introduced plant species and insect larvae (DotE 2015e). Food plants generally occur within proteaceous genera such as *Banksia, Dryandra, Hakea* and *Grevillea*, though are known to forage on eucalypt species in woodland areas. Carnaby's black cockatoos have also adapted to feeding on exotic species such as pines and cape lilac and weeds such as wild radish and wild geranium (DotE 2015e). Carnaby's black cockatoos usually breed between July and December in the hollows of live or dead eucalypts; primarily in Salmon Gum and Wandoo, but also within Jarrah, Marri and other eucalypt species (Johnstone 2010a). Hollows are usually at least 2 m above ground, sometimes over 10 m and the depth of the hollow vary from 0.25 m to 6 m (DotE 2015e). The Western Australian Department of Parks and Wildlife (Parks and Wildlife), renewed the Carnaby's Cockatoo Recovery Plan in 2013, clearly mapping the distribution of likely breeding and non-breeding areas in south-west WA for CBC (Parks and Wildlife 2013). Based on this map, the Survey area is situated within the CBC breeding range.

Baudin's Black-Cockatoos primarily occur in eucalypt forests and forage at all strata levels within the forests with a tendency to favour areas containing Marri (Johnstone and Kirkby 2008, DotE 2015e). Breeding generally occurs in the Jarrah, Marri and Karri forests of the southwest of Western Australia in areas averaging more than 750 mm of rainfall annually (DotE 2015e). As with the other two species of Threatened black cockatoos in Western Australia, breeding habitat also occurs in former woodland or forest that has been reduced to isolated trees (DotE 2015e).

Forest Red-tailed Black-Cockatoos depend primarily on Marri and Jarrah trees for both foraging and nesting. The seeds of both eucalypts are the favoured food source of the birds and hollows within live or dead individual trees are utilised for nesting purposes (Johnstone and Kirkby 1999). Breeding varies between years and occurs at times of Jarrah and Marri fruiting. These black cockatoos breed in woodland or forest, but may also breed in former woodland or forest that has been reduced to isolated trees (DotE 2015e).

4.2 Field survey results

4.2.1 Native flora

A total of 41 native vascular plant taxa from 34 plant genera and 18 plant families were recorded within the Survey area. The majority of taxa were recorded within the Fabaceae (8 taxa), Myrtaceae (6 taxa) and Proteaceae (5 taxa) families (Appendix 5). The relatively low number of plant genera recorded reflects the disturbed nature of the site.

4.2.2 Threatened and Priority flora

No Threatened flora species pursuant to Schedule 1 of the WC Act and as listed by Parks and Wildlife (2014c) or Priority flora species as listed by Western Australian Herbarium (1998-) were recorded within the Survey area (Appendix 5).

4.2.3 Threatened and Priority Ecological Communities

No TECs as listed by Parks and Wildlife (2014a) or PECs as listed by Parks and Wildlife (2014b) were identified within the Survey area. The closest PEC identified in proximity to the Survey area was SCP 25 (Southern *Eucalyptus gomphocephala – Agonis flexuosa* woodlands) which had a buffer of approximately 1.3 km from the Survey area (refer to section 4.1.1), but was not inferred to occur within the Survey area based on floristic composition.

4.2.4 Introduced (exotic) flora

A total of six introduced (exotic) taxa were recorded within the Survey area (Appendix 5):

- **Briza maxima*
- **Carpobrotus edulis*
- **Conyza sumatrensis*
- **Eragrostis curvula*
- **Hypochaeris glabra*
- **Lagurus ovatus.*

None of these species is a Declared Plant species in Western Australia pursuant to Section 22 of the *Biosecurity and Agriculture Management Act 2007* (BAM Act) according to the Western Australian Department of Agriculture and Food (DAFWA 2014).

4.3 Vegetation Types

Five native vegetation types (VTs) were defined and mapped within the Survey area (Appendix 1; Figure 4) and are summarised in Table 6. Areas containing pine plantations or cleared vegetation have not been counted as unique VTs. The flora and vegetation assessment and black cockatoo habitat assessment surveyed the majority of the Project area however did not include the Explosives Reserve Facility due to restricted access. The vegetation associated with this area has been inferred and a high level of confidence on this inference exists.

Total areas occupied within the Survey area by each of the identified VTs are set out in Table 7.

Table 6: Vegetation Types

Vegetation Type	Description
1	*Macrozamia fraseri, Daviesia triflora* and *Acacia stenoptera* mid open shrubland over *Lyginia barbata, Conostylis aculeata* and *Phlebocarya ciliata* low open sedgeland with *Xylomelum occidentale* and *Eucalyptus rudis* occurring as isolated trees.
2	*Banksia menziesii, B. attenuata, Allocasuarina fraseriana* and *Eucalyptus marginata* open woodland over *Kunzea glabrescens, Acacia pulchella* and *Macrozamia fraseri* mid sparse shrubland over *Hibbertia hypericoides, Conostephium pendulum* and *Gompholobium tomentosum* low sparse shrubland. Including 1.02 ha inferred VT2 within Explosives Reserve.
3	*Jacksonia sternbergiana* and *Adenanthos cygnorum* subsp. *cygnorum* mid shrubland over *Conostylis aculeata* and *Lyginia barbata* low sparse sedgeland.
4[1]	*Banksia menziesii, B. attenuata, Eucalyptus marginata* and *Allocasuarina fraseriana* low open woodland over *Jacksonia furcellata, Regelia ciliata* and *B. sessilis* mid sparse shrubland over *Tetraria octandra* and *Ficinia nodosa* low sparse sedgeland.
5	*Eucalyptus* sp. (planted) open woodland over *Acacia saligna, Jacksonia furcellata* and *Kunzea glabrescens* tall sparse shrubland over **Eragrostis curvula* low sparse tussock grassland.
P[2]	Pine plantation (*Pinus pinaster*).
C[2]	Cleared areas.

1 This vegetation type appears to be the result of rehabilitation activities.

2 Cleared areas and pine plantations have been mapped but are not counted as a unique VT.

4.3.1 Vegetation Type coverage

The total area mapped within the Survey area was 94.94 ha which includes cleared areas and pine plantations (Table 7). The dominant VT within the Survey area was VT 1 which can be broadly described as an open shrubland of *Macrozamia fraseri, Daviesia triflora* and *Acacia stenoptera* with isolated *Xylomelum occidentale* and *Eucalyptus rudis* trees.

Table 7: Area (ha) covered by each VT within the Survey area

VT	Area (ha)	Percentage of the Survey area
1	59.37	62.53
2	7.91	8.33
3	2.02	2.12
4	9.36	9.85
5	7.11	7.50
Pine plantation	3.29	3.47
Cleared areas	5.88	6.20
TOTAL	**94.94**	**100.00**

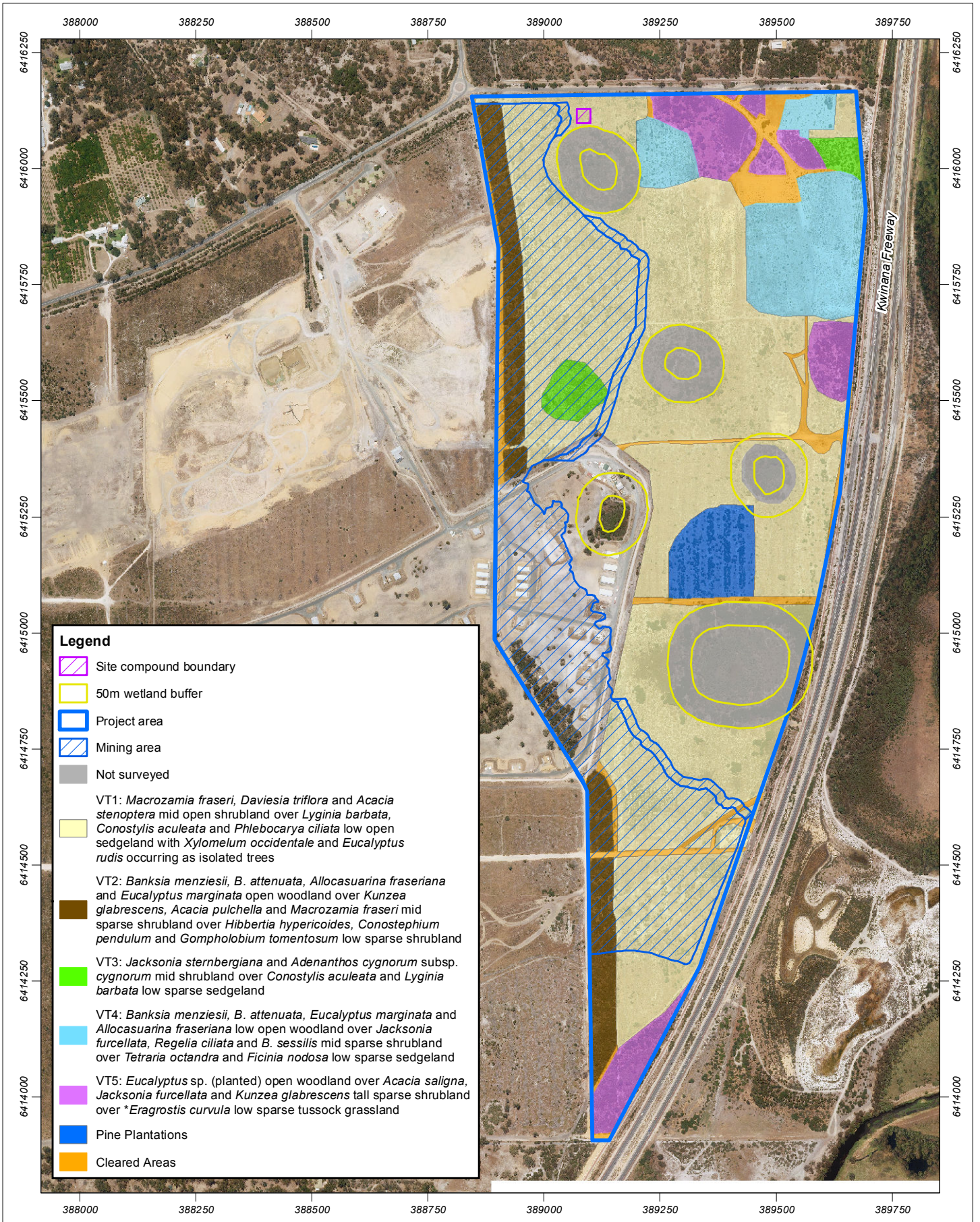

Figure 4: Vegetation types mapped within the Project area

Scale 1:10,997 at A4

0 50 100 150 200 250 Meters

N

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 23/06/2015
Author: JCrute
Source: Aerial image: Landgate, flown 11/2014.

Path: Q:\Consult\2015\URE\URE15096.01\ArcMap_documents\R004\RevC\URE15096_01_R004_RevC_F004.mxd

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4.4 Vegetation condition

The majority of the Survey area is in various stages of natural regeneration following the clearing of existing pine plantations from 2004 (approx.). Natural regeneration has been largely successful throughout majority of the Survey area and as such, vegetation condition within these areas was mapped as Good (Keighery 1994; Table 8). Vegetation condition throughout the remainder of the Survey area was mapped as follows:

- Very good: retained *Banksia* woodland in the vegetated strip on the western boundary of the Survey area
- Good: retained *Eucalyptus*/*Acacia* woodland along the southern boundary of the Survey area
- Completely Degraded: Cleared areas and pine plantations.

A summary of vegetation condition within the Survey area is displayed in Figure 5. Table 9 gives a numerical breakdown of the area occupied by each vegetation condition rating within the Survey area.

Table 8: Vegetation condition scale (Keighery 1994)

Condition rating	Description
Pristine (1)	Pristine or nearly so, no obvious sign of disturbance.
Excellent (2)	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
Very Good (3)	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 (4)	Vegetation structure significantly altered by 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, grazing.
Degraded (5)	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 (6)	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.

Table 9: Area (ha) covered by each vegetation condition rating category within the Survey area

Vegetation Condition	Area (ha)	Percentage of the Survey area
Excellent	-	-
Very Good	7.91	8.33
Good	77.86	82.01
Completely Degraded	9.17	9.66
Total	**94.94**	**100.00**

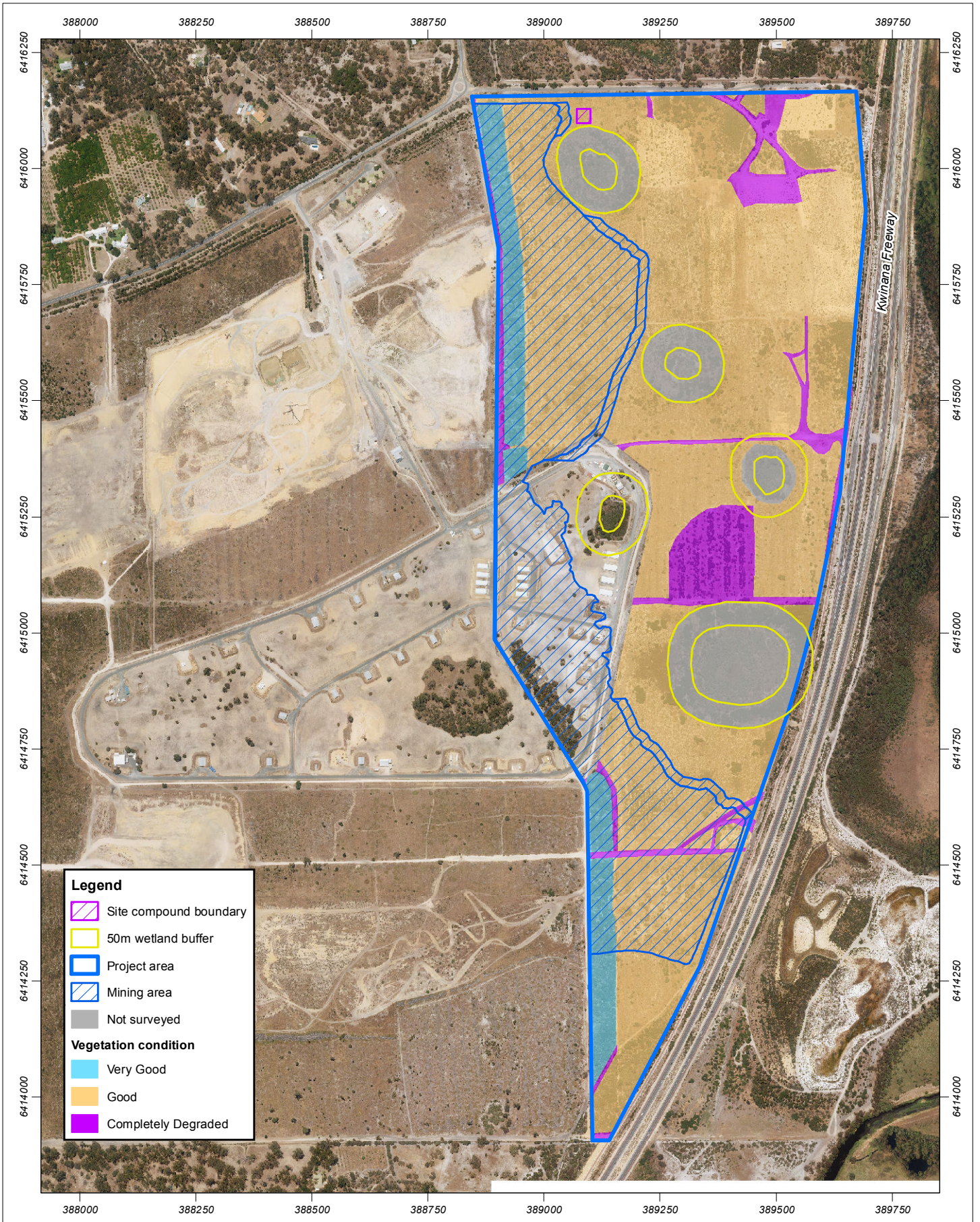

Figure 5: Vegetation condition mapped within the Project area

Scale 1:10,997 at A4

0 50 100 150 200 250 Meters

N

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 23/06/2015
Author: JCrute
Source: Aerial image: Landgate, flown 11/2014.

Path: Q:\Consult\2015\URE\URE15096.01\ArcMap_documents\R004\RevC\URE15096_01_R004_RevC_F005.mxd

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4.5 Black cockatoo habitat

4.5.1 Foraging assessment

The Survey area was divided into six different vegetation types (VTs) (including pine plantations) and cleared areas, as informed outlined in section 4.3. A summary of the value of each vegetation type as foraging habitat for black cockatoo species is presented in Table 10 (Groom 2011, Johnstone 2010b, Johnstone 2010c, Johnstone *et al.* 2011).

Foraging habitat for black cockatoos is generally defined as the availability of plant food sources within an area (Finn 2012). Food availability for black-cockatoos is a function of the diversity, abundance, distribution, energetic and nutritional qualities, and seasonality (phenology) of the food sources within a particular area. Table 11 summarises the value of each vegetation type in terms of the quality of foraging habitat provided for black cockatoos.

The highest quality foraging habitat for black cockatoos was noted within VT 2 which contained high densities of black cockatoo food species including eucalypts and *Banksia* spp. at canopy and midstorey levels. The lowest quality foraging habitat for black cockatoos (not including cleared areas) was noted within VT 5 which contained limited potential food resources for all three species of black cockatoos (refer to footnote following Table 10) and in the pine plantation which provides limited food resources for CBC only.

Based on the results of the foraging assessment, the Survey area is considered to contain 7.91 ha of very good quality foraging habitat, 9.36 ha of good quality foraging habitat and 66.48 ha of low quality foraging habitat for CBC, BBC and FRTBC. The Survey area also contains an additional 3.29 ha of low quality foraging habitat for CBC only (within the pine plantation).

Signs of CBC foraging were observed in scattered occurrences within VT 2.

Table 10: Vegetation types and black cockatoo foraging species within the Survey area

Vegetation type	Description	Black cockatoo foraging species	Area (ha)
1	*Macrozamia fraseri, Daviesia triflora* and *Acacia stenoptera* mid open shrubland over *Lyginia barbata, Conostylis aculeata* and *Phlebocarya ciliata* low open sedgeland with *Xylomelum occidentale* and *Eucalyptus rudis* occurring as isolated trees.	CBC – *E. rudis* BBC – Nil FRTBC – Nil.	59.37
2	*Banksia menziesii, B. attenuata, Allocasuarina fraseriana* and *Eucalyptus marginata* open woodland over *Kunzea glabrescens, Acacia pulchella* and *Macrozamia fraseri* mid sparse shrubland over *Hibbertia hypericoides, Conostephium pendulum* and *Gompholobium tomentosum* low sparse shrubland. Including 1.02 ha inferred VT2 within Explosives Reserve.	CBC – *B. menziesii, B. attenuata, A. fraseriana, E. marginata* BBC – *A. fraseriana, E. marginata* FRTBC – *A. fraseriana, E. marginata.*	7.91
3	*Jacksonia sternbergiana* and *Adenanthos cygnorum* subsp. *cygnorum* mid shrubland over *Conostylis aculeata* and *Lyginia barbata* low sparse sedgeland.	CBC – Nil BBC – Nil FRTBC – Nil.	2.02
4	*Banksia menziesii, B. attenuata, Eucalyptus marginata* and *Allocasuarina fraseriana* low open woodland over *Jacksonia furcellata, Regelia ciliata* and *B. sessilis* mid sparse shrubland over *Tetraria octandra* and *Ficinia nodosa* low sparse sedgeland.	CBC – *B. menziesii, B. attenuata, B. sessilis, A. fraseriana, E. marginata, J. furcellata* BBC – *B. sessilis, A. fraseriana, E. marginata* FRTBC – *A. fraseriana, E. marginata.*	9.36

Vegetation type	Description	Black cockatoo foraging species	Area (ha)
5	*Eucalyptus* sp. (planted) open woodland over *Acacia saligna, Jacksonia furcellata* and *Kunzea glabrescens* tall sparse shrubland over **Eragrostis curvula* low sparse tussock grassland.	CBC – *A. saligna, J. furcellata, E.* sp. (planted)* BBC – *E.* sp. (planted)* FRTBC – *E.* sp. (planted)*.	7.11
P	Pine plantation (*Pinus pinaster*).	CBC – *P. pinaster* BBC – Nil FRTBC – Nil.	3.29
C	Cleared areas.	CBC – Nil BBC – Nil FRTBC – Nil.	5.88

*The *Eucalyptus* species present in this vegetation type was unable to be identified at the time of assessment. The species did not appear to be native to Western Australia and was likely planted in the Survey area. All three species of black cockatoos may forage on this species; however this is not likely to constitute significant foraging species for black cockatoos.

Table 11: Quality of black cockatoo foraging habitat within the Survey area

Vegetation type	Foraging quality	Justification
1	Low	Low density of species suitable for foraging by black cockatoos (i.e. foliage cover of suitable species 10-20%) and presence of food sources at only one stratum (i.e. canopy).
2	Very good	High density of species suitable for foraging by black cockatoos (i.e. foliage cover of suitable species >60%) and presence of food sources at several strata (i.e. canopy, midstorey and understorey).
3	Nil	No suitable foraging species for black cockatoos present.
4	Good	High density of species suitable for foraging by black cockatoos (i.e. foliage cover of suitable species >60%) but food sources only present at one or two strata (i.e. canopy and midstorey).
5	Low	Low density of species suitable for foraging by black cockatoos (i.e. foliage cover of suitable species 10-20%) and presence of food sources at only one stratum (i.e. canopy).
Pine plantation	Low (CBC only)	Low density of species suitable for foraging by black cockatoos (i.e. foliage cover of suitable species 10-20%) and presence of food sources at only one stratum (i.e. canopy).
Cleared areas	Nil	Cleared areas - no vegetation present.

5. Discussion

Vegetation within the Survey area comprises five native VTs and a remnant pine plantation. Transitions between VTs were generally discontinuous, though occasionally abrupt with margins representing admixtures of more than one VT. This discontinuity is primarily due to changes in soil profile and topography, and presence of cleared areas. At a broad scale, the majority of the Survey area was observed to be in various states of natural regeneration following clearing of historical pine plantations with vegetation comprised of *Macrozamia fraseri, Daviesia triflora* and *Acacia stenoptera* open shrubland with emergent *Xylomelum occidentale* and *Eucalyptus rudis* trees. The linear strip of vegetation which runs along the western and southern boundaries of the Survey area represented a different vegetation structure which was primarily a Jarrah-*Banksia* woodland which was relatively undisturbed by the historical pine plantation.

The flora and vegetation assessment conducted within the Survey area was undertaken during autumn, outside the prime flowering time for majority of species within the area. Field reconnaissance involved traversing the majority of the Survey area, which ensures that an accurate representation of all VTs and potential conservation significant flora were obtained.

The number of native and exotic species recorded on the Survey area totalled 47 vascular plant taxa from 40 genera and 20 families. The relatively low number of plant genera recorded reflects the disturbed nature of the site. Six of these taxa were introduced (exotic species) which were present in moderate to high densities throughout the Survey area. No Declared Plant species pursuant to Section 22 of the BAM Act were recorded within the Survey area (DAFWA 2014).

No conservation significant species or ecological communities were recorded within the Survey area. Effort was made during the field assessment to look for areas of suitable habitat for conservation significant species but none were found, which is likely related to both the disturbed and regenerative nature of the Survey area and the time of year at which the survey was conducted. Given that the survey was conducted outside the prime flowering time for majority of the conservation significant species, there is a possibility that some of these species may occur on the Survey area – however majority of these are likely to be restricted to wetland areas which will not be impacted by the proposed mining.

Conservation significant flora species potentially occurring on the Survey area that may have been missed due to the survey timing are likely to be the three Threatened orchids; *Caladenia huegelii, Drakaea elastica* and *Drakaea micrantha* which are all diminutive in stature and are at their most visible when in flower. Both *Drakaea* species are likely to be restricted to wetland/damp areas and thus are highly unlikely to be impacted by the proposed mining. *C. huegelii* has the potential to occur outside of these wetland areas. Given the disturbed nature of the site and the relatively low number of plant genera recorded on the site it is considered unlikely that the species would be located.

All five native VTs appear to be well represented within the local area based on surrounding vegetation and are consistent with the vegetation expected to be found within the region. Levels of species diversity within each VT is likely to be a reflection of the regenerative nature of majority of the Survey area and impacts from historical pine plantations.

Vegetation condition within the Survey area ranged from Very Good to Completely Degraded (Keighery 1994), with majority of the Survey area (approximately 62%) mapped to be in “Good” condition.

Approximately 7.91 ha of very good quality foraging habitat, 9.36 ha of good quality foraging habitat and 66.48 ha of low quality foraging habitat for CBC, BBC and FRTBC was recorded within the Survey area. The Survey area also contains an additional 3.29 ha of low quality foraging habitat for CBC only (within the pine plantation). No potentially significant trees which could potentially be used by black cockatoos for roosting or breeding purposes in the future were recorded within the Survey area.

6. Recommendations

6.1 Black cockatoos

All three black cockatoo species with the potential to occur within the Survey area are classed as Threatened under the EPBC Act and impact to the breeding or foraging habitats of these species can require referral to, and possible assessment by, DotE.

The *Referral Guidelines for Three Threatened Black Cockatoo Species* (DSEWPaC 2012) assists in determining whether an action needs to be referred under the EPBC Act and has been used to identify whether an EPBC Act referral is recommended for the proposal.

Table 12 outlines the whether the proposal meets any of the trigger levels for referral. From the guidelines, a criterion that could be triggered is the clearing of more than 1 ha of good quality habitat; however, it is considered that no other criteria would be triggered. This indicates that the clearing of vegetation associated with the proposal may require referral under the EPBC Act.

Table 12: Assessment of the proposal against the black cockatoo Referral Guidelines

Referral trigger	Assessment of proposal against referral trigger	Significant impact triggered
High risk of significant impacts: referral recommended		
Clearing of any known nesting tree	No known nesting trees to be cleared.	No
Clearing or degradation of any part of a vegetation community known to contain breeding habitat	The Survey area does not contain breeding habitat or potentially significant trees which could potentially be used by black cockatoos for roosting or breeding purposes in the future.	No
Clearing or degradation of more than 1 ha of quality foraging habitat	Up to 6.54 ha of very good quality foraging habitat and 24.29 ha of low quality foraging habitat for all three species of black cockatoos may be cleared as a result of the proposal.	**Yes**
Clearing or degradation of a known night roosting tree	No known night roosting trees have been recorded within the Proposal Area.	No
Creating a gap of more than 4 km between patches of Black Cockatoo habitat	The Survey area is located in close proximity to a number of existing reserves within Rockingham Lakes Regional Park containing potential black cockatoo habitat including: • Anstey Swamp (4 km) • Paganoni Swamp (3.8 km). As such, the proposal will not create a gap of more than 4 km between patches of habitat.	No

6.2 Conservation significant flora

One conservation significant flora species, *Caladenia huegelii*, whilst unlikely due to disturbance, could potentially occur within the Survey area and may not have been recorded during the flora and vegetation survey due to timing constraints.

The abovementioned species is diminutive in stature and is most visible when in flower. A targeted spring survey in accordance with methodology outlined in DotE (2013) would determine if these species is present within the Survey area.

All other conservation significant flora species (listed in the survey report) are unlikely to occur within the Survey area. Most of these species should either have been visible during time of survey or have habitat requirements which do not occur within the Survey area (i.e. wetland areas).

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Appendix 1
Vascular plant taxa recorded by site and vegetation type

Species	Site					Legend
	1	2	3	4	5	VT1
Acacia pulchella var. *glaberrima*		x	x			VT2
Acacia saligna					x	VT3
Acacia stenoptera	x					VT4
Adenanthos cygnorum subsp. *cygnorum*			x	x		VT5
Allocasuarina fraseriana		x		x		
Banksia attenuata		x		x		
Banksia menziesii		x		x		
Banksia sessilis				x		
Brachyloma preissii		x				
**Briza maxima*	x	x	x			
Burchardia congesta		x				
**Carpobrotus edulis*	x	x	x	x	x	
Conostephium pendulum		x				
Conostylis aculeata subsp. *aculeata*	x	x	x			
**Conyza sumatrensis*				x		
Corymbia calophylla					x	
Dampiera linearis		x				
Dasypogon bromeliifolius	x	x				
Daviesia triflora	x	x				
Desmocladus flexuosus	x	x	x			
**Eragrostis curvula*		x		x	x	
Eucalyptus marginata		x		x		
Eucalyptus rudis	x					
Eucalyptus sp. (planted)				x	x	
Ficinia nodosa				x		
Gompholobium tomentosum	x	x	x			
Hemiandra pungens			x			
Hibbertia hypericoides		x				
**Hypochaeris glabra*	x			x		
Jacksonia furcellata				x	x	
Jacksonia sternbergiana			x	x		
Kennedia prostrata	x	x				
Kunzea glabrescens	x	x			x	
Lagenophora huegelii		x				
**Lagurus ovatus*					x	
Lechenaultia biloba	x					
Lepidosperma pubisquameum		x				
Lyginia barbata	x	x	x			
Macrozamia fraseri	x	x	x			
Olearia axillaris	x					
Patersonia occidentalis	x	x				
Phlebocarya ciliata	x					
Poaceae sp.	x		x			
Regelia ciliata				x		
Stylidium sp.	x					
Tetraria octandra		x		x		
Xylomelum occidentale	x					

* denotes introduced (exotic) species (Western Australian Herbarium 1998-)

Appendix 2
Photographic record of site and vegetation types

Plate 1: Site 01 (VT 1)

Plate 2: Site 02 (VT 2)

Plate 3: Site 03 (VT 3)

Plate 4: Site 04 (VT 4)

Plate 5: Site 05 (VT 5)

Plate 6: Pine plantation

Plate 7: Cleared areas

Appendix 3
Desktop assessment results (Parks and Wildlife 2007-, DotE 2015c)