

28 August 2012

Our Reference: 21053-12LRV1Rev0_120828

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Dear David,

Re: Nillibubbica Quarry – Level 1 Flora and Fauna Survey, July 2012

1 Introduction

Kimberley Quarry Pty. Ltd. (Kimberley Quarries) is expanding their Nillibubbica Quarry operations, located 73 km southwest of Derby. Kimberley Quarries commissioned Astron Environmental Services (Astron) to conduct a level 1 flora and fauna survey for the purposes of a Native Vegetation Clearing Permit. The survey area comprised the proposed new quarry area (10 hectares), an additional six hectare area and an access road approximately 800 metres long and 40 metres wide (Attachment A).

The scope of the level 1 flora and fauna survey was to:

- Undertake a review of the existing desktop assessment of the survey area and highlight the potential occurrence of Declared Rare Flora (DRF), Priority flora and fauna, Threatened Fauna, Threatened Ecological Communities (TECs), Priority Ecological Communities (PECs) and weed species.
- Conduct a level 1 flora and fauna survey designed to:
 - verify the results of the desktop assessment
 - provide a representative species list of flora and fauna present within the survey area
 - describe and map vegetation units within the survey area by sampling relevés within the representative vegetation units
 - identify and record any flora and fauna species of conservation significance
 - identify potential impacts.
- Prepare a letter report that will include:
 - brief summary of methods
 - brief summary of existing desktop assessment information
 - potential limitations of the survey
 - vegetation mapping
 - summary of DRF, Threatened Fauna, Priority flora and fauna, TECs, PECs and weeds identified
 - advice on measures to minimise environmental impacts, and potential impacts on protected species (State and Commonwealth).

2 Methodology

2.1 Desktop Survey

A review was undertaken of the desktop studies completed for flora and vegetation (Mattiske Consulting 2009) and fauna (Ninox Wildlife Consulting 2009) in the area around Nillibubica Quarry. These desktop studies included comprehensive database searches and lists of species likely to be present in the area.

Additional database searches were conducted in July 2012 to identify current listed flora and fauna species within, or in close proximity to, the survey area that are listed under the *Wildlife Conservation Act 1950* (WC Act), the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) or are endorsed by the Western Australian Minister for the Environment. Search details are summarised in Table 1. Each search was conducted centred on the coordinates 123°04'41" E and 17°42'46" S.

In April 2012, the Department of Environment and Conservation (DEC) released an updated list of PECs in Western Australia, which includes 17 PECs in the Kimberley region (DEC 2012a). Three of the 17 listed PECs are related to invertebrate assemblages or communities, while the remainder relate to vegetation communities. The current PEC list was consulted to determine if any PECs were analogous with ecological communities recorded in the survey area.

Table 1: Details of database searches conducted (DSEWPC 2012; Western Australian Herbarium 2012; DEC 2012b).

Database Name	Date Search Requested	Search Buffer	Search Focus
Protected Matters Search Tool	12 July 2012	20 km	Matters of National Environmental Significance including both listed ecological communities and flora and fauna species.
DEC FloraBase	12 July 2012	Dampierland IBRA [^] Region	Western Australian listed Declared Rare (T) and Priority flora species.
NatureMap	12 July 2012	40 km	Flora and fauna species, including conservation significant species.

[^]IBRA is the acronym for the Interim Biogeographic Regionalisation for Australia

2.2 Flora Survey

The field survey was undertaken as far as practicable in accordance with the requirements for a level 1 flora survey outlined in the Environmental Protection Authority's (EPA) *Position Statement 3 Terrestrial Biological Surveys as an Element of Biodiversity Protection* (2002) and EPA *Guidance Statement 51: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (2004a).

The survey was conducted by Astron Supervising Botanist Raimond Orifici on 23 and 24 July 2012. Based on climatic data from the nearest official Bureau of Meteorology (BOM) weather station at Derby Aero (Station no. 3032), 838.2 mm of rainfall was received in the 12 months prior to the field survey, 151.3 mm above the average annual rainfall of 686.9 mm (1951-2011) (BOM 2012). Rainfall associated with low pressure systems and cyclonic activity during January and March 2012 brought

the majority of the rainfall (380.8 mm and 316.6 mm respectively) received for the entire year (BOM 2012). No rainfall was received in the three months prior to the survey.

The level 1 flora survey included broad descriptions and mapping of individual vegetation associations in the survey area, targeted searches for flora species of conservation significance (as per the results of the DEC database searches) and a compilation of flora species recorded opportunistically as the survey area was traversed.

The survey area was accessed by light vehicle and then traversed on foot. An Arcpad Geographic Information System (GIS) with the survey area uploaded to a Trimble GPS Unit, plus a hard copy of colour aerial photography on A3 maps at a scale of 1:10,000 were used to locate the survey area on the ground, and to assist in vegetation mapping.

Vegetation was described to association level which is equivalent to level five in the National Vegetation Information System (NVIS). At this level, vegetation is categorised based on dominant growth form, cover, height and three dominant genera for upper, mid and ground strata (DEH 2003). Vegetation descriptions were based on observations made while traversing the survey area and recording dominant species, with their densities, in each of the upper, middle and understorey strata. Boundaries between discreet vegetation associations were marked onto aerial photographs in the field and then digitised by Astron GIS specialists to produce vegetation association maps. The structural formation and height classes used to describe the vegetation within the survey area were based on Aplin's (1979) modification of the vegetation classification of Specht (1970) (Attachment B).

Vegetation condition was recorded at each mapping note location using the Keighery (1994) and Kaeshagen (1995) adapted vegetation condition scale (Attachment B), along with records of any disturbance such as fire, tracks and grazing.

Plant specimens that were not able to be positively identified in the field were identified in Perth by Astron Supervising Botanist Raimond Orifici. Data from each mapping note descriptions were entered into an Access database developed by Mr. Ted Griffin. Introduced flora species were compared to the Western Australian Department of Agriculture and Food (DAFWA) list and the Weeds of National Significance to determine if any have been listed as Declared Plants (DAFWA 2012; Thorpe and Wilson 2011).

2.3 Terrestrial Fauna Survey

The level 1 fauna survey was undertaken in accordance with the requirements for a level 1 fauna surveys outlined in the *Environmental protection Authority's (EPA) Position Statement 3 Terrestrial Biological Surveys as an Element of Biodiversity Protection* (2002) and *EPA Guidance Statement 56: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia* (2004b).

The fauna field survey was conducted in conjunction with the level 1 flora survey. The survey was conducted by Astron Zoologist Megan Stalker.

The level 1 fauna survey included descriptions of fauna habitats in the survey area, targeted searches for fauna species of conservation significance (as per the results of the DEC database searches) and a compilation of fauna species recorded opportunistically as the survey area was traversed. The survey area was accessed by light vehicle and then traversed entirely on foot.

3 Results

3.1 Desktop Survey

No vegetation related Matters of National Environmental Significance listed under the Federal *EPBC Act* were identified by database search results for within 40 km of the survey area (DSEWPC 2012). No TECs or PECs were located during the database searches conducted by Mattiske Consulting (2009) within 20 km of the Nillibubica Quarry.

A total of 11 TECs are currently listed for the Kimberley region by DEC (DEC 2012b), with five of these located in the Dampierland bioregion of the West Kimberley, but not within a 20 km radius of the survey area. These five TECs are:

- Species-rich faunal community of the intertidal mudflats of Roebuck Bay
- Monsoon vine thickets on coastal sand dunes of Dampier Peninsula
- Assemblages of Bunda Bunda organic mound springs
- Assemblages of Big Springs organic mound springs
- Assemblages of the organic springs and mound springs of the Mandora Marsh area.

Of the 17 PECs currently listed for the Kimberley region, none are listed as occurring within a 20 km radius of the survey area (DEC 2012a). The closest listed PECs to the survey area are those which occur on the Dampier Peninsula in the vicinity of Broome:

- Dwarf pindan heath community of Broome coast
- *Corymbia paractia* dominated community on or behind dunes – Broome township area, Dampier Peninsula
- Mangarr (*Sersalisia sericea*) community on relict dune systems on the Broome Peninsula
- Nimalaica clay pan community, inland from Willie Creek, Broome.

Two DRF species are known from the Dampierland IBRA Region, *Pandanus spiralis* var. *flammeus* and *Keraudrenia exastia* (Mattiske Consulting 2009; FloraBase DEC 2012c). In addition, four Priority flora species have been recorded within a radius of 40 km from the survey area (NatureMap DEC 2012d), and are listed below:

- *Aphyllodium parvifolium* – Priority One
- *Nymphoides beaglensis* – Priority Two
- *Goodenia sepalosa* var. *glandulosa* – Priority Three
- *Triodia acutispicula* – Priority Three.

Based on information on their habitat preferences and/or previously recorded proximity to the survey area, it may be possible that nine Priority flora species (as listed by the DEC) have the potential to occur within the survey area (Attachment C) (FloraBase DEC 2012c).

Twenty conservation significant terrestrial fauna species have been previously recorded within 40 km of the survey area, including eight marine and wetland species (DSEWPC 2012 and DEC 2012b). Based on their habitat preferences, the following nine species have the potential to occur within the survey area:

- gouldian finch (*Erythrura gouldiae*) – EPBC Act Endangered
- red goshawk (*Erythrotriorchis radiatus*) – EPBC Act Vulnerable
- greater bilby (*Macrotis lagotis*) – EPBC Act Vulnerable, WC Act Schedule 1
- bush stone-curlew (*Burhinus grallarius*) – DEC Priority 4
- grey falcon (*Falco hypoleucos*) – DEC Priority 4
- flock bronzewing (*Phaps histrionica*) – DEC Priority 4
- Australian bustard (*Ardeotis australis*) – DEC Priority 4
- peregrine falcon (*Falco peregrinus*) – WC Act Schedule 4
- rainbow bee-eater (*Merops ornatus*) – EPBC Act Migratory.

In addition to the species listed above, Ninnox (2009) identified the following significant species as having a 'moderate to high' likelihood of occurring in the survey area:

- barn swallow (*Hirundo rustica*) – EPBC Act Migratory
- pictorella mannikin (*Heteromunia pectoralis*) – DEC Priority 4
- northern short-tailed mouse (*Leggadina lakedownensis*) – DEC Priority 4.

3.2 Flora Survey

3.2.1 Flora

A total of 72 vascular flora species representing 61 genera from 32 families were recorded from the survey area, none of which were Threatened (Declared Rare) or Priority flora species. A complete species list is presented in Attachment D.

None of the nine Priority flora species identified as possibly occurring in the survey area were recorded during the survey. Given that the field survey was undertaken following above average seasonal rainfall (in the period December to March), it is likely that these species are either not present in the survey area or if present, had already senesced.

3.2.2 Introduced Flora Species

Of the 72 vascular flora species recorded in the survey area, none were identified as introduced species. No Declared Plant species (DAFWA 2011) or Weeds of National Significance (Thorpe and Wilson 2011) were recorded.

3.2.3 Vegetation

A total of three vegetation associations were recorded in the survey area:

- **Sandstone Outcrops (SO):** *Corymbia dendromerinx* low woodland over *Terminalia canescens* low open woodland over *Acacia monticola*, *Grevillea refracta* and *G. pyramidalis* subsp. *pyramidalis* tall open shrubland over *Triodia schinzii* open hummock grassland.

- **Pindan Plain open (PPo):** *Corymbia polycarpa* low woodland over *Acacia tumida* var. *tumida*, *A. platycarpa* and *Erythrophleum chlorostachys* low woodland over *Chrysopogon pallidus*, *Eriachne obtusa* and *Sorghum stipoideum* tussock grassland to closed tussock grassland.
- **Pindan Plain dense (PPd):** *Corymbia dendromerinx*, *C. polycarpa* and *Erythrophleum chlorostachys* low open woodland over *Acacia platycarpa* and *A. tumida* var. *tumida* low woodland over *Eriachne obtusa*, *Aristida holathera* and *Sorghum stipoideum* tussock grassland.

Photos of the three vegetation associations recorded in the survey area are presented in Plates 1 to 4 below.



Plate 1: Sandstone Outcrops (SO) vegetation – *Corymbia dendromerinx* low woodland over *Terminalia canescens* low open woodland over *Acacia monticola*, *Grevillea refracta* and *G. pyramidalis* subsp. *pyramidalis* tall open shrubland over *Triodia schinzii* open hummock grassland.



Plate 2: Pindan Plain open (PPo) vegetation – *Corymbia polycarpa* low woodland over *Acacia tumida* var. *tumida*, *A. platycarpa* and *Erythrophleum chlorostachys* low woodland over *Chrysopogon pallidus*, *Eriachne obtusa* and *Sorghum stipoideum* tussock grassland to closed tussock grassland.



Plate 3: Pindan Plain dense (PPd) vegetation – *Corymbia dendromerinx*, *C. polycarpa* and *Erythrophleum chlorostachys* low open woodland over *Acacia platycarpa* and *A. tumida* var. *tumida* low woodland over *Eriachne obtusa*, *Aristida holathera* and *Sorghum stipoideum* tussock grassland.



Plate 4: Pindan Plain dense (PPd) vegetation – *Corymbia dendromerinx*, *C. polycarpa* and *Erythrophleum chlorostachys* low open woodland over *Acacia platycarpa* and *A. tumida* var. *tumida* low woodland over *Eriachne obtusa*, *Aristida holathera* and *Sorghum stipoideum* tussock grassland.

None of the three vegetation associations recorded are analogous to PECs or TECs listed for the Kimberley region by the DEC.

Vegetation mapping for the survey area is provided in Attachment A. The vegetation associations recorded within the survey area are typical of what might be expected in the Dampierland IBRA region of the Kimberley.

3.2.4 Vegetation Condition

The vegetation condition across all sites assessed in the survey area was recorded as Good to Excellent using the condition scale developed by Keighery (1994) and Kaesehagen (1994) (see Attachment B). There were some minor signs of vehicle disturbance noted, and evidence of cattle grazing in the survey area. No introduced (weed) species were recorded in any part of the survey area.

3.3 Terrestrial Fauna Survey

3.3.1 Habitats

Two main fauna habitats were recorded within the survey area:

- Plains with red-brown loamy sand – scattered *Corymbia* trees over *Acacia* woodland over hummock and tussock grassland
- Sandstone outcrops with shallow grey-brown loam – scattered *Corymbia* trees over sparse *Acacia* shrubland over hummock and tussock grasses.

The rocky outcrops present in the survey area appear to be common in the coastal region of the Dampier Peninsula, but less so inland (McKenzie 1983). Areas of rocky outcrops likely to be similar to those in the survey area can be seen on aerial photography extending for approximately 13 km southwest from the survey area and to the north of the Great Northern Highway.

3.3.2 Fauna Observations

A total of 22 fauna species was recorded during the survey; 20 of those by direct evidence and two species by secondary evidence (i.e. tracks). No fauna species of conservation significance were observed during the survey. Three introduced fauna species were observed, the introduced cat (*Felis catus*), dog/dingo (*Canis lupis*) and cattle (*Bos taurus*). A complete list showing the vertebrate species recorded during the survey is presented in Attachment E.

Several diggings were observed in the sandy plains habitat of the survey area (Table 2; Plates 5-8; Attachment A). The diggings were all located at the base of a spinifex hummock, conical in shape, up to 15 cm wide and approximately 10 cm deep, and were surrounded by scattered soil. No tracks were observed in the soil around the holes and no potential burrow entrances were observed.

Table 2: Locations of diggings in the survey area.

Observation	GPS Coordinate (Zone 51K)
Digging with distinct conical shape.	507986mE, 8070054mN
Digging with distinct conical shape.	507981mE, 8070029mN
Digging with distinct conical shape.	507981mE, 8070031mN
Digging with distinct conical shape.	507940mE, 8070434mN



Plate 5: Digging observed at coordinates (51K) 507986mE, 8070054mN.



Plate 6: Digging observed at coordinates (51K) 507981mE, 8070029mN.



Plate 7: Digging observed at coordinates (51K) 507981mE, 8070031mN.



Plate 8: Digging observed at coordinates (51K) 507940mE, 8070434mN.

5 Limitations

The survey was completed at the end of July 2012, approximately four months after the last significant rainfall event of 316.6 mm in March 2012 (see Section 2.2). The survey area was therefore assessed during the ‘dry period’ and consequently few annual and/or ephemeral flora species were recorded. Additionally, the lack of reproductive material (flowers and fruit) present on perennial species at this time of the year can make it difficult to discern or conclusively determine the identity of these species.

The dry conditions are also considered a limitation of the fauna assessment. In the dry season the more mobile species such as birds may move to areas with a water source, especially smaller birds such as finches. In the wet season it is likely that more fauna species would be present in the survey area.

6 Discussion

No TECs or PECs, Threatened (DRF) or Priority flora species were recorded in the survey area. As there had been a period of dry conditions in the four months prior to the survey, the majority of ephemeral species (annual and perennial) likely to be present in the vegetation associations were not recorded due to their senescence (aestivation) as a result of these conditions. Eight out of the nine Priority flora species which may have a possible presence in the survey area due to suitable habitats, may also be absent due to the dry seasonal conditions.

No introduced flora species were recorded during this survey, which may be a result of the Good to Excellent Condition of the vegetation in the survey area or due to the dry seasonal conditions. The following introduced species have been recorded within a 40 km radius of the survey area (NatureMap DEC 2012d):

- **Aerva javanica* – kapok bush
- **Flaveria trinervia* – speedy weed
- **Citrullus lanatus* – pie melon
- **Stylosanthes hamata* – verano stylo
- **Moringa oleifera*
- **Cynodon dactylon* – couch
- **Urochloa mutica*
- **Phyla nodiflora* var. *nodiflora* – frog fruit or lippia

In addition, two weeds of national significance, **Parkinsonia aculeata* and **Salvinia molesta*, have been recorded in the Dampierland IBRA region (Mattiske Consulting 2009).

No fauna species of conservation significance were directly recorded within the survey area. Several diggings were observed in the sandy plains portion of the survey area, the characteristics of which are typical of those made by foraging greater bilbies (*Macrotis lagotis*, EPBC Act Vulnerable) (Triggs 1996). Foraging areas of greater bilbies are characterised by numerous scattered conical-shaped diggings, and are often temporary and dictated by the availability of food (Johnson 2008). Despite

targeted searches in the survey area for a potential burrow entrance, none were observed. The lack of tracks and the crusting of the soil around some of the holes suggested that they were not dug very recently. The greater bilby was identified by Ninox (2009) as having a ‘low to moderate’ potential for occurrence in the survey area. No other mammal species recorded from the vicinity of the survey area would make similar conical-shaped burrows (DEC2012b; Ninox 2009). Thus it is possible that the survey area may be used by greater bilbies for occasional foraging, and possibly for burrowing, however the presence of this species was unable to be confirmed with the current level 1 assessment. Moseby and O’Donnell (2003) found that greater bilbies have an average home range of between 316 hectares for males, and 18 hectares for females. Greater bilbies may also move up to 5 km between burrows (Southgate et al. 2007). Therefore if the greater bilby is present, the 10 hectare survey area is not likely to comprise the entire home range of an individual, and the impact of the quarry development may be considered low.

Ninox (2009) identified the northern short-tailed mouse (*Leggadina lakedownensis*, DEC Priority 4) as having a ‘moderate’ potential for occurrence in the survey area, however it was not possible to determine the presence of this species through a level 1 assessment. The northern short-tailed mouse stays in burrows during the day (Moro and Kutt 2008), and therefore if present in the survey area, it may be impacted during vegetation clearing and soil stripping. Suitable habitat is present in the survey area for the other fauna species of conservation significance identified as potentially occurring (section 3.1), however these are highly mobile bird species and are unlikely to be affected by the proposal. Other fauna present in the survey area, particularly the small ground-dwelling mammals and reptiles that may be restricted to a particular habitat type, may be directly impacted during clearing activities for the quarry development.

An assessment against the ten clearing principles has identified that the proposed clearing of vegetation may be at variance with principles b and c (Attachment F).

Yours sincerely

ASTRON ENVIRONMENTAL SERVICES



Raimond Orifici
Supervising Botanist



Megan Stalker
Zoologist

Attachments:

- Attachment A: Survey area Location Map, Vegetation Association Mapping, and Fauna Locations
- Attachment B: Vegetation Classification and Condition Scales
- Attachment C: Database Search Results
- Attachment D: Vascular Flora List
- Attachment E: Terrestrial Vertebrate Fauna List
- Attachment F: Ten Clearing Principles Assessment

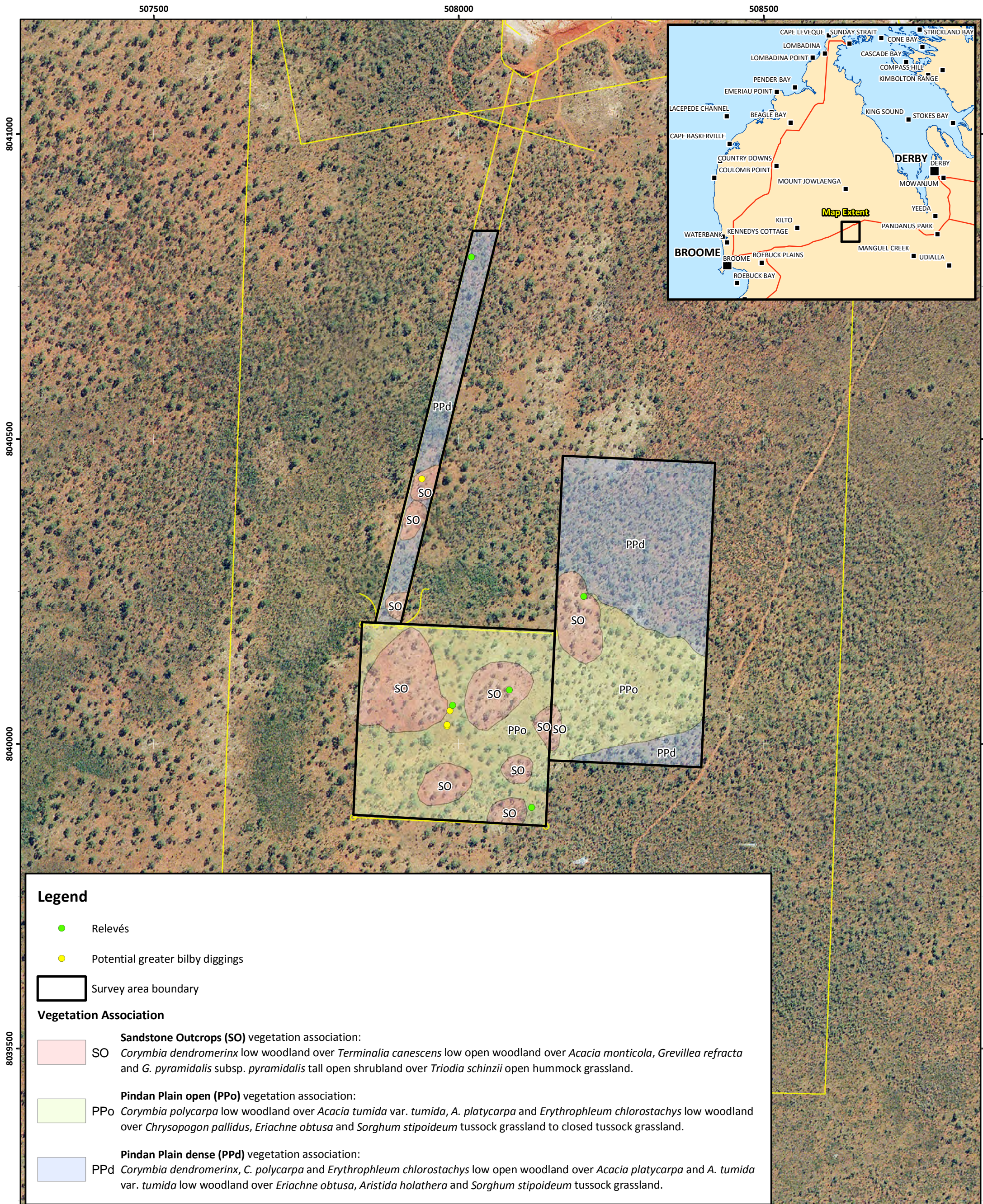
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Attachment A. Survey Area Location Map

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Kimberley Quarry Pty. Ltd.
 Nillibubbica Quarry Level 1 Flora and Fauna Survey

Figure A.1. Survey area location, vegetation association mapping, and fauna records.



Author: R. Orifici	Date: 08-08-2012	Datum: GDA 1994		
Drawn: E. Ongee	21053-12FMV1RevA_120808_Figure_1	Projection: MGA Zone 50		

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Attachment B: Vegetation Classification and Condition Scale

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Table B.1: Vegetation Classification System Specht (1970) as modified by Aplin (1979).

Stratum	70-100% cover	30-70% cover	10-30% cover	2-10% cover	<2% cover
Trees > 30 m	Tall closed forest	Tall open Forest	Tall woodland	Tall open woodland	Scattered tall trees
Trees 10-30 m	Closed forest	Open forest	Woodland	Open woodland	Scattered trees
Trees < 10 m	Low closed forest	Low open forest	Low woodland	Low open woodland	Scattered low trees
Shrubs > 2 m	Tall closed scrub	Tall open scrub	Tall shrubland	Tall open shrubland	Scattered tall shrubs
Shrubs 1-2 m	Closed heath	Open heath	Shrubland	Open shrubland	Scattered shrubs
Shrubs < 1 m	Low closed heath	Low open heath	Low shrubland	Low open shrubland	Scattered low shrubs
Hummock grasses	Closed hummock grassland	Hummock grassland	Open hummock grassland	Very open hummock grassland	Scattered hummock grasses
Grasses, sedges, herbs	Closed tussock grassland/ sedgeland/ herbland	Tussock grassland/ sedgeland/ herbland	Open tussock grassland/ sedgeland/ herbland	Very open tussock grassland/ sedgeland/ herbland	Scattered tussock grasses / sedges / herbs

Table B.2: Summary of adapted Vegetation Condition Scale as developed by Keighery (1994) and Kaesehagen (1994).

Rating	Condition	Descriptive Features
1	Excellent	>80% native flora composition Vegetation structure (nearly) intact Minor signs of disturbance Weeds are non-aggressive species (cover <5%)
2	Good	60-80% native flora composition Vegetation structure altered in places Obvious signs of disturbance Weed abundance / cover 5-20%
3	Fair	40-60% native flora composition Vegetation structure significantly altered yet retains basic structure or ability to regenerate to it Very obvious signs of multiple disturbance Weed cover / abundance 50-80%
4	Poor/ Partially Degraded	20-40% native flora composition Vegetation structure severely impacted by disturbance Scope for regeneration but not to a level approaching “Good” condition without intensive management Weed cover / abundance 50-80%
5	Completely Degraded	<20% native flora composition Vegetation structure impacted beyond regeneration Extensive modification and disturbance present Weeds are highly invasive (cover / abundance >80%)

Attachment C: Database Search Results

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Table C.1: Summary of Priority flora recorded within 40 km of the Survey Area (DEC 2012; Western Australian Herbarium 2012) and from the broader Dampier Peninsula.

Species	Priority Code	Life Form	Flowering Time	Habitat (FloraBase)	Likely occurrence in Survey Area
<i>Acacia</i> sp. Broome (B.R. Maslin 4918)	P3	Open shrub 1.5 – 4m high.	April - June	Rocky clay, red sand. Coastal cliffs, low-lying areas.	Unlikely
<i>Acacia</i> sp. Riddell Beach (T. Willing 71)	P3	Semi-prostrate shrub to 1.5m high.	June	Exposed cliff top, footscree below steep gorge, road verges.	Unlikely
<i>Aphyllodium glossocarpum</i>	P3	Spreading or erect shrub to 1.2m high.	April – Oct.	Sand. Pindan.	Possible
<i>Aphyllodium parvifolium</i>	P1	Prostrate, trailing low shrub to 0.3m high.	April; July	Sand, sandhills, swampy margins of lagoon or creek, edge of pindan areas.	Unlikely
<i>Byblis guehoi</i>	P1	Ephemeral herb	Sept.	Seasonally wet, sandy loam soils with <i>Eucalyptus</i> woodland and scattered shrubs.	Unlikely
<i>Colocasia esculenta</i> var. <i>aquatilis</i>	P3	Aquatic or semi-aquatic lily (herb) to 1.5m.	March - April	Shallow pools, wet swamp in rainforest, permanent springs	Unlikely
<i>Corymbia paractia</i>	P1	Tree to 4-6m high.	April – May; Oct. – Dec.	Skeletal soils. In transition zone between coastal beach dunes and red pindan soils.	Unlikely
<i>Croton aridus</i>	P3	Multistemmed shrub to 1.5m high.	August	Deep red sand, pindan soil. Sandplains or ridges, spinifex sandplains.	Unlikely
<i>Cyperus haspan</i> subsp. <i>haspan</i>	P1	Sedge (grass-like herb)	Unknown	Growing in peat on bank at edge of spring.	Unlikely
<i>Dendrophthoe odontocalyx</i>	P3	Aerial shrub, hemiparasitic on stems of specific hosts.	June – Aug.	On the stems of <i>Melaleuca</i> or <i>Eucalyptus</i> species in swampy areas.	Unlikely
<i>Eriachne</i> sp. Dampier Peninsula (K.F. Kenneally 5946)	P3	Fine annual grass (erect herb) to 0.2m high.	March - April	Areas of pindan sandplain; monsoonal vine thickets behind coastal sand dunes.	Unlikely
<i>Fuirena incrassata</i>	P3	Annual sedge (grass-like herb) to 0.3m high.	May – Aug.	Sand or sandy clay. Swamps, creek beds, claypans, semi-saline lakes.	Unlikely
<i>Glycine pindanica</i>	P1	Prostrate or scrambling perennial herb or climber.	Feb. – March; June	Pindan soils.	Possible
<i>Gomphrena pusilla</i>	P2	Slender branching annual, herb to 0.2m high.	March – April; June	Fine beach sand. Behind foredune, on limestone.	Unlikely

Species	Priority Code	Life Form	Flowering Time	Habitat (FloraBase)	Likely occurrence in Survey Area
<i>Goodenia byrnesii</i>	P1	Prostrate to decumbent herb.	Jan. – Feb.	Sand. Edge of creek.	Unlikely
<i>Goodenia sepalosa</i> var. <i>glandulosa</i>	P3	Prostrate to sprawling, perennial herb to 0.3m high.	In April – July (mainly)	Red sand or loam in dense mixed woodland; red pindan sand.	Possible
<i>Haemodorum gracile</i>	P4	Bulbaceous, perennial herb to 0.65m high.	Aug. – Nov.	White or red sand, sandy clay, sandstone, granite dome and screes, <i>Melaleuca</i> woodland black soils.	Unlikely
<i>Ipomoea gracilis</i>	P1	Creeping or prostrate herb.	March – May; Sept.	Black cracking clay or black sand. Irrigated areas.	Unlikely
<i>Ipomoea</i> sp. A Kimberley Flora	P1	Creeping or twining perennial herb.	June	Shallow soils on sandstone.	Possible
<i>Isolepis humillima</i>	P2	Tufted, decumbent annual, sedge (grass-like herb) to 0.08m high.	April – Aug.	Red-brown clay. Claypans, seepages, along watercourses.	Unlikely
<i>Jacquemontia</i> sp. Broome (A.A. Mitchell 3028)	P1	Creeping, scrambling herb	? April - June	Brown orange sand on pindan plain. Previously recorded near Broome.	Possible
<i>Keraudrenia exastia</i>	T – DRF	Erect, compact shrub to 1m	April – Dec.	Red sand in pindan. Coastal sites, relict desert dune swale.	Unlikely
<i>Keraudrenia katatona</i>	P3	Erect, compact shrub to 1m	March – Aug.	Desert dunes in pindan, ranges, disturbed areas.	Unlikely
<i>Lophostemon grandiflorus</i> subsp. <i>grandiflorus</i>	P3	Tree to 8m tall.	Jan. – Dec. (apparently)	Damp habitats (swamps, seepages).	Unlikely
<i>Nicotiana heterantha</i>	P1	Short-lived annual or perennial herb to 0.5m.	March – June, Sept.	Black clay. Seasonally wet flats.	Unlikely
<i>Nymphoides beaglensis</i>	P2	Aquatic annual, herb.	March - June	In shallow freshwater. Edges of permanent waterholes or in seasonally inundated claypans and depressions.	Unlikely

Species	Priority Code	Life Form	Flowering Time	Habitat (FloraBase)	Likely occurrence in Survey Area
<i>Phragmites karka</i>	P3	Tall, clumping, erect, rhizomatous grass/reed.	? April - June	Riverine areas; on margins of permanently wet springs on coastal plain; on edges of pools and small lagoons.	Unlikely
<i>Phyllanthus aridus</i>	P3	Erect shrub to 0.25m.	May - June	Sandstone, gravel, red sand.	Possible
<i>Pittosporum moluccanum</i>	P4	Large shrub or tree 2-6m high.	Feb. – Aug.	White sand. Sand dunes.	Unlikely
<i>Polymeria distigma</i>	P3	Prostrate trailing herb	April - July	Sandy soils.	Unlikely
<i>Rothia indica</i> subsp. <i>australis</i>	P1	Prostrate annual, herb to 0.3m.	April – Aug.	Sandy soils. Sandhills and sandy flats.	Unlikely
<i>Schoenus punctatus</i>	P3	Rhizomatous, tufted perennial, grass-like or herb (sedge) to 0.6m.	August	Watercourses	Unlikely
<i>Stackhousia clementii</i>	P3	Dense broom-like perennial herb to 0.45m.	? April – Aug.	Skeletal soils. Sandstone hills.	Possible
<i>Stylidium costulatum</i>	P3	Erect, tufted annual herb to 0.2m.	April – Aug.	Creeks or seasonally wet areas.	Unlikely
<i>Tephrosia andrewii</i>	P1	Ascending, multistemmed shrub to 0.8m.	April or Oct.	Sand. In pindan country.	Possible
<i>Tetragonia coronata</i>	P3	Decumbent annual, herb.	July	Red clay loam. Calcrete outcrops.	Unlikely
<i>Thespidium basiflorum</i>	P1	Densely tufted, multi-stemmed perennial, herb to 0.2m.	May – Aug.	Sandy soils. Creeks.	Unlikely
<i>Triodia acutispicula</i>	P3	Hummock-forming resinous perennial, grass-like or herb to 1.5m.	Jan. – April	Sandy soils. River levees, pindan plains, rocky hillslopes and outcrops.	Possible
<i>Utricularia stellaris</i>	P1	Floating aquatic perennial, herb.	June - July	Swamps, lagoons.	Unlikely

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Attachment D: Vascular Flora List

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Species recorded at the Kimberley Quarry site – Nillibubbica (July 2012)

ACANTHACEAE

Dicliptera armata

AMARANTHACEAE

Gomphrena canescens

Ptilotus ? corymbosus (annual species – dead remnants)

APOCYNACEAE

Carissa lanceolata

ASTERACEAE

Pterocaulon serrulatum

BIGNONIACEAE

Dolichandrone heterophylla

BORAGINACEAE

Ehretia saligna

BYBLIDACEAE

Byblis ? filifolia/liniflora

CARYOPHYLLACEAE

Polycarpaea corymbosa

Polycarpaea longiflora

CLEOMACEAE

Cleome viscosa (dead remnants)

COMBRETACEAE

Terminalia canescens

COMMELINACEAE

Murdannia graminea (dead remnants)

CONVOLVULACEAE

Bonamia ? linearis/media

CYPERACEAE

Bulbostylis barbata

Cyperus conicus

Fimbristylis sp. (ephemeral species – dead remnants)

EUPHORBIACEAE

Microstachys chamaelea

FABACEAE

Acacia colei

Acacia monticola

Acacia platycarpa

Acacia tumida var. *tumida*

Bauhinia cunninghamii

Chamaecrista symonii

Crotalaria medicaginea

Erythrophleum chlorostachys

Galactia tenuiflora

Glycine tomentella

Indigofera linifolia

Senna costata

LAMIACEAE

Clerodendrum ? floribundum var. *coriaceum*

LECYTHIDACEAE

Planchonia careya

LORANTHACEAE

Amyema bifurcata

Lysiana spathulata subsp. *spathulata*

MALVACEAE

Brachychiton diversifolius subsp. *diversifolius*

Corchorus sidoides

Hibiscus geranioides/leptocladus

Triumfetta ? albida

Triumfetta plumigera

Waltheria indica

MENISPERMACEAE

Tinospora smilacina

MYRTACEAE

Calytrix exstipulata

Corymbia dendromerinx

Corymbia polycarpa

Corymbia zygophylla

OLEACEAE

Jasminum didymum

OROBANCHACEAE

Buchnera ramosissima

PHYLLANTHACEAE

Flueggea virosa subsp. *melanthesoides*

POACEAE

Aristida holathera

Aristida ? inaequiglumis

Chrysopogon pallidus

Eragrostis cumingii

Eragrostis eriopoda

Eriachne ciliata

Eriachne obtusa

Perotis rara

Schizachyrium fragile

Sorghum stipoideum

Triodia schinzii

PORTULACACEAE

Portulaca pilosa

PROTEACEAE

Grevillea pyramidalis subsp. *pyramidalis*

Grevillea refracta

Hakea arborescens

Persoonia falcata

RHAMNACEAE

Ventilago viminalis

RUBIACEAE

Gardenia pyriformis subsp. *keartlandii*

Oldenlandia ? galioides (annual species – dead remnants)

Psydrax pendulina

SANTALACEAE

Santalum lanceolatum

SAPINDACEAE

Atalaya hemiglauca

Dodonaea hispidula

SOLANACEAE

Solanum cunninghamii

Attachment E: Terrestrial Vertebrate List

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Table E.1: List of terrestrial vertebrate species recorded during the survey.

Common Name	Species	Observation Type	GPS Coordinates
Whistling Kite	<i>Haliastur sphenurus</i>	Individuals	-
Brown Falcon	<i>Falco berigora</i>	Individuals	-
Red-winged Parrot	<i>Aprosmictus erythropterus</i>	Individuals	-
Little Corella	<i>Cacatua sanguinea</i>	Individuals	-
Red-tailed Black-cockatoo	<i>Calyptorhynchus banksii</i>	Individuals	-
Rainbow Lorikeet	<i>Trichoglossus haematodus</i>	Individuals	-
Diamond Dove	<i>Geopelia cuneata</i>	Individuals	-
Bar-shouldered Dove	<i>Geopelia humeralis</i>	Individuals	-
Peaceful Dove	<i>Geopelia striata</i>	Individuals	-
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>	Individuals	-
Grey Strike-thrush	<i>Colluricincla harmonica</i>	Individuals	-
Willie Wagtail	<i>Rhipidura leucophrys</i>	Individuals	-
Torresian Crow	<i>Corvus orru</i>	Individuals	-
Magpie Lark	<i>Grallina cyanoleuca</i>	Individuals	-
Varied Sitella	<i>Daphoenositta chrysoptera</i>	Individuals	-
Jacky Winter	<i>Microeca fascinans</i>	Individuals	-
Yellow-tinted Honeyeater	<i>Lichenostomus flavescens</i>	Individuals	-
Little Friarbird	<i>Philemon citreogularis</i>	Individuals	-
Agile Wallaby	<i>Macropus agilis</i>	Individuals	-
Dingo/Dog	<i>Canis lupis</i>	Tracks	-
Cat	* <i>Felis catus</i>	Tracks	-
Cattle	* <i>Bos taurus</i>	Individuals	-

*denotes introduced animal

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Attachment F: Ten Clearing Principles Assessment

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(a) Native vegetation should not be cleared if it comprises a high level of biological diversity.

There were three vegetation associations recorded in the survey area and a total of 72 vascular flora species. The families with the highest amount of species recorded were Fabaceae (legumes) with 12 species, Poaceae (grasses) with 11 species and Malvaceae (mallows) with six species. This is consistent with the families most commonly recorded in botanical surveys in the Dampierland IBRA region of the Kimberley.

The survey area does not have a high level of biological diversity present during the dry season, due to ephemeral species aestivation, but species numbers would be increased following significant summer (wet season) rainfall.

Based on the information recorded during this dry season survey, the proposed clearing is therefore not likely to be at variance to this principle.

(b) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.

While no fauna species of conservation significance were observed, several conical-shaped diggings were observed in the sandy plains portion of the survey area, the characteristics of which are typical of those made by foraging greater bilbies (*Macrotis lagotis*, EPBC Act Vulnerable and WC Act Schedule 1) (Triggs 1996). The lack of tracks and the crusting of the soil around some of the holes suggested that they were not dug very recently. No other mammal species recorded from the vicinity of the survey area would make similar conical-shaped burrows (DEC2012b; Ninox 2009). Thus it is possible that the survey area is used by greater bilbies for occasional foraging, and possibly for burrowing. Moseby and O'Donnell (2003) found that greater bilbies have an average home range of between 316 hectares for males, and 18 hectares for females. Greater bilbies may also move up to 5 km between burrows (Southgate et al. 2007). Therefore if the greater bilby is present, the 10 hectare survey area is not likely to comprise the entire home range of an individual, and the impact of the quarry development may be considered low.

The DEC Priority 4 listed northern short-tailed mouse (*Leggadina lakedownsensis*) also has the potential to be present in the survey area, however this could not be confirmed during the level 1 assessment.

There is also the potential for several birds of conservation significance to be present in the survey area, including the EPBC Act Endangered Gouldian finch (*Erythrura gouldiae*) and the EPBC Act Vulnerable red goshawk (*Erythrotriorchis radiatus*). These species, if present, would be unlikely to be affected by the vegetation clearing as they are highly mobile, aerial species.

As the survey area would provide suitable habitat for several fauna species of conservation significance, and diggings were observed that could indicate the presence of the greater bilby, the proposed clearing may be at variance to this principle.

(c) Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.

No Threatened (DRF) or Priority flora species were identified within the survey area. Dry seasonal conditions for the four to five months prior to the field survey meant that ephemeral species (annual

and perennial) likely to be present in the vegetation associations were not recorded due to their senescence (aestivation). Eight of the nine Priority flora species which may have a possible presence in the survey area due to suitable habitats, may also be absent as a result of the dry seasonal conditions.

The proposed clearing may be at variance to this principle.

(d) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a threatened ecological community.

No Threatened Ecological Communities or Priority Ecological Communities were recorded in the survey area. The proposed clearing is therefore not likely to be at variance to this principle.

(e) Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.

The survey area is 19.2 hectares in size and is located in the Dampierland IBRA region, which is not extensively cleared of vegetation. Stock grazing, inappropriate fire regimes and introduced flora species are the three main disturbances that threaten the biodiversity values of the region. The proposed clearing is not likely to be at variance to this principle.

(f) Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.

The survey area does not include any watercourses or wetlands, therefore the proposed clearing is not likely to be at variance with this principle.

(g) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.

Soils in the survey area comprise red-brown loamy sand on plains and shallow grey-brown loam (skeletal soils) on rocky outcrops. The removal of vegetation from these soils across the survey area is likely to result in some wind and water erosion, however is unlikely to be significant. The proposed clearing is unlikely to be at variance with this principle.

(h) Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.

There are no conservation areas (National Parks, Conservation Parks or Nature Reserves) adjacent to, or nearby to the survey area. The clearing of vegetation is unlikely to be at variance with this principle.

(i) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.

While the removal of vegetation may result in some localised deterioration of surface water quality through water erosion, the surrounding vegetation is intact and water is unlikely to be impacted in any nearby watercourses. The clearing is unlikely to be at variance with this principle.

(j) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.

The survey area alternates between low plains and rocky outcrops and has well draining, sandy pindan soils present. The clearing of vegetation from the survey area is unlikely to cause or exacerbate flooding, and is therefore not likely to be at variance with this principle.

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