Tectonic Resources NL

KUNDIP MINING LEASES
M74/41, 51, 53 & 135 and P74/153

VEGETATION & FLORA SURVEY

April 2004

Cover photo: *Eucalyptus clivicola* low forest with *Melaleuca stramentosa* heath understorey, Kundip mining leases.

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A report prepared for
Tectonic Resources NL
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Summary

The Kundip mining leases M74/41, 51, 53 & 135, and P74/153 (664 ha) are located in an important vegetation corridor that links the Fitzgerald River National Park and the Crown land east of the Vermin Proof Fence and beyond to the Goldfields. The land surrounding the leases has been identified as proposed Nature Reserve.

A survey of the vegetation and flora in December 2003 identified eighteen vegetation units based on their vegetation formations and plant associations. The four most widespread units were:

1. open mallee and thicket/scrub heath characterised by *Banksia lemmaniana* on upper slopes;
2. mallee and dense shrubs of *Melaleuca stramentosa* (Priority One) on upper slopes;
3. mallee with an understorey characterised by *Melaleuca hamata* on mid- and lower slopes; and
4. open woodland and thicket dominated by *Melaleuca acuminata* along drainage lines.

One vegetation unit [Mx] in the south-west sector of the survey area is of special interest as it includes two species which are apparently new, ie *Melaleuca* sp. Kundip (GF Craig 6020) and *Pultenaea* sp. Kundip (GF Craig 6008). The *Melaleuca* has been verified as a new, undescribed species (B. Lepschi, pers.comm.) and the *Pultenaea* will require flowering specimens for verification (L. Orthia, pers.comm.).

A total of 249 native plant species and 23 exotics were identified on the leases. The most represented families were Myrtaceae, Proteaceae and Papilionaceae. This confirms that Kundip lies in one of the most species diverse areas of the South West, as well as being located in one of the three areas of highest endemism in the State.

The Declared Rare *Marianthus villosus* is present in two localities:

1. an estimated 1,500 plants north of the 'Western Gem' mine covering 4.84 ha in a narrow valley; and
2. approximately 700 plants covering 1.4 ha to the north-east of the 'Flag' mine in a weak drainage line.

Regional surveys of known populations of *Marianthus villosus* estimated over 40,000 plants east of the Vermin Proof Fence (Population 1), and about 800 plants in two Ravensthorpe Range populations to the north and east of the Kundip mining leases (Populations 3A and 4).

Nine priority species were found, ie Priority One *Melaleuca stramentosa,* Priority Two *Acacia disticha* and *A. laricina* var. *crassifolia,* Priority Three *A. durabilis, Boronia oxyantha* var. *brevicalyx, Dodonaea trifida* and *Spyridium glaucum,* and Priority Four *A. pinguiculosa* subsp. *pinguiculosa* and *Siegfriedia darwinioides.* The priority species *Eucalyptus depauperata* (P3) identified by Outback Ecology (2003), was determined to be the common and widespread *E. suggrandis,* while *Microcorys pimeleoides* (Priority One) was not found.

A Weed of National Significance, bridal creeper *Asparagus asparagoides* occurs at a number of locations on the leases. A number of other exotics, particularly those in the Asteraceae family and some succulents are gradually spreading.

Recommendations

1. Project planning and management should make efforts to minimise fragmentation of natural vegetation within the project area. Where there is unavoidable fragmentation, it is important to maximise the area: perimeter ratio of remnant vegetation.

2. Operational procedures should be adopted to minimise the risk of dieback introduction and spread into the project area. This can be achieved by:
   - minesite operations planned so that water runoff is minimised into communities with a high component of dieback susceptible, proteaceous species, ie the [**Bl**] and [**Bm**] vegetation units;
   - vehicle and machinery wash-down facilities, and cessation of vehicle and machinery movement in extreme situations when high temperature and moisture conditions combine to spread the fungal spores.

3. Survey for further populations of Priority One *Melaleuca stramentosa* in the region in October, ie when this species is flowering.

4. Verify occurrence of *Microcorys pimeleoides* (Priority One), apparently found by Outback Ecology (2003), when this species is flowering during October-November.

5. Collect flowering specimens of *Pultenaea* sp. Kundip (GF Craig 6008), probably during spring, and have them verified by Canberra taxonomist, L. Orthia. If confirmed that this is a new species, its distribution on the leases should be surveyed while it is flowering.

   Furthermore, if this *Pultenaea* is new, it along with the new taxon *Melaleuca* sp. Kundip (GF Craig 6020) would be recommended for inclusion on CALM's Priority flora list. Both species occur in the [**Mx**] vegetation unit, which is potentially a Threatened Ecological Community. Consequently, further regional surveys of these species would be recommended, particularly if they are likely to be impacted by mining operations.

6. Survey the Kundip mining leases in late winter for annual species, particularly orchids, and any other perennial species that may have been overlooked during the summer survey.

7. Document the current boundaries of the Weed of National Significance, bridal creeper *Asparagus asparagoides*. Monitor the efficacy of biological control organisms, ie bridal creeper leaf hopper and rust, and introduce these organisms to all bridal creeper sites on the Kundip mining leases during August - September.

Introduction

Regional Setting

Location

The Kundip mining leases M74/41, 51, 53 & 135 and P74/153 comprise approximately 664 ha, the majority of which is located east of the Hopetoun-Ravensthorpe Road, 17 km south east of Ravensthorpe and 31 km north of the coastal town of Hopetoun (Fig.1). The historical townsite of Kundip lies on the western margin of the leases.

The Kundip leases are surrounded by an area of the Ravensthorpe Range recommended by the EPA Red Book (Recommendation 3.8 (Figure 3.19)) to become a nature reserve (Fig.2). This remains the favoured outcome by the Department of Conservation and Land Management (CALM) in whom the area would be vested. Due to active mining and mineral prospecting activities, however, there remain numerous unresolved issues between the Department of Industry and Resources (DoIR), CALM and the Shire (EPA 1993, CALM 1992). The Kundip Nature Reserve (Reserve No. 31128) lies 0.4-1 km south of the boundary of the mining leases.

Historical

The Ravensthorpe district was first settled in 1868 for pastoral purposes, and it was not until 1892 that gold and copper deposits were opened up just north of Ravensthorpe. The principle copper and gold deposits of the Phillips River Goldfields extend in a belt from 4 km north of Ravensthorpe to 20 km south-east in the vicinity of the old Kundip townsite.

In 1906, the growth of copper production gave the impetus for the Government to go ahead with a railway linking Hopetoun port with the mines and smelting works. The line opened in 1908 with permanent rail services continuing until 1931 then only sporadically until 1935, after which it was closed. Kundip station was placed close to the mines and a large Mines Department dam. A barracks building was provided for the flying gang's headquarters as well as toolsheds. (Archer 1979). Evidence of these sites is still visible - mainly by the weeds, wire, bricks and other debris – on the mining leases. Today, the Railway Heritage Trail, a walking trail that follows the old railway route between Ravensthorpe and Hopetoun (and passes through the leases), provides a pleasant recreational experience for locals and tourists.

Mining activity tapered off during World War I (1914-1918), buildings were shifted as people moved away. In 1934, the Claude de Benarles Group opened up new workings at the Beryl mine which resulted in 150 miners being employed in three shifts. Activity wound down again during World War II due the reduction in manpower. In the late 1950s, when the Eldverton mine started up again, a number of houses were built for their workers. Today, only the foundations of a few buildings remain to indicate that 100 years ago, Kundip was once a bustling townsite with a baker, school, churches, hall, hotel, tinsmith, blacksmith and post office (Archer 1979; Goldfinch 2001). It now serves as a picnic area with historical information provided on sign boards.

Following the ensuing mining 'rush' in the early 1900s, some prospectors with farming experience from elsewhere decided to try farming on the rich red-brown loams surrounding the Ravensthorpe Range and the first crop was planted in 1902. Since then both mining and agriculture have provided the economic basis of life in the district. More recently conservation as a secondary industry including tourism and interpretation, research and management have brought people and some income to the district.

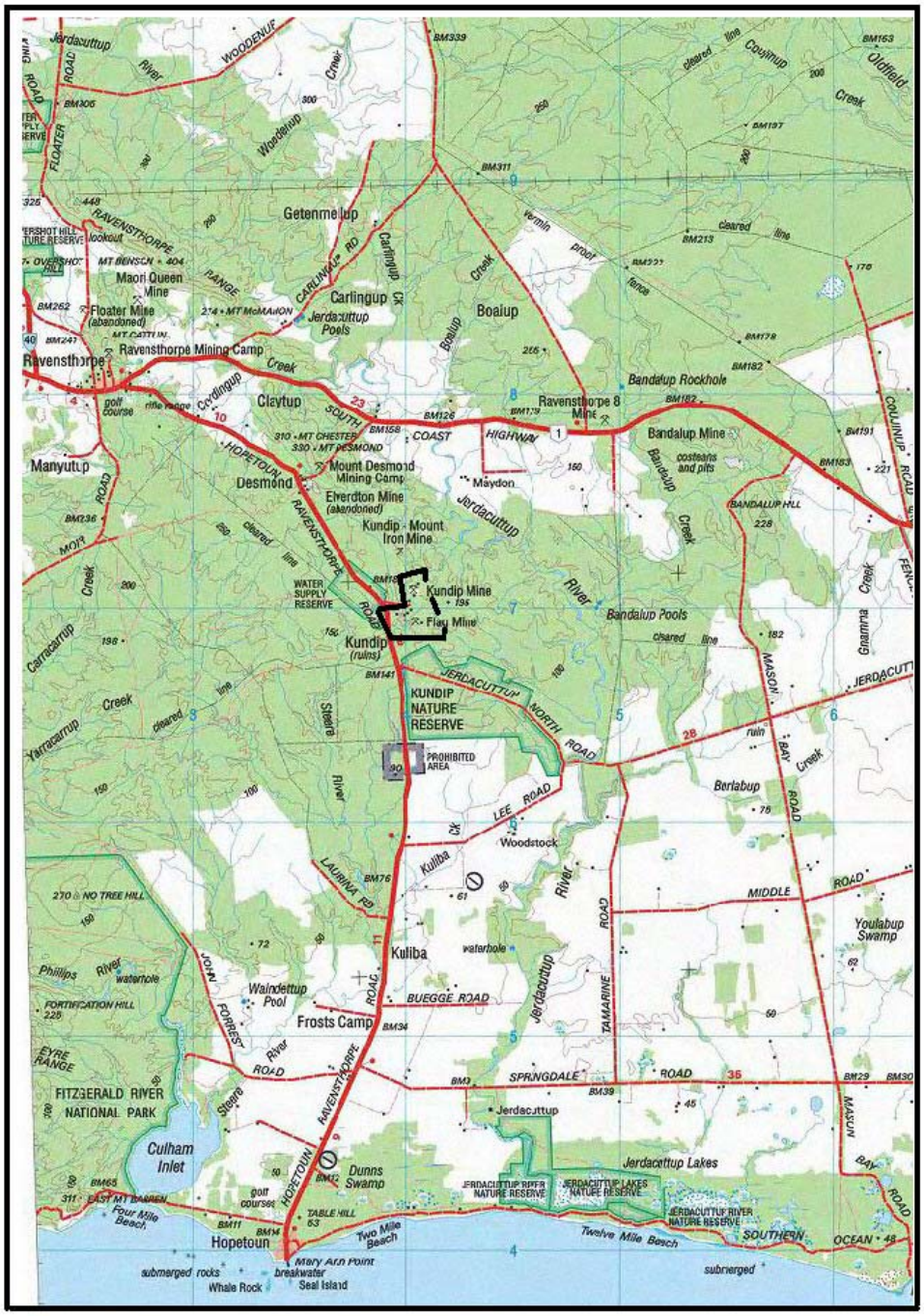

Fig.1 - Location of Kundip mining leases

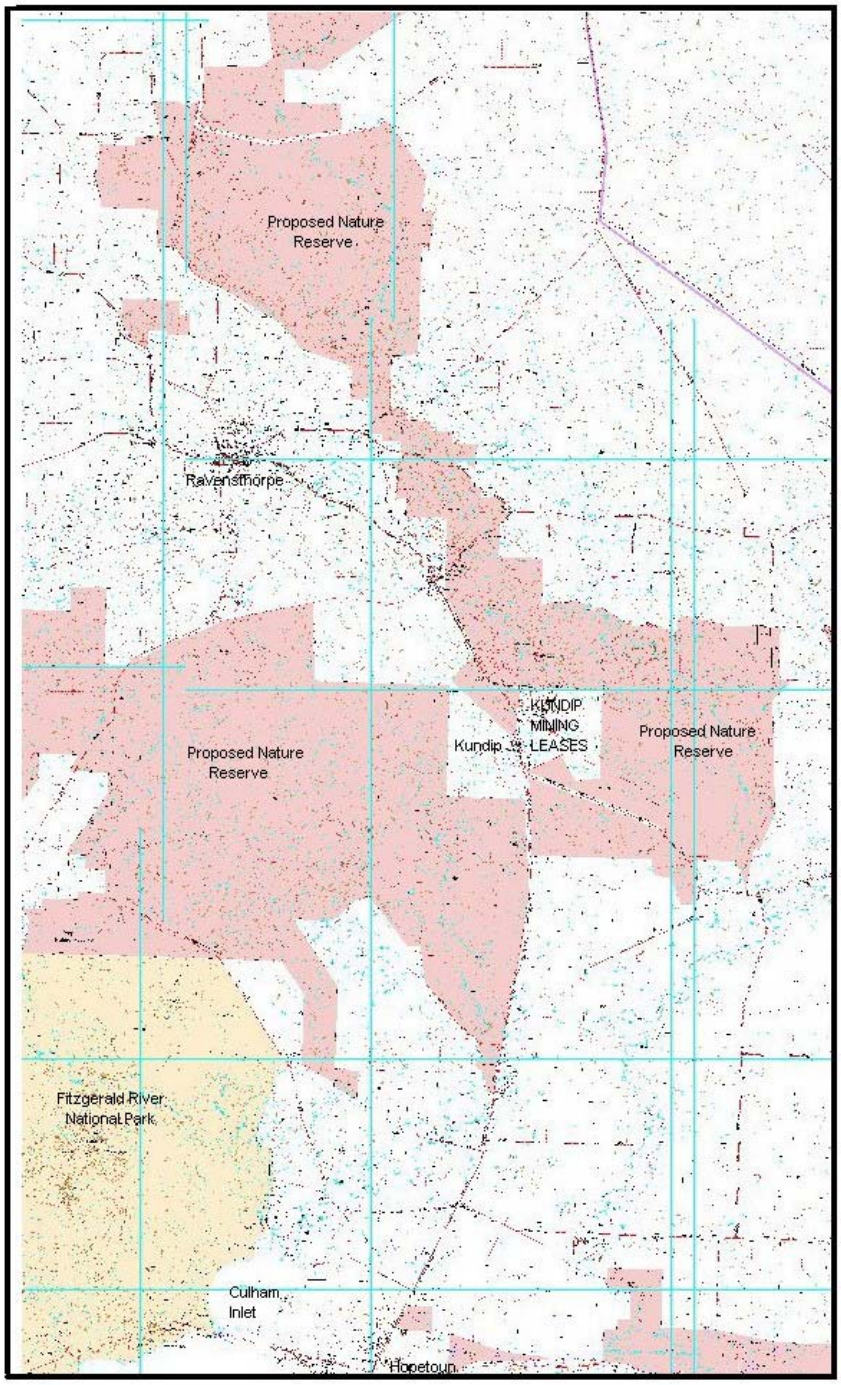

Fig.2 - Proposed Nature Reserves near the Kundip mining leases

Fitzgerald Biosphere

Kundip lies in the eastern sector of the Fitzgerald Biosphere which is a part-tenured management concept recognised by UNESCO as well as State and Commonwealth governments. The concept includes a *core area* (the Fitzgerald River National Park (FRNP) 329,000 ha), a *buffer zone* (Crown land and some unvested reserves totalling 130,000 ha) and a *zone of cooperation* (private freehold farmland including 557,000 ha cleared and 160,000 ha uncleared). As such this Biosphere is one of only two in Western Australia, but more importantly one of only two *functioning* biosphere reserves in Australia (Bradby 1989, CALM 1991).

It is functioning because of community recognition of land management systems and practices in both the buffer and co-operation zones. In recognition of this both UNESCO and Commonwealth funding has been available for management. Mining, subject to sound environmental management practices, is one of many human impacts acceptable in the zone of cooperation. The holistic 'big picture' approach adopted by the Biosphere concept is important for this and another reason, ie it acknowledges that man and his activities are part of the environment in which we live, but that they do require appropriate management.

The Fitzgerald Biosphere project and CALM's *South Coast Region* management plan (1992) recognise the Ravensthorpe Range vegetation as an important linkage between the Fitzgerald River National Park and Crown land east of the Vermin Proof Fence which extends to the southern Goldfields – the green areas in Fig.1 show the vegetation linkages. The corridor allows for the continuity of biological processes including floral and faunal succession following fire or other disturbance, emigration and immigration of less mobile animals dependent on natural vegetation and genetic processes. The long-term sustainability and viability of this corridor will largely depend on maintaining the vegetation in excellent condition.

The Fitzgerald Biosphere is recognised as being a 'hotspot' within one of Earth's 25 global biodiversity 'hotspots'. The south-west, which represents 5% of the continent, has 8000+ plant species or 40% of Australia's higher plants (Saunders & Ingram 1995). Of these, 75% are endemic and more than 300 are threatened (Hopper 2002).

Steere River and Jerdacuttup River catchments

The Kundip mining leases occur across a catchment divide. The Steere River flows through the western sector of the leases, while in the eastern sector drainages flow to the Jerdacuttup River (Fig.1).

The Jerdacuttup River rises in Archaean granite country north of Ravensthorpe. It follows a tortuous course along the eastern side of the Ravensthorpe Range and then across the coastal sandplain. In places it has cut down to granite bedrock where it crosses the sandplain. The Jerdacuttup River flows into the Jerdacuttup Lakes through a swamp which restricts water flow to the lake. The river water is saline, but salinity varies from almost fresh to greater than sea water salinity (Hodgkin and Clark 1990). The Jerdacuttup Lakes are in a Nature Reserve (A 40156) managed by the Department of Conservation and Land Management. It has been recognised as a conservation reserve of regional significance, contributing to the conservation of flora and fauna and protecting regionally important landscape values (SCRAP and SCRIPT 1997).

At the head of the Steere River lies the Eldverton mine. Erosion of the Eldverton waste dump is causing serious siltation of the river for many kilometres downstream. The Steere River flows southwards on the west side of the Ravensthorpe Range and through the Kundip mining leases which are 7-8 km downstream from the headwaters. The Steere River is the smaller of two rivers that flow into Culham Inlet, which lies 7 km west of Hopetoun.

Previous Studies

Previous biological studies which are relevant to this survey are:

- vegetation survey of the Kundip Mining Lease by Outback Ecology (2003);
- vegetation and flora survey of RAV8 by Craig (1999);
- biological survey of the Ravensthorpe Range by Chapman and Newbey (1995a);
- the Fitzgerald Biosphere reserve buffer zone, including the Ravensthorpe Range, examined for its conservation values by Sanders (1996);
- botanical studies of the Fitzgerald River National Park by Aplin and Newbey (1988b), Newbey and McQuoid (1997), and Chapman and Newbey (1995b) – the latter includes fauna studies;
- rare flora studies of the south coast by Robinson and Coates (1995), and Craig and Coates (2001);
- BHP-Billiton's Ravensthorpe Nickel Project have commissioned a number of unpublished reports by Craig, Chapman, Landcare Services (Cockerton and Evelegh) plus others.

Climate

The nearest weather station to Kundip is Ravensthorpe which has an average annual rainfall of 426 mm. About two-thirds of the annual rain falls in the six months between May and October. This means that there is significant summer rain in many years which provides moisture for vegetation to grow actively.

The average annual Class A Pan evaporation is about 1850 mm (SCRAP and SCRIPT 1997). Thus, potential evaporation is more than four times annual rainfall.

Daily maximum temperatures at Ravensthorpe average from 29^{o}C in January to 16^{o}C in July, and daily minimum temperatures average 14^{o}C in January-February and 7^{o}C in July-September. Temperatures have reached as high as 46 ^{o}C in January-February and as low as –1.0 to 0.0 ^{o}C between June and August.

Geology

The Ravensthorpe Range is a significant landmark in the region, rising to 330 m at Mt Desmond, which lies 9 km north of Kundip. The Kundip mining leases are near the southern limit of the range, at levels 130 m to 230 m above sea level.

Most of the region is underlain by the Yilgarn Craton which is composed of gneissic and granitic rocks of Archaean age 2500 to 3000 Ma. The Ravensthorpe Range and adjacent hilly country covers a very old greenstone belt (2600 to 3000 Ma) which runs through the Archaean granitoid gneiss.

The greenstone belt comprises three components, with the Kundip mining leases being included in the central Ravensthorpe Terrane, a calc-alkaline complex that has been dated at c.2990-2970 Ma. The tonalite and volcanic rocks of the Ravensthorpe Terrane is where the main copper-gold mineralization occurs in the region (Witt 1998).

Deposition of quartz-rich Mt Barren Group sediments occurred in the southern sector of the leases in the Proterozoic era some time between 1550 and 1300 Ma. At the contact between the Archaean rocks to the north and the Proterozoic to the south, a narrow zone ($\leq$ 500 m) of Kundip Quartzite is massively to coarsely bedded. The quartzite is typically a white to grey to blue-green rock. Further south, Kybulup Schist is the uppermost unit which in the Kundip area forms a substantial thickness of dolomite and calc-silicate schist (Witt 1997).

During the Tertiary period, about 30 Ma, the region was laterised and a rock consisting of annular quartz grains in a ferruginous cement developed locally over the Ravensthorpe Terrane. Colluvium has accumulated along major drainages where laterite and related deposits

have been stripped away form Archaean rocks. As far north as Kundip, remnants of an extensive quartz sandplain, overlie Archaean and Proterozoic rocks, as well as overlying laterite.

Soils

In the greenstone belt the soils vary from skeletal, shallow and rocky on the more broken ground to mature deeply weathered red loams on the lower and more even ground. The former soils carry mallee and thicket, and the latter woodlands. Soils of the steep sides of valleys are skeletal; where rock is close to the surface a mallee-heath vegetation predominates.

Flat land surfaces that have been intensely laterised, typically consist of bleached sand overlying a dense band of pea ironstone about 5 cm thick, underlain by a mottled clay or loam. In areas where clay is close to the surface, mallet-form eucalypts predominate, while patches of mallee-heath occur where sand is deeper locally (Beard 1979).

Chapman and Newbey (1995) describe the soils of the southern section of the Ravensthorpe Range, where slopes are more moderate. Deep soil profiles to at least 1 m have developed, the A horizon varies from loamy sand to clayey sand, about 10 cm deep, over a sandy clay B horizon. East of Kundip, where the crest of the ridge is a few hundred metres wide, a colluvial sand sheet up to 1 m deep is present over massive laterite. In the major drainage lines, narrow deposits of saline and sub-saline alluviums have accumulated.

Vegetation and Flora

A survey for declared rare and priority flora and mapping of the vegetation communities occurring at Kundip covered by leases M74/41, 51, 53 & 135 and P74/153 (a total of 664 ha) was carried out in December 2003.

Methods

Although the area of interest is Crown Land, the survey was carried out according to the *Guidelines for flora and fauna surveys of land vested in the National Parks and Nature Conservation Authority* obtained from CALM, and the Environmental Protection Authority's Draft Guidance No.51 (EPA 2003).

Vegetation Mapping

Vegetation units were initially mapped from desktop interpretation of stereo pairs of 1:10 000 scale aerial photographs of Ravensthorpe Runs 6, 7 & 8 taken on 10 February 1995. A fire burnt the eastern sector of the leases between 29 December 1987 and 6 January 1988 (Chapman and Newbey 1995) and the boundary of the fire was determined from interpretation of 1:8 000 scale aerial photos Kundip Runs 2 & 3, taken on 22 February 1988.

In December 2003, eight days were spent in the field ground-truthing each of the mapped units. It was found that many of the units, previously delineated from aerial photos, needed their boundaries modified. The complexity of the vegetation communities, and the subtle changes in species of *Eucalyptus* and *Melaleuca* through the landscape, could not be readily determined from aerial photos.

Vegetation units were classified and mapped according to their dominant life form or structure following the Muir (1977) classification system (Appendix 1). In addition, the dominant or typical species was used to identify each unit. In most cases, this was a *Melaleuca* species for mallee-thicket/heath communities, or a *Eucalyptus* species for low forest/ woodland communities.

During the survey, plant taxa were recorded in each vegetation unit. A specimen of each taxon not recognised by the author, was taken for identification. Plant specimens were verified using the author's private herbarium, the Ravensthorpe Herbarium or the Perth Herbarium; nomenclature follows that of PERTH (Paczkowska and Chapman 2000). Assistance with some taxa was provided by specialist botanists. Duplicate specimens of special interest have been lodged at both the Ravensthorpe and Perth herbaria.

Declared Rare and Priority Flora

Under the Wildlife Conservation Act, CALM is responsible for the protection of flora and fauna of all lands and waters throughout the State. Section 23F of the ACT (Appendix 2) gives the Minister responsible for the Act statutory responsibility for the protection of those classes of flora declared to be rare.

CALM has ranked plant taxa considered to be threatened under a series of conservation codes, depending on their apparent degree of threat (see Appendix 2). Taxa listed as Declared Rare Flora require permission from the Minister responsible for the Wildlife Conservation Act 1950, if any portion of the plant is to be, or likely to be, disturbed.

A search was made of CALM's databases for Declared Rare (DRF) and Priority Flora species which have the potential to occur in the area. The search co-ordinates were $33^{o}30'$ – $34^{o}0'$ S and $120^{o}0'$ – $120^{o}45'$ E on 16 May 2003. A more defined area, centred on Kundip, was made by Outback Ecology (2003). A list of the threatened species with the potential to occur in the Kundip area is given in Appendix 2. Transects were made along grid lines through the area

over an eight day period, simultaneously with the ground-truthing of vegetation units. Locations of DRF and Priority flora were mapped and their positions taken with a GPS (Garmin II).

Following the discovery of two populations of the Declared Rare *Marianthus villosus* on the Kundip mining leases, further regional surveys of known populations of this species were carried out over three days between the 4 – 10 February 2004. On 17 March 2004, the three sub-populations of *Melaleuca* sp. Kundip (GF Craig 6020) were surveyed. The area covered by each population was determined either by pacing its extent or marking the boundary with GPS points and calculating the area using ARCVIEW®. An estimate of the number of plants in each population was determined by counting the number of plants in at least 100 m x 1 m and calculating the number for the given area.

Results

Vegetation Classification

Kundip lies in the South West Botanical Province and the Esperance Biogeographic Region and is within the Ravensthorpe system described by Beard (1979).

Beard (1979) recognised four vegetation communities in the vicinity of the Kundip mining leases:

- 'Barren Ranges thicket' including *Dryandra quercifolia*, on the crest of the Ravensthorpe Range;
- 'Mallee on greenstone' including *Eucalyptus cernua* and *E. gardneri* subsp. *ravensthorpensis,* on range slopes;
- 'Mallee heath on lateritic plain with *Eucalyptus pleurocarpa'* extending eastwards to Jerdacuttup and beyond;
- 'Mallee in valleys' including *E. phaenophylla* and *E. uncinata,* south of the range and lower catchment of the Steere River.

Vegetation Units

Eighteen units, identified by their vegetation formations and associated plant species, were mapped on the Kundip mining leases (Fig. 3). Most of the vegetation was extremely old, possibly greater than 100 years, and in excellent condition. Approximately one-fifth of the lease area was burnt between 29 December 1987 and 6 January 1988 (Chapman and Newbey 1995), mostly in areas to the east of the divide, ie in the Jerdacuttup River catchment (Fig. 4).

A list of the 272 plant species identified, and a matrix of the vegetation units in which they are found is given in Appendix 3.

An overview of each vegetation unit (see Fig. 3 for the annotations in brackets), with its typical plant association is provided below; photos depicting each unit are provided in Appendix 4. The vegetation is described according the landform; however it must be noted that, in the field, intergrades between the vegetation units usually occur at their boundaries.

(1) CRESTS and UPPER SLOPES

Laterite and quartzite:

Skeletal pale grey to orange loamy sands with lateritic gravel typify the crest and upper slopes in the eastern sector of the lease. In the western sector, a low quartzite ridge straddles the Steere River. Both areas are vegetated with open mallee and very dense proteaceous thicket where *Banksia lemmaniana* [**Bl**] is typical. The mallees *Eucalyptus falcata* and *E. pleurocarpa* are common, and on the west side of the Hopetoun-Ravensthorpe Road, *E. lehmannii* is found. Common shrub species include *Taxandria spathulata, Dryandra quercifolia* and *Calothamnus pinifolius.*

Clays, loamy clays and ironstone rubble, loamy clays and ironstone rubble:
At lower altitudes, the crests and upper slopes between minor drainage lines have orange-brown mottled clay loams with ironstone rubble. In some areas, the A horizon has been eroded away leaving pallid zone clays. These support mid-dense to open mallee and dense heath communities dominated by Priority One *Melaleuca stramentosa* [**Ms**]. A frequent species is the Priority Two *Acacia laricina* var. *crassifolia.* On the south-facing slopes in the southern sector of the lease area, *M. stramentosa* is co-dominant with *M. bracteosa* [**Mb**]. Mallees include *Eucalyptus flocktoniae, E. phaenophylla* and *E.leptocalyx.*

Small breakaways support pockets of low *Eucalyptus clivicola* forest [**Ec**]. These usually have an understorey of *M. stramentosa.*

Calcareous clay loams:
A low rise near the southern boundary of the leases is characterised by grey, calcareous clay loam which supports a mid-dense low forest of Brown Mallet *Eucalyptus astringens* [**Ea**], with occasional *E.clivicola.* The understorey is sparse, although *Melaleuca rigidifolia* is a frequent component.

Sixteen years ago, the area to the east of this vegetation unit was burnt (Fig.4). Dense mallet regrowth, including *E. astringens, E.clivicola* and *E. cernua* [**Ea/ Ec/ En**] occurs in the drainage to the east of the above [**Ea**] unit. In the far south-east sector of the lease area, a deeply incised drainage line runs through this mallet regrowth [**Ea/ Ec/ En**] unit. The understorey is usually sparse and includes *Acacia glaucoptera, Thomasia foliosa,* and two Priority Three species *Dodonaea trifida* and *Boronia oxyantha* var. *brevicalyx.*

(2) SLOPES

Gravelly loamy clay sand:
Grey-brown to red-brown loamy clay sand with lateritic gravel covers the mid- and lower slopes. These are characterised by dense to mid-dense shrub mallee (1-4 m tall) and myrtaceous heath dominated by *Melaleuca hamata* [**Mh**]. This is a widespread mallee-heath community in the survey area. No particular species of mallee dominates, but a mixed community of *Eucalyptus cernua, E. flocktoniae, E. leptocalyx, E. phaenophylla, E.phenax, E.pilieata, E. pleurocarpa, E. suggrandis* and *E. uncinata* prevails. The lowest strata is characterised by a variety of *Lepidosperma* and *Gahnia* species.

Gravelly loamy sand:
Yellow-brown loamy sands with lateritic gravel occur in the south-east sector of the lease, a large area of which was burnt sixteen years ago (Fig.4). Open low mallee and dense heath (1 m) dominated by *Melaleuca rigidifolia* [**Mr**] typifies this unit. Mallees include *E. leptocalyx,* both varieties of *E. phaenophylla* and *E. uncinata.*

Loamy clay:
A discrete pocket of poorly drained, pale brown loamy clay with quartz and laterite rubble occurs near the divide between the two catchments. A mid-dense mallee heath community characterised by *Melaleuca calycina* [**My**] along with *E. scyphocalyx, E.pileata* and *E. phaenophylla* grows here.

Loamy sand with quartz rubble:
A gentle slope in the south-west sector of the lease, consisting of pale grey loamy sand with quartz rubble, supports an unusual plant association of very open mallee and dense shrub heath (1-1.5 m) dominated by *Melaleuca* sp. Kundip (GF Craig 6020) [**Mx**]. Associated species include *M. haplantha, M.stramentosa, E. cernua, E. phaenophylla* and *Pultenaea* sp. Kundip (GF Craig 6008).

Melaleuca sp. Kundip (GF Craig 6020) is a new, undescribed species (B.Lepschi, pers.comm.) and *Pultenaea* sp. Kundip (GF Craig 6008) is potentially new and awaits flowering material for verification by Lindy Orthia in Canberra. Both species appear to have a very restricted distribution.

(3) LOWER SLOPES

Duplex soils:

Lower slopes comprise areas of grey to yellow sand of varying depth over mottled clay loams. The vegetation is typically very open mallee and low proteaceous and myrtaceous heath (< 1 m) with *Banksia media* [**Bm**] a characteristic species. There are a variety of mallees, however the most outstanding is *Eucalyptus pleurocarpa.* There is a great diversity of shrub species - common ones include: *Dryandra cirsioides, Grevillea patentiloba, Hakea corymbosa, H. lissocarpha, H. marginata* and *H. pandanicarpa.* The sedge *Lepidosperma squamatum* is abundant.

Clay loams;

Poorly drained, orange-brown clay loams are dominated by *Melaleuca cucullata* [**Mc**] often in association with *Eucalyptus cernua.*

White clay (Moort clays):

Areas of white clay or loamy clays with quartz rubble, often referred to locally as 'moort clays' after the characteristic species *Eucalyptus platypus* (Moort) [**Ep**] are found in the old Kundip townsite, as well as in the north-west sector of the leases. On the lower slopes the moort becomes more open, the shrub strata denser and dominated by *Melaleuca haplantha* [**Mp**].

Komatiite:

Komatiite red-clay loams are characterised by the shrub *Melaleuca* sp. Gorse (AS George 7224) [**Mg**] with an overstorey of *E. flocktoniae* and *E. pileata.*

Calcareous loams:

A small patch of *Eucalyptus indurata* and *E. longicornis* ssp. *corvina* tall mallee with a dense understorey of *M. pauperiflora* [**Mm**] occurs west of the Flag mine and adjacent to the Steere River. This community is typical of calcareous loams in the region.

(4) DRAINAGE LINES

The principal drainage in the survey area is the Steere River which passes through the western sector of the leases. Another two major drainage lines flow into this river in an westerly direction. The brown loamy alluviums associated with the drainages support an open woodland and thicket characterised by *Melaleuca acuminata* [**Ma**]. *Eucalyptus sporadica* occurs in the minor creeklines, while Yate *E. occidentalis* frequents larger drainages and the Steere River. *Acacia cyclops* is common, particularly in areas disturbed by mining activities.

Threatened Ecological Communities

All of the above communities lie within the Ravensthorpe System of Beard (1979) which has been proposed for inclusion in CALM's Threatened Ecological Community database (English and Blythe 1997). The majority of the mallee-heath and mallet communities indicated above are well-represented in the region, except for the units dominated by *Melaleuca stramentosa* [**Ms**] and [**Mb**], and the *Melaleuca* sp. Kundip (GF Craig 6020) dominant [**Mx**] unit. The latter community appears to be very geographically restricted and apparently has two new plant species which could be impacted by future exploration and mining activities.

Species Diversity

A total of 249 native species were found on the Kundip mining leases, as well as 23 exotics (five of which occurred in the Hopetoun-Ravensthorpe Road reserve). This does not include any annual species, such as orchids and grasses that may be present during late winter – spring. The family Myrtaceae was well represented with 26 *Eucalyptus* and 23 *Melaleuca* species. The family Proteaceae included 29 species and there were 24 species of Papilionaceae. At least nine species of *Lepidosperma* sedge occur in the survey area.

The most species rich communities were also the most widespread, ie the *Banksia lemmaniana* open mallee-thicket [**Bl**] unit with 114 species, *Melaleuca hamata* mallee-heath [**Mh**] with 90 species and the *Melaleuca acuminata* open woodland and thicket/heath [**Ma**] with 76 species. Ten of the vegetation units had less than 30 species each recorded (Appendix 3).

Declared Rare and Priority Flora

The survey identified one Declared Rare and nine Priority taxa on the leases. Their localities are mapped (Fig. 5), GPS locations are given in Appendix 5 and details of each taxon given below:

Declared Rare flora:

Marianthus villosus (Turcz.) Benth. – a low, spreading, mid-dense shrub which grows to 50 cm tall. The flat leaves are covered with long white hairs when young, but become hairless with age except along the midvein and margins. The solitary flowers are deep blue.

Two populations are located in the survey area:

1. POPULATION 5 (Plate 1) – c. 1,500 plants covering 4.84 ha north of the 'Western Gem' mine in upper catchment of a minor drainage. The southern portion of this population has been disturbed by earlier mining activities, with grid lines, tracks and two shafts present.

Plate 1 – *Marianthus villosus* POPULATION 5

2. POPULATION 3C (Plate 2) – c. 700 plants over 1.4 ha located 600 m NE of the 'Flag' mine, again in the upper catchment of a minor drainage line. This area is largely undisturbed, occurring in an area which has not been burnt for possibly 75 years or more.

Regional surveys of known populations of *Marianthus villosus* estimated over 40,000 plants east of the Vermin Proof Fence (Population 1), and about 800 plants in two Ravensthorpe Range populations to the north and east of the Kundip mining leases (Populations 3A and 4). A summary of the results from the survey of new and re-survey of the known populations is given in Table 1. GPS locations are given in Appendix 5, and *Rare Flora Report Forms* in Appendix 6.

Plate 2 – *Marianthus villosus* POPULATION 3C (foreground) and *Siegfriedia darwinioides* (mid-ground)

Table 1 – *Marianthus villosus* populations in the Ravensthorpe region. (Population numbers are those used by CALM).

POP. NO.	LOCATION	STATUS	AREA (ha)	NO. OF PLANTS	CONDITION
1A	Vermin Proof Fence	resurvey	2.65	c. 35,000	burnt May/June 2001 ? and Feb 2003?
1B	Vermin Proof Fence	resurvey		nil	burnt May/June 2001
1C	Vermin Proof Fence	resurvey		nil	burnt May/June 2001
1D	Vermin Proof Fence	resurvey	0.03	54	burnt Feb 2003
1E	Vermin Proof Fence	resurvey	0.3	c. 4,000	burnt Feb 2003 east side; May/June 2001 west side of firebreak
1F	Vermin Proof Fence	not surveyed		(20+)	(26/11/81 survey)
1G	Vermin Proof Fence	new	0.2	c. 2,500	burnt Feb 2003
1H	Vermin Proof Fence	new	<0.01	10	burnt Feb 2003
1I	Vermin Proof Fence	new		100s	burnt Feb 2003
1J	Vermin Proof Fence	new	<0.01	c.20	burnt Feb 2003
2	1.2 km N of Mt Desmond	resurvey			not found; habitat wrong for given lat/long
3A	9.9 km SE of Mt Desmond; Hecla mine	resurvey	1	300+	undisturbed, unburnt > 40 years
3B	9.3 km SE of Mt Desmond	resurvey			not found at given lat/long, although described locality seems equivalent to POP 3C
3C	9.4 km SE of Mt Desmond; NE of Flag mine (Kundip mining leases)	new (?= 3B)	1.4	c. 700	undisturbed, not burnt > 60 years
4	4.7 km SE of Mt Desmond; N of Mt Iron mine	resurvey	1.0	500+	undisturbed, not burnt > 60 years
5	7.9 km SE of Mt Desmond; N of Western Gem mine (Kundip mining leases)	new	4.84	c. 1,500	10-15% disturbed by old grids and tracks, remainder unburnt > 60 years

Priority One:

Melaleuca stramentosa Craven - a robust shrub to 1 m tall with deep mauve flowers. This species is very common on the mining lease, being the dominant shrub in the [**Ms**] and [**Ec**] vegetation units, and co-dominant with *Melaleuca bracteosa* in the [**Mb**] unit (Fig. 3). As well, it appears occasionally in other plant associations within the survey area. It grows in loamy clays on the upper slopes of the catchments.

Although many thousands of plants occur on the Kundip mining leases, *M. stramentosa* is very poorly known and appears to be very geographically restricted, with a known range of only 8 km – the southern limit being Jerdacuttup Road. Large numbers of plants were found during the survey of *Marianthus villosus* Population 4 (see Appendix 5 for GPS locations), ie about 2.5 km north of the Kundip mining leases.

M. stramentosa is difficult to distinguish from a number of the *Melaleuca* species growing in the Ravensthorpe Range. It is recommended that any further surveys for this species be carried out when it flowers in October.

Plate 3 – *Melaleuca stramentosa* fruits

Priority Two:

Acacia disticha Maslin - a shrub to 2 m tall with reddish-green stems that are considerably flattened. Phyllodes ('leaves') are dull green and arranged in opposite rows.

It is widespread, but rare, over the survey area, being found in minor drainage lines and the Steere River in sandy loams. Often there are only one or two plants at any location.

A. disticha has been collected in creeklines from the Corackerup Creek area, through Thumb Peak in the Fitzgerald River National Park, to Kundip, a range of 150 km (Robinson and Coates 1995).

Plate 4 – *Acacia disticha*

Acacia laricina Meisn. var. *crassifolia* Maslin – a low, spreading shrub to 40 cm tall and 60 cm wide. Phyllodes ('leaves') are cylindrical, strongly ribbed and have a sharp point at the apex. This species prefers skeletal soils on the upper slopes on the west side of the divide between the Steere River and Jerdacuttup River catchments. It grows in a number of the vegetation types, being particularly common in the [**Ms**] and occasional in the [**Mr**] units (Fig.3). It tends to grow in patches of 10-30 plants, scattered throughout the eastern sector of the leases.

A. laricina var. *crassifolia* has a restricted distribution, being mainly collected from Mt Desmond to Kundip, and one collection from Mt Short, a range of 30 km.

Plate 5 – *Acacia laricina* var. *crassifolia*

Priority Three:

Acacia durabilis Maslin - an attractive, open, spreading shrub to 2 m tall with prominently striate, ribbed branchlets. The flat phyllodes ('leaves') have a short hook at the tip. Single plants are widespread from the NE to the SW corners of the mining leases, mainly in the [**Bl**] and [**Mh**] vegetation units and occasionally in minor drainage lines.

This species is restricted to the Ravensthorpe Range, being collected from 7 km north of Ravensthorpe, and from Mt Desmond through to Kundip. It grows on ridges and slopes of the range in gravelly lateritic, red sandy or rocky clays supporting mallee scrub or thicket.

Plate 6 – *Acacia durabilis*

Plate 7 – *Boronia oxyantha* var. *brevicalyx*

Boronia oxyantha Turcz. var. *brevicalyx* (Benth.) Paul G Wilson - a low shrub, to 60 cm tall, with hairy branchlets. Leaves have 3-7 pairs of cylindrical leaflets. The solitary flowers are pink. This species is frequent, but scattered, in the southern sector of the leases growing beneath the mallets, *Eucalyptus astringens, E. clivicola* and *E.cernua,* both in the old growth low forest [**Ea**] unit and the regrowth [**Ea/ Ec/ En**] area which burnt sixteen years ago.

B. oxyantha var. *brevicalyx* is known from Ravensthorpe Range, Kundip and the Fitzgerald River National Park (Robinson and Coates 1995), and further west near the Pallinup River. In the range, it has been collected 12 times, distributed over about 25 km. Five populations were located during a survey by A.Chapman in October 1998, from Mt Short to near Kundip. During the survey of *Marianthus villosus* Population 4, ie 2.5 km north of the Kundip mining leases, a number of small populations were found (Appendix 5).

At Bandalup Hill this *Boronia* is sporadic and widespread, with an estimated 50,000+ plants growing in the proteacous thicket community on the ridgetop (Craig 2000). The latter population will be destroyed if the Ravensthorpe Nickel Project proceeds (Landcare Services, pers.comm.).

Dodonaea trifida F.Muell. - a dioecious shrub to 1.5 m tall; leaves have a tri-dentate apex. Both male and female flowers are inconspicuous, although the fruit is a more obvious three-angled, subglobose capsule. This species is widespread through the leases, with scattered occurrences in the majority of minor drainage lines.

D. trifida has been collected from Bandalup Hill to Mt Melville at Cape Riche, 180 km to the south-west. In the Ravensthorpe Range, the majority of collections have been in the Kundip area. A few populations are known in the Fitzgerald River National Park where it should remain secure (Craig and Coates 2001).

Plate 8 – *Dodonaea trifida*

Spyridium glaucum Rye - an inconspicuous shrub to 2 m tall, with small flower heads of 3-6 flowers. Leaves are dark, shiny green on the upper surface and densely hairy below. On the Kundip mining leases, c. 20 plants grow on a breakaway of brown loam beneath *Eucalyptus clivicola* low forest in association with *Dodonaea trifida.*

S. glaucum is also known from at least seven localities in the Ravensthorpe Range, from Mt Short to Kundip, a distance of 30 km. Until recently, the largest known population on the range is NNE of Mt Desmond where c. 500 plants occur beneath *Eucalyptus megacornuta.* However, during the survey of *Marianthus villosus* Population 4, thousands of plants were found in the gully c. 2.5 km north of the Kundip mining leases (Appendix 5). It is also known from Bandalup Hill where over 15,000 plants grow in three sub-populations covering over 2 ha (Craig 2000). Similar to Kundip, it is often found growing in association with *D. trifida.*

Plate 9 – *Spyridium glaucum*

Priority Four:

Acacia pinguiculosa RS Cowan & Maslin subsp. *pinguiculosa* – a densely branching, spreading shrub to 1.3 m tall and 2 m diameter with yellow-green, flattened phyllodes ('leaves'). Four populations are located on the leases, one on the east boundary of the leases (100s of plants), two in the [**BI**] unit on either side of the Steere River (20+ plants), and another on the west side of the Hopetoun-Ravensthorpe Road in an old gravel pit (c.10 plants).

Personal observation has found *A. pinguiculosa* subsp. *pinguiculosa* to be a widespread and frequent species in the Steere River catchment usually growing in skeletal, sandy soils with patch sizes varying from tens to thousands of plants. Landcare Services (pers.comm.) have found large populations in Crown land north-east of the range in the 'Carlingup Corridor'. It is recommended that this species be deleted from the Priority Flora list.

Siegfriedia darwinioides CA Gardner - a low shrub, to 50 cm tall, with pendulous, yellow-green flowers. On the Kundip mining leases, it is frequent in the upper catchments of three drainage lines that flow to the Steere River.

S.darwinioides is distributed between the Pallinup River and Starvation Boat Harbour, a range of 180 km. It prefers stoney red loam or kaolinitic-lateritic breakaways, in mallee scrub or woodland communities (Craig and Coates, 2001). This species is relatively common and widespread through the Ravensthorpe system, being collected from the Ravensthorpe Range, Mt Short, Bandalup Hill, as well as the Eyre Range in the Fitzgerald River National Park.

Plate 10 – *Siegfriedia darwinioides*

It should be noted that *Microcorys pimeleoides* (Priority 1), which was identified by Outback Ecology (2003) during a February survey as occurring in the "eastern part of Area 2", ie to the east of the Harbour View mine, was not found during the current survey. The common *Microcorys glabra* is widespread through the area and has similar leaves to the priority species, making them difficult to distinguish when not flowering. Surveys would need to be carried out in October-November, ie during flowering, to verify whether *M. pimeleoides* has been correctly identified (the original collection cannot be found (Outback Ecology, pers.comm.)) and, if present, its location and extent on the Kundip mining leases determined.

Outback Ecology (2003) had wrongly identified *Eucalyptus depauperata* (Priority 3) which is now confirmed as the common and widespread *E. suggrandis.*

Plant Species of Special Interest

The following two taxa are of special interest as they are considered to be new species that were collected during this survey.

Pultenaea sp. Kundip (GF Craig 6008) – a low spindly shrub, to 30 cm tall. Leaves are 4 mm long, cylindrical with a groove in the upper side and recurved at the tip. The small, rounded pods are hairy. Scattered plants are found shaded beneath the *Melaleuca* shrubs in the [**Mx**] unit and further to the east in the *Eucalyptus astringens* [**Ea**] low forest. This species has affinity to *Pultenaea calycina* subsp. *proxena* ms, but requires flowering material to confirm its status (L. Orthia, pers.comm.). It is expected to flower in spring.

Melaleuca sp. Kundip (GF Craig 6020) – an erect, robust shrub, 1-2 m tall with recurved leaves, and white flowers (Plates 11 & 12). This species is new and undescribed (Lepschi, pers.comm.). It is restricted to the south-western sector of the leases, growing on pale grey sandy loam with quartzite rubble. This species is dominant in the [**Mx**] vegetation unit, with three sub-populations being found on the leases and one to the south of the lease area (Fig.3 and Table 2). Its currently known range is approximately 1.1 km x 0.5 km.

Table 2 – Estimated number of plants in *Melaleuca* sp. Kundip (GF Craig 6020) sub-populations at the Kundip mining leases

Sub-population	Area (ha)	Number of plants (estimated)
South-west	10	25,000
Centre	1	1,200
East	0.03	100
South of lease area	0.4	500
TOTAL	**11.43**	**26,800**

Plates 11 & 12 – *Melaleuca* sp. Kundip (GF Craig 6020)

Exotic Species

Eighteen exotics were recorded in the survey area, mostly from old building sites (Fig.6), plus another five on the edge of the Hopetoun – Ravensthorpe Road (Appendix 3). A Moreton Bay Fig and an edible fig (Plate 13) were present. At one site, an array of succulent species, large *Agave* and geraniums occur (Plate 14). Many of the exotics have been purposely planted around now-demolished buildings by earlier tenants and have remained confined to those areas.

A number of exotics, however, have become weedy and are gradually spreading, notably the introduced Asteraceae, succulents (Plate 15) and bridal creeper. Boxthorn *Lycium ferocissiumum,* a noxious weed that is common in the Ravensthorpe region, is present in the [**Mm**] unit (Plate 16). Bridal creeper *Asparagus asparagoides* is now listed as a Weed of National Significance and is discussed further below.

Plate 13 – Edible fig, senescent bridal creeper (left foreground), and ?iris bulbs (right foreground) at Gordon Halbert's old camp.

Plate 14 – Large *Agave* , geranium, succulents and senescing bridal creeper, north of the old vault.

Plate 15 – The exotic succulent *Cotyledon orbiculare* is gradually spreading through bush north of the old vault.

Plate 16 – Boxthorn *Lycium ferocissimum* occurs in the [Mm] vegetation unit west of the Flag mine.

Discussion

Species Diversity and Endemism

The Kundip mining leases had at least 249 native species in an area of c.3 km x 3 km which verifies the work of Hopper and Gioia (in prep.), who found that the region south of Ravensthorpe is one of the peak areas of species diversity in the south-west with about 340 species present per 0.25 degree cell (c. 30 km x 30 km).

Kundip is centred in one of the three areas of highest endemism in Western Australia (Mt Lesueur area and the Stirling Range being the other two), with more than 60 endemic species per 0.25 degree cell (Hopper and Gioia in prep.), ie a range of less than 30 km. Many of the declared rare and priority species that occur in Kundip mining leases are local endemics, eg *Marianthus villosus, Melaleuca stramentosa, Acacia durabilis* and *A. laricina* var. *crassifolia* which although may be locally abundant have a very restricted range and are consequently vulnerable to threatening processes, eg fire, plant disease and climate change.

Threatening Processes

Plant Disease

The flora of the south-west of Western Australia has long been recognised for its richness and high degree of endemism, especially the heath communities of the Northern and Southern Sandplains. The Proteaceae and Myrtaceae are the most dominant families in these communities, with the Epacridaceae forming a less substantial but significant presence.

Dieback (*Phythophthora* species), various canker causing fungi, and *Armillaria luteobubalina* pose an enormous threat to the flora, especially Proteaceae which are particularly susceptible to diseases.

The introduced soil-borne pathogen, *Phytophthora cinnamomi* has the potential to kill the majority of species from the Proteaceae, Epacridaceae and Papilionaceae families. When it invades communities rich in these species, major changes in plant abundance and floristic structure may be observed. In recognition of the severe threat that this pathogen poses, CALM (Albany) have prepared *A Plan for the Protection of South Coast Vegetation from Dieback: No.3 1994-1998.* At present there is no evidence of *Phytophthora* infection in the Kundip mining leases.

Several aerially-dispersed, canker-causing fungi including species of *Botryosphaeria, Diplodina* and *Zythiostroma,* have been isolated from *Banksia* in the Hopetoun region. The unusually hot, dry weather experienced in Hopetoun in February 1991, triggered off existing *Botryosphaeria ribis* infections which invaded down the branches, killing from the top down Showy Banksia (*Banksia speciosa)* and Baxter's Banksia (*B.baxteri)* (Shearer, pers.comm.). Canker fungi have the potential to kill mainly woody perennials from a range of families – Proteaceae appear to be particularly susceptible (Wills and Keighery 1994). There does not appear to be any canker fungi in the vicinity of Kundip.

Good health of the various plant communities, in particular those dominated by Proteaceae (eg the [**Bl**] and [**Bm**] units), is required for the survival of vertebrate-pollinators as they provide key nectar sources (eg *Banksia).* Reduction in the population size of pollinators could affect the stability and viability of plant populations (Wills and Keighery 1994).

Fire

Hopper (2002) tells us that unprecedented turnover of plant species over short distances across south-western landscapes has existed throughout the last 10,000 years, with fire-adapted and fire-evading flowering plants intermixed in complex mosaics from 70-100 million years ago. Consequently, we should expect different responses and biodiversity outcomes over short distances from the same fire regime.

Threatening or inappropriate fire regimes may include long periods of fire exclusion, sustained frequent burning, or large and intense wildfires (Burrows and Wardell-Johnson 2003). About four-fifths of the Kundip mining leases have remained unburnt for possibly more than 80 -100 years. Chapman and Newbey (1995) indicate that at the time of writing, almost all the Ravensthorpe Range had not been burnt for at least 45 years, and the size of many of the trees and mallees suggested no fires for at least 75 years. A fire occurred in the eastern sector of the leases between 29 December 1987 and 6 January 1988, mainly east of the divide in the Jerdacuttup River catchment. Despite the old age of much of the vegetation, it appears in extremely good health with no evidence of plant degeneration.

Since 1990, there have been a number of fires in the Ravensthorpe Range and surrounds. In December 1990, the large block of Crown land west of Kundip townsite to Moir Road was aerially fire-bombed to control a large wildfire which started as a control burn on the north boundary of the Fitzgerald River National Park. In the last few years, lightning strikes have started fires near Eldverton and north of Mt McMahon. A number of prescribed burns have been initiated over the last 5 years, mainly north of the South Coast Highway.

Weed Invasion

Weed invasion is likely to increase from the edges of disturbed areas. Introduction of more grid lines, tracks and roads to access the leases will favour weed spread. Of greatest concern is the occurrence of bridal creeper, particularly where it occurs close to drainage lines. Bridal creeper is a Weed of National Significance and the Steere River, further downstream, has had its riparian vegetation engulfed by this smothering creeper.

Two biological control organisms have been released in the Kundip area. The bridal creeper leaf hopper (*Zygia* sp.) was released in the old Kundip townsite in spring 2000 and 2003, and at Gordon Halbert's old campsite (where the fig tree grows on the Kundip mining leases) in 2000. The rust *Puccinia myrsiphylii* was released in the Kundip townsite in spring 2001 and 2003, and Gordon Halbert's campsite in early August 2003 (M.Bennett, M.Grant and J.Hill, pers.comms.). The efficacy of the leaf hopper and bridal creeper rust should be monitored in the Kundip area and every effort made to prevent further spread of this weed.

Project Impacts on Ravensthorpe Corridor

The natural vegetation surrounding Kundip has been identified as an important corridor between the FRNP and the Goldfields by the Fitzgerald Biosphere Project (Sanders 1996). As indicated in the Regional Setting of this report, in the context of current conservation theories and practices maintenance of the integrity of the corridor must be an important part of project planning and management. Without sound environmental planning and management, secondary impacts such as spread of dieback, erosion and drainage effects can impact an area far in excess of the immediate project area.

The protection of biodiversity is increasingly seen as a global concern. This change in perspective has been associated with an increasing number of international instruments addressing biodiversity conservation issues. Some of these instruments, such as those relating to Biosphere Reserves, have been given some recognition in the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999.* Moreover, the Environmental Protection Authority has recognised the importance of maintaining ecosystem/ecological processes for ecologically sustainable management (EPA 1999).

The government of Western Australia is presently discussing regulations for the *Biodiversity Conservation Act*. This Act proposes to enhance legislation for the protection, restoration and sustainable use of our native plants, animals and other native organisms. The government recognises that "all of our natural biodiversity is important and it is our responsibility to ensure that our biodiversity is conserved" (Government of WA 2002).

Recommendations

1. Project planning and management should make efforts to minimise fragmentation of natural vegetation within the project area. Where there is unavoidable fragmentation, it is important to maximise the area: perimeter ratio of remnant vegetation.

2. Operational procedures should be adopted to minimise the risk of dieback introduction and spread into the project area. This can be achieved by:
   - minesite operations planned so that water runoff is minimised into communities with a high component of dieback susceptible, proteaceous species, ie the [**Bl**] and [**Bm**] vegetation units;
   - vehicle and machinery wash-down facilities, and cessation of vehicle and machinery movement in extreme situations when high temperature and moisture conditions combine to spread the fungal spores.

3. Survey for further populations of Priority One *Melaleuca stramentosa* in the region in October, ie when this species is flowering.

4. Verify occurrence of *Microcorys pimeleoides* (Priority One), apparently found by Outback Ecology (2003), when this species is flowering during October-November.

5. Collect flowering specimens of *Pultenaea* sp. Kundip (GF Craig 6008), probably during spring, and have them verified by Canberra taxonomist, L. Orthia. If confirmed that this is a new species, its distribution on the leases should be surveyed while it is flowering.

   Furthermore, if this *Pultenaea* is new, it along with the new taxon *Melaleuca* sp. Kundip (GF Craig 6020) would be recommended for inclusion on CALM's Priority flora list. Both species occur in the [**Mx**] vegetation unit, which is potentially a Threatened Ecological Community. Consequently, further regional surveys of these species would be recommended, particularly if they are likely to be impacted by mining operations.

6. Survey the Kundip mining leases in late winter for annual species, particularly orchids, and any other perennial species that may have been overlooked during the summer survey.

7. Document the current boundaries of the Weed of National Significance, bridal creeper *Asparagus asparagoides*. Monitor the efficacy of biological control organisms, ie bridal creeper leaf hopper and rust, and introduce these organisms to all bridal creeper sites on the Kundip mining leases during August - September.

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Appendix 1

Muir's (1977) Vegetation Classification

LIFE FORM/ HEIGHT CLASS		CANOPY COVER			
		DENSE	MID-DENSE	SPARSE	VERY SPARSE
		70-100%	30-70%	10-30%	2-10%
T	Trees >30m	Dense Tall Forest	Tall Forest	Tall Woodland	Open Tall Woodland
M	Trees 15-30m	Dense Forest	Forest	Woodland	Open Woodland
LA	Trees 5-15m	Dense Low Forest A	Low Forest A	Low Woodland A	Open Low Woodland A
LB	Trees <5m	Dense Low Forest B	Low Forest B	Low Woodland B	Open Low Woodland B
KT	Mallee tree form	Dense Tree Mallee	Tree Mallee	Open Tree Mallee	Very Open Tree Mallee
KS	Mallee shrub form	Dense Shrub Mallee	Shrub Mallee	Open Shrub Mallee	Very Open Shrub Mallee
S	Shrubs >2m	Dense Thicket	Thicket	Scrub	Open Scrub
SA	Shrubs 1.5-2m	Dense Heath A	Heath A	Low Scrub A	Open Low Scrub A
SB	Shrubs 1-1.5m	Dense Heath B	Heath B	Low Scrub B	Open Low Scrub B
SC	Shrubs 0.5-1m	Dense Low Heath C	Low Heath C	Dwarf Scrub C	Open Dwarf Scrub C
SD	Shrubs <0.5m	Dense Low Heath D	Low Heath D	Dwarf Scrub D	Open Dwarf Scrub D
P	Mat plants	Dense Mat Plants	Mat Plants	Open Mat Plants	Very Open Mat Plants
H	Hummock grass	Dense Hummock Grass	Mid-Dense Hummock Grass	Hummock Grass	Open Hummock Grass
GT	Bunch grass >0.5m	Dense Tall Grass	Tall Grass	Open Tall Grass	Very Open Tall Grass
GL	Bunch grass <0.5m	Dense Low Grass	Low Grass	Open Low Grass	Very Open Low Grass
J	Herbaceous spp.	Dense Herbs	Herbs	Open Herbs	Very Open Herbs
VT	Sedges >0.5m	Dense Tall Sedges	Tall Sedges	Open Tall Sedges	Very Open Tall Sedges
VL	Sedges <0.5m	Dense Low Sedges	Low Sedges	Open Low Sedges	Very Open Low Sedges
X	Ferns	Dense Ferns	Ferns	Open Ferns	Very Open Ferns
	Mosses, liverwort	Dense Mosses	Mosses	Open Mosses	Very Open Mosses

Appendix 2

Department of Conservation and Land Managment's declared rare and priority flora list

Rare flora legislation and guidelines for gazettal

The State Conservation Strategy, Wildlife Conservation Act, 1950, and Conservation and Land Management Act 1984 provide the guidelines and legislative basis for the conservation of the State's indigenous plant and animal species. Under the Wildlife Conservation Act, the Department of Conservation and Land Management (CALM) is responsible for the protection of flora and fauna of all lands and waters throughout the State. Section 23F of the Act gives the Minister responsible for the Act statutory responsibility for the protection of those classes of flora declared to be rare.

The Wildlife Conservation Act (1950-1985) protects all classes of indigenous flora throughout the State. Protected flora includes:

Spermatophyta - flowering plants, conifers and cycads
Pteridophyta - ferns and fern allies
Bryophyta - mosses and liverworts
Thallophyta - algae, fungi and lichens

Section 23F of the Act provides special protection to those taxa (species, subspecies, varieties) considered by the Minister to be:

* in danger of extinction - the taxon is in serious risk of disappearing from the wild state within one or two decades if present land use and other factors continue to operate;
* rare - less than a few thousand adult plants of the taxon existing in the wild;
* in need of Special Protection - the taxon is not presently in danger of extinction but is at risk over a longer period through continued depletion, or occurs largely on sites likely to experience changes in land use which could threaten its survival in the wild;

  or

* presumed Extinct - taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently.

This is achieved by declaring them to be 'rare' by notice published in the Government Gazette. CALM's Policy Statement No.9 discusses the legislation relating to Declared Rare Flora and outlines the criteria for gazettal.

Under the provisions of Section 23F, the 'taking' of Declared Rare Flora is prohibited by any person on any category of land throughout the State without the written consent of the Minister. A breach of the Act is liable to a penalty of up to $10 000. The legislation refers only to wild growing populations and applies equally to Government officers and private citizens on Crown and private land.

To 'take' in relation to any flora includes 'to gather, pluck, cut, pull up, destroy, dig up, remove or injure the flora or to cause a permit the same to be done by any means'. This includes not only direct destruction or injury by human hand or machine but also such activities as allowing grazing by stock, introducing pathogens, altering water-tables so as to inundate or deprive the flora of adequate soil moisture, allowing air pollutants to harm foliage, and burning.

The schedule published in the Government Gazette is revised annually to accommodate additions and deletions to the Declared Rare Flora. To qualify for gazettal, plants must satisfy certain requirements as defined in Policy Statement No.9, namely:

* the taxon (species, subspecies, variety) must be well-defined, readily identifiable and represented by a voucher specimen in the State or National Herbarium. It need not be formally described under conventions in the International Code of Botanical Nomenclature, but such a description is preferred and should be undertaken as soon as possible after listing on the schedule;
* the taxon must have been thoroughly searched for in most likely habitats in the wild by competent botanists during the past five years;
* the searches have established that the plant in the wild is either rare, endangered or deemed to be threatened and in need of special protection.

Plants may be deleted from the Rare Flora schedule where:

* recent botanical survey has shown that the taxon is no longer rare, endangered or in need of special protection;
* the taxon is shown to be a hybrid;
* the taxon is no longer in danger of extinction because it has been adequately protected by reservation of land on which it occurs or because population numbers have increased beyond the danger point.

CALM's Priority Species List

CALM maintains a priority species list to determine for survey of plants of uncertain conservation status. The list comprises some 1000+ taxa that are poorly known and in need of high priority survey or are adequately surveyed but in need of monitoring. The poorly known taxa are possibly at risk but do not meet the survey requirements for gazettal as Declared Rare Flora (DRF), as outlined in Policy Statement No.9. Only those plants considered to be threatened on the basis of thorough survey or presumed extinct can be included on the DRF schedule.

The priority flora list is divided into the following categories according to the degree of threat.

Priority One - Poorly known Taxa
: Taxa which are known form one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat, e.g. road verges, urban areas, farmland, active mineral leases, etc., or the plants are under threat, e.g. from disease, grazing by feral animals, etc. May include taxa with threatened populations on protected lands. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

Priority Two - Poorly known Taxa
: Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

Priority Three - Poorly known Taxa
: Taxa which are known from several populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in need of further survey.

Priority Four - Rare Taxa
: Taxa which are considered to have been adequately surveyed and which, while being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5-10 years.

Table 2 - Declared Rare and Priority species potentially occurring in the Kundip Mining Leases.

Declared Rare:
Acacia rhamphophylla
Daviesia megacalyx
Eucalyptus bennettiae x
Eucalyptus burdettiana
Marianthus villosus

Priority One:
Astartea sp. Jerdacutttup (A.Strid 21898)
Beyeria sp. A Ravensthorpe (AS George 9497)
Dryandra corvijuga
Goodenia phillipsiae
Guichenotia anota
Guichenotia apetala
Melaleuca stramentosa
Microcorys pimeleoides
Pultenaea sp. Bandalup (GF Craig 3625)

Priority Two:
Acacia dictyoneura
Acacia disticha
Acacia laricina var. *crassifolia*
Acacia papulosa
Astroloma sp. Fitzgerald (GJ Keighery 8376)
Austrostipa exilis
Dryandra foliosissima
Eucalyptus petila
Hakea acuminata
Melaleuca penicula
Petrophile crispata
Thysanotus parviflorus

Priority Three:
Acacia bifaria
Acacia errabunda
Acacia ophiolithica
Acacia sp. Ravensthorpe (BR Maslin 5463)
Adenanthos glabrescens subsp. *exasperatus*
Boronia oxyantha var. *brevicalyx*
Dodonaea trifida
Grevillea fulgens
Micromyrtus tryptycha subsp. *carinata*
Spyridium glaucum

Priority Four:
Acacia argutifolia
Acacia dictyoneura
Acacia pinguiculosa subsp. *pinguiculosa*
Banksia laevigata subsp. *laevigata*
Dampiera deltoidea
Eucalyptus desmondensis
Eucalyptus stoatei
Goodenia stenophylla
Pimelea physodes
Siegfriedia darwinioides

Appendix 3

Plant species x vegetation unit matrix

The plant species occurring in each of the predominant vegetation formations and associated plant associations are depicted in the following table. The vegetation units are mapped in Fig. 3 and photgraphed in Appendix 4.

Vegetation Formations			Low Forest/Woodland			Open Woodland + Thicket/Heath				Mallee + Thicket/Heath									
Plant Associations		Priority Status	Ea	En/Ec/ Ea	Ep	Ma	Mc	Mx	Mp	Mh	Mm	Ms± Mb	Mg	My	Mr	Bl	Bm	Disturbed#	
GYMNOSPERMS																			
Cupressaceae	Callitris drummondii					x													1
	Callitris roei									x						x			2
MONOCOTYLEDONS																			
Agavaceae	*Agave americana CENTURY PLANT																	x	1
Arecaceae	*?Washingtonia filifera COTTON PALM																	x	1
Cyperaceae	Gahnia ancistrophylla					x									x	x	x		4
	Gahnia lanigera					x		x		x				x	x				5
	Gahnia trifida					x													1
	Lepidosperma brunonianum									x						x	x		3
	Lepidosperma leptostachyum									x						x	x		3
	Lepidosperma pubisquameum					x													1
	Lepidosperma squamatum																**X**		1
	Lepidosperma sp. A2 Island Flat (Keighery 7000)					x				x									2
	Lepidosperma sp. Kundip (GF Craig 6011)									x									1
	Lepidosperma sp. Ravensthorpe (GF Craig 5188)					x	x												2
	Lepidosperma sp. Z dark sheath					x				x							x		3
	Lepidosperma tuberculatum															x	x		2
	Mesomelaena stygia															x			1
Dasypogonaceae	Lomandra effusa					x				x							x		3
	Lomandra mucronata															x	x		2
Iridaceae	*?Iris sp.																	x	1
Haemodoraceae	Conostylis bealiana															x			1
	Haemodorum discolor															x			1
Juncaceae	Juncus pallidus				x														1

Vegetation Formations			Low Forest/Woodland			Open Woodland + Thicket/Heath				Mallee + Thicket/Heath									
Plant Associations		Priority Status	Ea	En/Ec/ Ea	Ep	Ma	Mc	Mx	Mp	Mh	Mm	Ms± Mb	Mg	My	Mr	Bl	Bm	Disturbed#	
Liliaceae	*Aloe sp. ALOE																	x	1
Phormiaceae	Dianella sp.										x								1
Poaceae	*Cynodon dactylon COUCH																	(x)	1
	*Eragrostis curvula AFRICAN LOVEGRASS																	(x)	1
	Neurachne alopecuroidea									x					x	x	x		4
	Spartochloa scirpoidea					x				x									2
Xanthorrhoeaceae	Xanthorrhoea platyphylla															x			1
DICOTYLEDONS																			
Aizoaceae	Carpobrotus sp.									x	x								2
	Disphyma crassifolium					x													1
	*Mesembryanthemum crystallinum ICEPLANT																	x	1
Ascelpiadaceae	*Stapelia variegata STAR FLOWER																	x	1
Asparagaceae	*Asparagus asparagoides BRIDAL CREEPER																	**X**	1
Asteraceae	Angianthus tomentosus					x												x	2
	*Centaurea solstitialis ST BARNABY'S THISTLE																	x	1
	*Cirsium vulgare SPEAR THISTLE				x													x	2
	*Conyza bonariensis FLEABANE																	x	1
	*Dittrichia graveolens STINKWORT																	x	1
	*Hypochaeris radicata FLATWEED																	(x)	1
	Olearia dampieri ssp. eremicola									x									1
	Olearia passerinoides					x													1
	Ozothamnus lepidophyllus									x							x		2
	*Sonchus oleraceus SOW THISTLE				x													x	2
	Vittadenia gracilis																	x	1
Boraginaceae	Halgania andromedifolia						x				x								2

Vegetation Formations			Low Forest/Woodland			Open Woodland + Thicket/Heath				Mallee + Thicket/Heath									
	Plant Associations	Priority Status	Ea	En/Ec/ Ea	Ep	Ma	Mc	Mx	Mp	Mh	Mm	Ms± Mb	Mg	My	Mr	Bl	Bm	Disturbed#	
Caesalpiniaceae	Labichea lanceolata					x													1
	Senna artemisioides										x					x			2
Casuarinaceae	Allocasuarina campestris									x									1
	Allocasuarina humilis															x			1
	Allocasuarina thuyoides															x	x		2
Chenopodiaceae	Atriplex semibaccata				x														1
	Chenopodium pumilo																	x	1
	Enchylaena tomentosa				x	x					x							x	4
	Halosarcia lepidosperma					x													1
	Maireana marginata					x													1
	Threlkeldia diffusa										x								1
	Sclerolaena diacantha				x														1
Convolvulaceae	Wilsona humilis					x				x									2
Crassulaceae	*Cotyledon orbiculare																	x	1
Dilleniaceae	Hibbertia acerosa									x						x	x		3
	Hibbertia gracilipes														x	x	x		3
	Hibbertia aff. gracilipes (glabrous)									x									1
	Hibbertia mucronata															x			1
	Hibbertia psilocarpa ms							x											1
	Hibbertia rupicola									x									1
Epacridaceae	Acrotriche ?plurilocularis		x					x											2
	Acrotriche ramiflora					x				x							x		3
	Andersonia parvifolia							x				**X**				x			3
	Astroloma serratifolium					x				x						x			3
	Coeleanthera myrtoides																x		1
	Leucopogon carinatus														x	x			2

Vegetation Formations			Low Forest/Woodland			Open Woodland + Thicket/Heath				Mallee + Thicket/Heath									
	Plant Associations	Priority Status	Ea	En/Ec/ Ea	Ep	Ma	Mc	Mx	Mp	Mh	Mm	Ms± Mb	Mg	My	Mr	Bl	Bm	Disturbed#	
	Leucopogon conostephioides															x	x		2
	Leucopogon cuneifolius															x			1
	Leucopogon dielsianus														x	x	x		3
	Leucopogon infuscatus			x				x		x		x			x	x			6
	Lysinema ciliatum														x	x			2
	Styphelia intertexta									x									1
Euphorbiaceae	Beyeria brevifolia var. brevifolia															x			1
	Beyeria ?brevifolia var. robustior										x								1
	Beyeria lechenaultii										x								1
	Stachystemon virgatum															x			1
Gentianaceae	*Centaurium erythraea COMMON CENTAURY																	x	1
Geraniaceae	*Geranium sp. GERANIUM																	x	1
Goodeniaceae	Coopernookia polygalacea		x	x				x		x					x	x	x		7
	Coopernookia strophiolata					x				x							x		3
	Dampiera angulata									x					x	x			3
	Dampiera incana															x			1
	Dampiera sacculata																x		1
	Goodenia laevis ssp. humifusa									x							x		2
	Goodenia scapigera ssp. scapigera									x									1
Lamiaceae	Microcorys glabra			x						x				x	x				4
Lauraceae	Cassytha melantha					x				x	x			x					4
	Cassytha pomiformis									x		x				x			3
Loganiaceae	Logania buxifolia															x			1
Mimosaceae	Acacia assimilis ssp. atroviridis					x													1
	Acacia brachyclada			x						x					x				3
	Acacia chrysocephala															x	x		2

Vegetation Formations			Low Forest/Woodland			Open Woodland + Thicket/Heath				Mallee + Thicket/Heath									
	Plant Associations	Priority Status	Ea	En/Ec/ Ea	Ep	Ma	Mc	Mx	Mp	Mh	Mm	Ms± Mb	Mg	My	Mr	Bl	Bm	Disturbed#	
	Acacia crispula															x			1
	Acacia cyclops					**X**										x			2
	Acacia disticha	P2				x						x							2
	Acacia durabilis	P3						x				x				x			3
	Acacia erinacea									x							x		2
	Acacia ferocior									x		x							2
	Acacia glaucoptera		x	x		x	x			x									5
	Acacia gonophylla					x										x	x		3
	Acacia heterochroa ssp. heterochroa															x			1
	Acacia ingrata									x	x					x	x		4
	Acacia laricina var. crassifolia	P2								x		**X**			x	x			4
	Acacia pinguiculosa ssp. pinguiculosa	P4								x						x		x	3
	Acacia rostellifera					x													1
	Acacia saligna					x													1
	Acacia spongolitica					x													1
	Acacia subcaerulea					x										x			2
	Acacia sulcata var. platyphylla									x						x			2
Moraceae	*Ficus carica FIG																	x	1
	*Ficus macrophylla MORETON BAY FIG																	x	1
Myrtaceae	Baeckea corynophylla					x		x		x		x			x	x	x		7
	Baeckea crispiflora									x						x			2
	Baeckea aff. latens (= KR Newbey 11085)					x													1
	Beaufortia micrantha var. micrantha															x	x		2
	Beaufortia orbifolia											x				x			2
	Beaufortia shaueri									x						x	x		3
	Callistemon phoeniceus					x													1

Vegetation Formations		Low Forest/Woodland			Open Woodland + Thicket/Heath								Mallee + Thicket/Heath					
Plant Associations	Priority Status	Ea	En/Ec/ Ea	Ep	Ma	Mc	Mx	Mp	Mh	Mm	Ms± Mb	Mg	My	Mr	Bl	Bm	Disturbed#	
Calothamnus pinifolius															x			1
Calothamnus quadrifidus					x				x						x	x		4
Calytrix leschenaultii																x		1
Chamelaucium ciliatum															x			1
Eucalyptus astringens		**X**	**X**															2
Eucalyptus austrina					x													1
Eucalyptus brachycalyx										x								1
Eucalyptus calycogona					x							x						2
Eucalyptus cernua		x	**X**		x	x	**X**		x		x							7
Eucalyptus clivicola		x									x							2
Eucalyptus conglobata					x				x							x		3
Eucalyptus falcata															**X**			1
Eucalyptus flocktoniae			x			**X**	x		x	x	x				x			7
Eucalyptus incrassata														x	x	x		3
Eucalyptus indurata										x								1
Eucalyptus lehmannii															x			1
Eucalyptus leptocalyx					x				x		x			**X**		x		5
Eucalyptus longicornis ssp. corvina										x								1
Eucalyptus occidentalis					**X**													1
Eucalyptus phaenophylla ssp. interjacens									x					x				2
Eucalyptus phaenophylla ssp. phaenophylla			x		x		x		x		x		**X**	x	x	x		9
Eucalyptus phenax					x				x									2
Eucalyptus pileata		x			x	x	x		x			x	**X**					7
Eucalyptus platypus				**X**				**X**										2
Eucalyptus pleurocarpa									x						**X**	**X**		3
Eucalyptus scyphocalyx													**X**					1

Vegetation Formations		Low Forest/Woodland			Open Woodland + Thicket/Heath								Mallee + Thicket/Heath					
Plant Associations	Priority Status	Ea	En/Ec/ Ea	Ep	Ma	Mc	Mx	Mp	Mh	Mm	Ms± Mb	Mg	My	Mr	Bl	Bm	Disturbed#	
Eucalyptus sporadica					x													1
Eucalyptus suggrandis								x	x		x							3
Eucalyptus tetraptera															x			1
Eucalyptus uncinata									x		x			x	x			4
Kunzea affinis									x									1
Kunzea cincinnata									x									1
Leptospermum maxwellii									x						x	x		3
Leptospermum spinescens															x	x		2
Melaleuca acuminata					**X**													1
Melaleuca bracteosa			x		x		x				**X**			x				5
Melaleuca cf. bracteosa						x			x									2
Melaleuca bromelioides					x			x	x	x								4
Melaleuca calycina ssp. calycina					x								**X**			x		3
Melaleuca carrii															x	x		2
Melaleuca coronicarpa		x	x															2
Melaleuca cucullata				x			**X**	x				x						4
Melaleuca cuticularis					x													1
Melaleuca glaberrima					x										x			2
Melaleuca hamata					**X**				**X**					x	x			4
Melaleuca haplantha		x		x			x	**X**										4
Melaleuca lateriflora					x				x				x			x		4
Melaleuca pauperiflora ssp. pauperiflora		x						x	x	**X**								4
Melaleuca pomphostoma					x													1
Melaleuca rigidifolia		**X**					x		x					**X**	x	x		6
Melaleuca sp. gorse (AS George 7224)						x	x		x			x						4
Melaleuca sp. Kundip (GF Craig 6020)	Signif.						**X**		x									2

Vegetation Formations			Low Forest/Woodland			Open Woodland + Thicket/Heath				Mallee + Thicket/Heath									
	Plant Associations	Priority Status	Ea	En/Ec/ Ea	Ep	Ma	Mc	Mx	Mp	Mh	Mm	Ms± Mb	Mg	My	Mr	Bl	Bm	Disturbed#	
	Melaleuca stramentosa	P1		x				x		x		**X**				x			5
	Melaleuca subfalcata			x		x				x					x		x		5
	Melaleuca subtrigona																x		1
	Melaleuca undulata						x												1
	Melaleuca viminea ssp. demissa					x													1
	Taxandria spathulata									x						**X**			2
	Verticordia densiflora ssp. cespitosa															x			1
Onagraceae	*Oenothera stricta EVENING PRIMROSE																	(x)	1
Papilionaceae	Brachysema latifolium																	x	1
	Chorizema nervosum									x					x	x			3
	Chorizema trigonum															x	x		2
	Daviesia anceps			x						x	x					x			4
	Daviesia articulata											x		x	x				3
	Daviesia benthamii					x				x			x				x		4
	Daviesia emarginata															x	x		2
	Daviesia lancifolia														x				1
	Daviesia mollis															x			1
	Daviesia nematophylla					x				x			x						3
	Daviesia teretifolia															x	x		2
	Eutaxia cuneata									x					x	x			3
	Eutaxia microphylla var. microphylla					x													1
	Gastrolobium congestum											x				x			2
	Gastrolobium parviflorum			x						x		x				x			4
	Gastrolobium tetragonophyllum					x													1
	Gompholobium confertum					x		x		x					x	x	x		6
	Jacksonia elongata															x	x		2

Vegetation Formations			Low Forest/Woodland			Open Woodland + Thicket/Heath				Mallee + Thicket/Heath									
	Plant Associations	Priority Status	Ea	En/Ec/ Ea	Ep	Ma	Mc	Mx	Mp	Mh	Mm	Ms± Mb	Mg	My	Mr	Bl	Bm	Disturbed#	
	Jacksonia viscosa															x			1
	Otion microphyllum																x		1
	Pultenaea conferta																x		1
	Pultenaea empetrifolia															x	x		2
	Pultenaea sp. Kundip (GF Craig 6008)	Signif.	x					x					x						3
	Templetonia retusa					x													1
Pittosporaceae	Billardiera bicolor									x									1
	Marianthus villosus	DRF				x										x			2
	Sollya heterophylla					x													1
Polygalaceae	Comesperma acerosum															x			1
Primulaceae	*Anagallis arvensis PIMPERNEL																	x	1
Proteaceae	Banksia lemmaniana															**X**			1
	Banksia media														x		**X**		2
	Dryandra cirsioides															x			1
	Dryandra falcata															x			1
	Dryandra quercifolia															x			1
	Dryandra tenuifolia var. tenuifolia															x			1
	Grevillea concinna ssp. lemanniana															x			1
	Grevillea dolichopoda															x			1
	Grevillea disjuncta					x									x				2
	Grevillea oligantha					x				x					x				3
	Grevillea patentiloba									x					x	x	x		4
	Grevillea rigidia ssp. rigida															x			1
	Hakea corymbosa															x	x		2
	Hakea laurina					x				x						x	x		4
	Hakea lissocarpha									x					x	x	x		4

Vegetation Formations			Low Forest/Woodland			Open Woodland + Thicket/Heath				Mallee + Thicket/Heath									
	Plant Associations	Priority Status	Ea	En/Ec/ Ea	Ep	Ma	Mc	Mx	Mp	Mh	Mm	Ms± Mb	Mg	My	Mr	Bl	Bm	Disturbed#	
	Hakea marginata ssp. marginata															x	x		2
	Hakea nitida									x									1
	Hakea obtusa															x			1
	Hakea pandanicarpa ssp. crassifolia															x	x		2
	Hakea trifurcata															x			1
	Hakea verrucosa									x	x					x			3
	Isopogon axillaris														x	x			2
	Isopogon trilobus																x		1
	Persoonia striata															x			1
	Persoonia teretifolia														x	x	x		3
	Petrophile fastigiata															x	x		2
	Petrophile seminuda															x			1
	Petrophile squamata															x	x		2
	Synaphea interioris															x			1
Rhamnaceae	Siegfriedia darwinioides	P4				x						x				x			3
	Spyridium cordatum									x						x	x		3
	Spyridium glaucum	P3										x							1
Rutaceae	Boronia crassifolia															x			1
	Boronia inconspicua									x									1
	Boronia inornata ssp. inornata									x	x						x		3
	Boronia oxyantha var. brevicalyx	P3	x	x								x							3
	Phebalium microphyllum		x																1
Santalaceae	Choretrum glomeratum															x	x		2
	Exocarpus aphyllus			x		x				x									3
	Exocarpus sparteus															x			1
Sapindaceae	Dodonaea caespitosa																x		1

Vegetation Formations			Low Forest/Woodland			Open Woodland + Thicket/Heath				Mallee + Thicket/Heath									
	Plant Associations	Priority Status	Ea	En/Ec/ Ea	Ep	Ma	Mc	Mx	Mp	Mh	Mm	Ms± Mb	Mg	My	Mr	Bl	Bm	Disturbed#	
	Dodonaea concinna						x				x								2
	Dodonaea pinifolia					x	x			x	x								4
	Dodonaea ptarmicaefolia					x													1
	Dodonaea trifida	P3		x		x		x		x		x							5
Solanaceae	*Lycium ferocissimum AFRICAN BOXTHORN										x							x	2
Sterculiaceae	Lasiopetalum compactum			x						x		x							3
	Lasiopetalum rosmarinifolium					x													1
	Thomasia foliosa					x													1
	Thomasia microphylla			x						x					x				3
Stylidiaceae	Stylidium albomontis															x			1
Thymelaeaceae	Pimelea erecta					x													1
Violaceae	Hybanthus epacroides					x				x									2
	Hybanthus floribundus							x											1
TOTAL	272	10	14	20	9	77	11	23	6	90	22	26	7	9	36	113	68	30	

* Introduced species

\# Species in brackets (x) located on Hopetoun-Ravensthorpe Road reserve

Appendix 4

Vegetation Units

The predominant vegetation formations and associated plant associations identified on the Kundip mining leases are depicted below and have been mapped (see Fig.3). The vegetation units are in the same order as Appendix 3.

LOW FOREST [**Ea**] *Eucalyptus astringens*
Unburnt >80 years Upper slopes – calcareous clay loams

LOW FOREST [**Ec**] *Eucalyptus clivicola – Melaleuca stramentosa*
Unburnt > 55 years Upper slopes/ breakaways – loamy clays

LOW FOREST [**Ea**] *Eucalyptus astringens* (NB Tawny Frogmouths)
Unburnt > 50 years (?) Upper slopes – calcareous clay loams

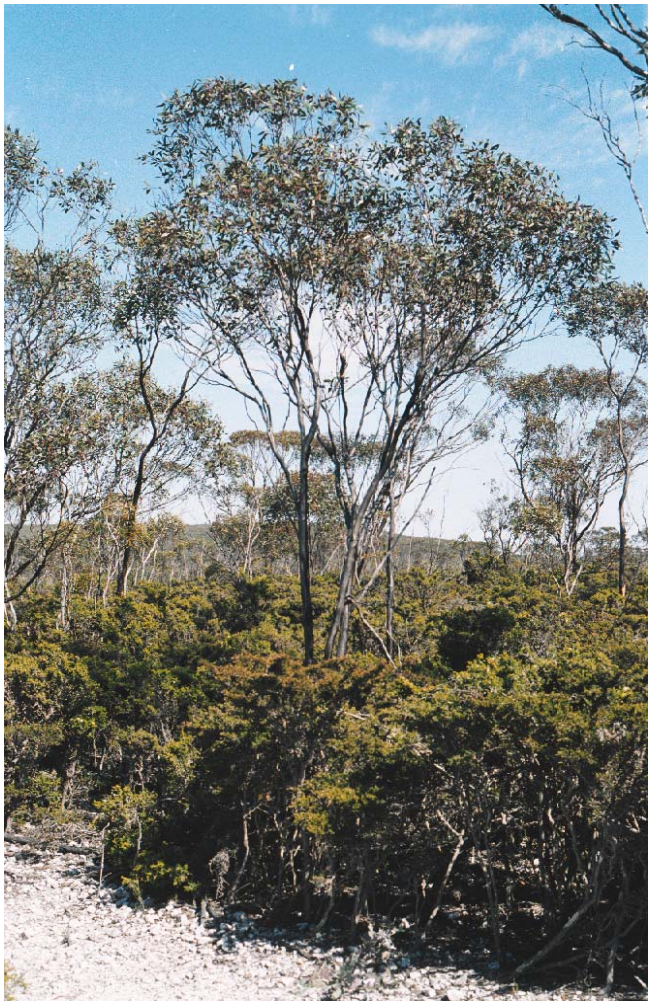
DENSE LOW FOREST [**En/Ea/Ec**] (mallet regrowth) *Eucalyptus cernua/ E.astringens/ E.clivicola*
Burnt January 1988 (16 years ago) Upper catchment of drainage line

LOW WOODLAND [**Ep**] *Eucalyptus platypus*
Unburnt > 55 years Lower slopes – white 'moort' clay

OPEN WOODLAND & THICKET [**Ma**] *Eucalyptus sporadica - Melaleuca acuminata*
Unburnt > 55 years Minor drainage lines – alluvium

OPEN WOODLAND & THICKET [**Ma**] *Eucalyptus phaenophylla - Melaleuca acuminata*
Unburnt > 55 years [Railway Heritage Trail] Drainage lines - alluvium

OPEN LOW WOODLAND & THICKET [**Mc**] *Eucalyptus cernua – Melaleuca cucullata*
Unburnt > 80 years Lower slopes – clay loams



OPEN LOW WOODLAND & DENSE HEATH [**Mx**]

Eucalyptus cernua – *Melaleuca* sp. Kundip (GF Craig 6020)

Slopes – loamy sand with quartz rubble

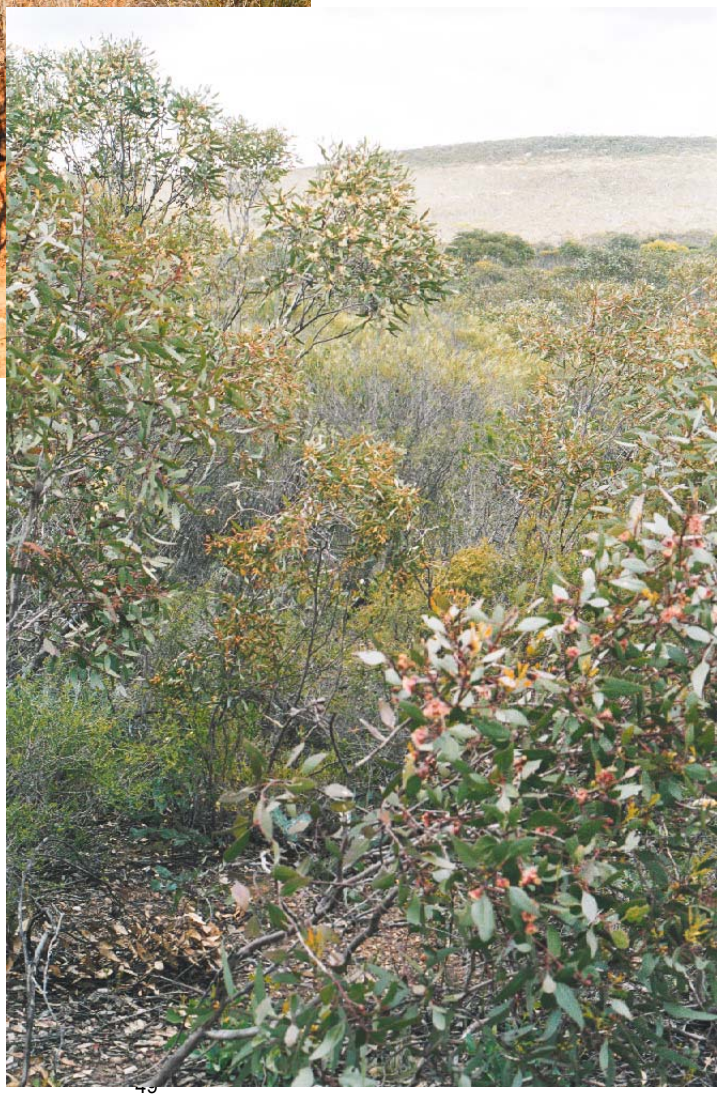
OPEN LOW WOODLAND & DENSE HEATH [**Mp**] *Eucalyptus platypus – Melaleuca haplantha*

Unburnt > 55 years

MALLEE [**Mh**]
Unburnt > 55 years

Numerous *Eucalyptus* spp. - *Melaleuca hamata*

Slopes – gravelly loamy clay sand



MALLEE [**Mh**]
Unburnt > 55 years

Numerous *Eucalyptus* spp. - *Melaleuca hamata*

Slopes – gravelly loamy clay sand

TREE MALLEE &THICKET [**Mm**] *Eucalyptus indurata – Melaleuca pauperiflora*
Unburnt > 80 years Lower slopes – calcareous loams

MALLEE & DENSE HEATH [**Ms**] *Melaleuca stramentosa*
Unburnt > 55 years Upper slopes – loamy clays and ironstone rubble

MALLEE & DENSE HEATH [**Mb**]
Unburnt > 80 years

Melaleuca bracteosa + *M. stramentosa*

South-facing slopes – loamy clays

ALLEE & DENSE HEATH [**Mg**]
Unburnt > 80 years

Eucalyptus flocktoniae – *Melaleuca* sp. gorse (AS George 7224)

Lower slopes – komatiite

MALLEE & HEATH [**My**] *Eucalyptus pileata – Melaleuca calycina*
Burnt January 1988 (16 years ago) Poorly drained – loamy clay

OPEN MALLEE & DENSE HEATH [**Mr**] *Eucalyptus* spp. – *Melaleuca rigidifolia*
Burnt January 1988 (16 years ago) Gravelly loamy sand

OPEN MALLEE & THICKET [**BI**] *Euc. pleurocarpa – Banksia lemmaniana – Dryandra quercifolia*
Unburnt > 80 years Crests – skeletal loamy sand with quartz

OPEN MALLEE & SCRUB HEATH [**BI**] *Euc. pleurocarpa – Banksia lemmaniana – Dryandra cirsioides*
Unburnt > 55 years Upper slopes – skeletal loamy sand with quartz/ laterite

OPEN MALLEE & SCRUB HEATH [**Bm**] *Eucalyptus pleurocarpa – Banksia media*
Unburnt > 80 years Lower slopes – sand over gravelly clay (duplex soils)

Appendix 5

GPS Locations of Declared Rare and Priority Flora

Datum: Geocentric Datum Australia 1994 (GDA94)

	ZONE	EASTING	NORTHING	NOTES
KUNDIP MINING LEASES:				
Declared Rare Flora:				
Marianthus villosus (POP 5)	51	240404	6271155	10 plants
Marianthus villosus (POP 5)	51	240402	6271214	
Marianthus villosus (POP 5)	51	240367	6271308	
Marianthus villosus (POP 5)	51	240324	6271351	frequent in drainage line
Marianthus villosus (POP 5)	51	240141	6271345	frequent in drainage line
Marianthus villosus (POP 5)	51	240213	6271474	frequent in drainage line
Marianthus villosus POP 5	51	240393	6271164	
Marianthus villosus POP 5	51	240439	6271134	
Marianthus villosus POP 5	51	240524	6271170	
Marianthus villosus POP 5	51	240498	6271224	
Marianthus villosus POP 5	51	240462	6271240	
Marianthus villosus POP 5	51	240462	6271258	
Marianthus villosus POP 5	51	240486	6271261	
Marianthus villosus POP 5	51	240457	6271302	
Marianthus villosus POP 5	51	240466	6271317	
Marianthus villosus POP 5	51	240440	6271354	
Marianthus villosus POP 5	51	240421	6271342	
Marianthus villosus POP 5	51	240405	6271381	
Marianthus villosus POP 5	51	240394	6271393	
Marianthus villosus POP 5	51	240355	6271396	
Marianthus villosus POP 5	51	240371	6271422	
Marianthus villosus POP 5	51	240331	6271433	
Marianthus villosus POP 5	51	240287	6271399	
Marianthus villosus POP 5	51	240245	6271379	
Marianthus villosus POP 5	51	240199	6271375	
Marianthus villosus POP 5	51	240177	6271389	
Marianthus villosus POP 5	51	240086	6271403	
Marianthus villosus POP 5	51	240171	6271362	
Marianthus villosus POP 5	51	240191	6271347	
Marianthus villosus POP 5	51	240198	6271320	
Marianthus villosus POP 5	51	240218	6271296	
Marianthus villosus POP 5	51	240283	6271268	
Marianthus villosus POP 5	51	240336	6271263	
Marianthus villosus (POP 3C)	51	240999	6269693	occasional in weak drainage line
Marianthus villosus (POP 3C)	51	240705	6269604	
Marianthus villosus POP 3C	51	240999	6269623	
Marianthus villosus POP 3C	51	240994	6269750	
Marianthus villosus POP 3C	51	240960	6269741	
Marianthus villosus POP 3C	51	240875	6269689	
Marianthus villosus POP 3C	51	240748	6269611	
Marianthus villosus POP 3C	51	240907	6269644	

Priority One:				
Melaleuca stramentosa	51	240441	6270825	
Melaleuca stramentosa	51	240590	6271091	100s/ abundant
Melaleuca stramentosa	51	240213	6271474	frequent in drainage line
Melaleuca stramentosa	51	240512	6269844	
Priority Two:				
Acacia disticha	51	239956	6268954	1 plant
Acacia disticha	51	240086	6271403	20+ plants
Acacia disticha	51	240140	6270777	
Acacia disticha	51	240141	6271345	frequent in drainage line
Acacia disticha	51	240177	6271389	50+ plants
Acacia disticha	51	240213	6271474	frequent in drainage line
Acacia disticha	51	240241	6270872	3 plants
Acacia disticha	51	240685	6268985	20+ plants in weak drainage
Acacia disticha	51	240705	6269604	
Acacia disticha	51	240748	6269611	
Acacia disticha	51	239792	6268995	
Acacia disticha	51	240181	6270837	
Acacia disticha	51	240535	6269475	
Acacia disticha	51	240546	6268999	
Acacia disticha	51	240546	6269120	
Acacia disticha	51	240618	6270452	
Acacia laricina var. crassifolia	51	240301	6268735	few/ scattered
Acacia laricina var. crassifolia	51	240441	6270825	5 plants
Acacia laricina var. crassifolia	51	240590	6271091	100s
Acacia laricina var. crassifolia	51	240404	6271155	few/ scattered
Acacia laricina var. crassifolia	51	240574	6269953	frequent in drainage line
Acacia laricina var. crassifolia	51	240998	6269026	frequent
Acacia laricina var. crassifolia	51	240393	6271164	
Acacia laricina var. crassifolia	51	240439	6271134	
Acacia laricina var. crassifolia	51	240440	6271354	
Acacia laricina var. crassifolia	51	240938	6270357	
Acacia laricina var. crassifolia	51	240830	6269982	
Acacia laricina var. crassifolia	51	240916	6270135	
Acacia laricina var. crassifolia	51	240420	6271046	
Acacia laricina var. crassifolia	51	240499	6269963	
Acacia laricina var. crassifolia	51	240507	6269884	
Acacia laricina var. crassifolia	51	240519	6269797	
Acacia laricina var. crassifolia	51	240642	6269967	
Acacia laricina var. crassifolia	51	240701	6270908	
Acacia laricina var. crassifolia	51	240765	6270301	
Acacia laricina var. crassifolia	51	240816	6270773	
Acacia laricina var. crassifolia	51	240920	6268920	
Acacia laricina var. crassifolia	51	240959	6268844	
Acacia laricina var. crassifolia	51	240963	6268773	
Acacia laricina var. crassifolia	51	241019	6268773	
Priority Three:				
Acacia durabilis	51	239857	6268686	1 only
Acacia durabilis	51	240358	6270780	1 only
Acacia durabilis	51	240441	6270825	few/ scattered
Acacia durabilis	51	239846	6270613	1 only

Acacia durabilis	51	240140	6270777	
Acacia durabilis	51	240590	6271091	occasional/ scattered
Acacia durabilis	51	240402	6271214	
Acacia durabilis	51	240367	6271308	
Acacia durabilis	51	240324	6271351	frequent in drainage line
Acacia durabilis	51	240754	6270570	
Acacia durabilis	51	240263	6268990	
Acacia durabilis	51	239744	6269984	
Acacia durabilis	51	240439	6271134	
Acacia durabilis	51	240245	6271379	
Acacia durabilis	51	240938	6270357	
Acacia durabilis	51	240916	6270135	
Acacia durabilis	51	240420	6271046	10 plants
Acacia durabilis	51	239368	6270602	
Acacia durabilis	51	239419	6270606	
Acacia durabilis	51	239519	6268709	
Acacia durabilis	51	239709	6270007	
Acacia durabilis	51	239761	6270618	
Acacia durabilis	51	240151	6268991	
Acacia durabilis	51	240169	6270710	
Acacia durabilis	51	240225	6271483	
Acacia durabilis	51	240340	6270670	
Acacia durabilis	51	240380	6271468	
Acacia durabilis	51	240638	6269844	
Acacia durabilis	51	240693	6270987	
Acacia durabilis	51	240697	6269217	
Acacia durabilis	51	240745	6270948	
Acacia durabilis	51	240799	6270770	
Acacia durabilis	51	240923	6269614	
Acacia durabilis	51	241320	6269725	
Boronia oxyantha var. brevicalyx	51	240711	6268766	100s
Boronia oxyantha var. brevicalyx	51	240358	6270780	< 10 plants
Boronia oxyantha var. brevicalyx	51	240754	6270570	
Boronia oxyantha var. brevicalyx	51	240512	6269844	50+
Boronia oxyantha var. brevicalyx	51	240263	6268990	
Boronia oxyantha var. brevicalyx	51	239901	6268872	
Boronia oxyantha var. brevicalyx	51	240817	6269591	50+
Boronia oxyantha var. brevicalyx	51	240773	6269598	
Boronia oxyantha var. brevicalyx	51	239392	6268777	
Boronia oxyantha var. brevicalyx	51	240154	6269003	
Boronia oxyantha var. brevicalyx	51	240550	6269122	
Boronia oxyantha var. brevicalyx	51	240590	6268761	
Boronia oxyantha var. brevicalyx	51	241483	6269201	
Boronia oxyantha var. brevicalyx	51	241757	6268975	
Boronia oxyantha var. brevicalyx	51	241765	6268848	
Boronia oxyantha var. brevicalyx	51	239808	6268899	
Dodonaea trifida	51	240141	6271345	frequent in drainage line
Dodonaea trifida	51	240754	6270570	
Dodonaea trifida	51	240512	6269844	50+
Dodonaea trifida	51	241285	6268834	occasional/ scattered
Dodonaea trifida	51	241398	6268838	frequent
Dodonaea trifida	51	240999	6269693	occasional in weak drainage line

Dodonaea trifida	51	240705	6269604	
Dodonaea trifida	51	240325	6269170	
Dodonaea trifida	51	240263	6268990	
Dodonaea trifida	51	239601	6268686	
Dodonaea trifida	51	239736	6268882	
Dodonaea trifida	51	239901	6268872	
Dodonaea trifida	51	239789	6269071	
Dodonaea trifida	51	240171	6271362	
Dodonaea trifida	51	240748	6269611	
Dodonaea trifida	51	240907	6269644	
Dodonaea trifida	51	240364	6270209	
Dodonaea trifida	51	240931	6269666	
Dodonaea trifida	51	240900	6269574	
Dodonaea trifida	51	240630	6269531	
Dodonaea trifida	51	239388	6268737	
Dodonaea trifida	51	239443	6268701	
Dodonaea trifida	51	239467	6268912	
Dodonaea trifida	51	239523	6268884	
Dodonaea trifida	51	239800	6268908	
Dodonaea trifida	51	239991	6268721	
Dodonaea trifida	51	240173	6269209	
Dodonaea trifida	51	241122	6268785	
Dodonaea trifida	51	241424	6268793	
Dodonaea trifida	51	241547	6269197	
Dodonaea trifida	51	241760	6268842	
Dodonaea trifida	51	240508	6269788	
Dodonaea trifida	51	240767	6270292	
Dodonaea trifida	51	240151	6268991	
Dodonaea trifida	51	240417	6268871	
Dodonaea trifida	51	240320	6268873	
Dodonaea trifida	51	239516	6271454	
Spyridium glaucum	51	240754	6270570	ca. 20 plants
Priority Four:				
Acacia pinguiculosa ssp. pinguiculosa	51	241898	6269268	common
Acacia pinguiculosa ssp. pinguiculosa	51	239392	6269224	
Acacia pinguiculosa ssp. pinguiculosa	51	239068	6269753	
Acacia pinguiculosa ssp. pinguiculosa	51	239124	6269143	
Acacia pinguiculosa ssp. pinguiculosa	51	238987	6269860	
Acacia pinguiculosa ssp. pinguiculosa	51	239360	6269344	
Acacia pinguiculosa ssp. pinguiculosa	51	239042	6269162	
Acacia pinguiculosa ssp. pinguiculosa	51	241749	6269201	
Siegfriedia darwinioides	51	240324	6271351	frequent in drainage line
Siegfriedia darwinioides	51	240141	6271345	frequent in drainage line
Siegfriedia darwinioides	51	240213	6271474	frequent in drainage line
Siegfriedia darwinioides	51	240999	6269693	occasional in weak drainage line
Siegfriedia darwinioides	51	240394	6271393	
Siegfriedia darwinioides	51	240355	6271396	

Siegfriedia darwinioides	51	240371	6271422	
Siegfriedia darwinioides	51	240331	6271433	
Siegfriedia darwinioides	51	240198	6271320	
Siegfriedia darwinioides	51	241462	6269913	3 plants
Siegfriedia darwinioides	51	241099	6269618	50+ plants
Siegfriedia darwinioides	51	240999	6269623	
Siegfriedia darwinioides	51	240994	6269750	
Siegfriedia darwinioides	51	240960	6269741	
Siegfriedia darwinioides	51	240875	6269689	
Siegfriedia darwinioides	51	240748	6269611	
Siegfriedia darwinioides	51	240907	6269644	
Siegfriedia darwinioides	51	240830	6269982	
Siegfriedia darwinioides	51	240916	6270135	
Siegfriedia darwinioides	51	240420	6271046	
Siegfriedia darwinioides	51	240324	6271702	
Siegfriedia darwinioides	51	240757	6269967	
Siegfriedia darwinioides	51	240936	6269656	
Siegfriedia darwinioides	51	240374	6271454	

RAVENSTHORPE RANGE (N of Mt Iron mine):

Declared Rare Flora:

Marianthus villosus POP 4	51	239035	6274214	
Marianthus villosus POP 4	51	238856	6274141	
Marianthus villosus POP 4	51	238894	6274193	
Marianthus villosus POP 4	51	238878	6274296	

Priority One:

Melaleuca stramentosa	51	238894	6274193	abundant
Melaleuca stramentosa	51	238710	6274288	abundant
Melaleuca stramentosa	51	239120	6274234	abundant
Melaleuca stramentosa	51	239035	6274214	abundant

Priority Two:

Acacia disticha	51	238878	6274296	
Acacia disticha	51	238797	6274165	c. 10 plants
Acacia disticha	51	238878	6274296	
Acacia laricina var. crassifolia	51	238710	6274288	
Acacia laricina var. crassifolia	51	239120	6274234	
Acacia laricina var. crassifolia	51	238894	6274193	

Priority Three:

Acacia durabilis	51	238797	6274165	1 plant
Acacia durabilis	51	238710	6274288	
Acacia durabilis	51	239120	6274234	
Boronia oxyantha var. brevicalyx	51	238894	6274193	
Boronia oxyantha var. brevicalyx	51	238710	6274288	
Boronia oxyantha var. brevicalyx	51	239120	6274234	
Dodonaea trifida	51	238941	6274095	
Dodonaea trifida	51	238710	6274288	
Dodonaea trifida	51	238797	6274165	frequent
Spyridium glaucum	51	238941	6274095	thousands
Spyridium glaucum	51	238797	6274165	frequent
Spyridium glaucum	51	238894	6274193	frequent
Spyridium glaucum	51	238878	6274296	hundreds
Spyridium glaucum	51	239120	6274234	frequent

Priority Four:				
Siegfriedia darwinioides	51	238894	6274193	
Siegfriedia darwinioides	51	238878	6274296	
Siegfriedia darwinioides	51	238710	6274288	
Siegfriedia darwinioides	51	239120	6274234	
RAVENSTHORPE RANGE (Hecla Mine):				
Marianthus villosus POP 3A	51	242829	6270767	
Marianthus villosus POP 3A	51	242786	6270907	
Marianthus villosus POP 3A	51	242764	6270910	
Marianthus villosus POP 3A	51	242733	6270763	
Marianthus villosus POP 3A	51	242836	6270753	
Marianthus villosus POP 3A	51	242859	6270734	
RABBIT PROOF FENCE:				
Marianthus villosus POP 1A	51	244963	6289376	c. 52,000 plants
Marianthus villosus POP 1A	51	245128	6289430	& seedlings
Marianthus villosus POP 1A	51	245090	6289370	
Marianthus villosus POP 1A	51	244785	6289488	
Marianthus villosus POP 1A	51	244878	6289503	
Marianthus villosus POP 1A	51	245145	6289298	
Marianthus villosus POP 1D	51	243340	6290949	54 seedlings
Marianthus villosus POP 1E	51	244373	6290249	1,000s seedlings &
Marianthus villosus POP 1E	51	244406	9290230	mature plants
Marianthus villosus POP 1G:	51	243752	6290413	c. 5,000 seedlings
Marianthus villosus POP 1G:	51	243809	6290405	
Marianthus villosus POP 1G:	51	243664	6290459	
Marianthus villosus POP 1G:	51	243808	6290376	
Marianthus villosus POP 1H	51	243788	6290618	10 seedlings
Marianthus villosus POP 1I	51	243842	6290565	100s seedlings
Marianthus villosus POP 1J	51	243936	6290497	c. 20 seedlings

Appendix 6

Marianthus villosus ***Rare Flora Report Forms***

POPULATION 1A: Vermin Proof Fence
POPULATION 1D: Vermin Proof Fence
POPULATION 1E: Vermin Proof Fence
POPULATION 1G, H, I, J: Vermin Proof Fence

POPULATION 2: North of Mt Desmond

POPULATION 3A: Hecla Mine
POPULATION 3C: NE of Flag Mine (Kundip Mining Leases)

POPULATION 4: N of Mt Iron Mine

POPULATION 5: N of Western Gem Mine (Kundip Mining Leases)

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

RARE FLORA REPORT FORM

TAXON: Marianthus villosus **POPULATION No.:** 1A

File No. Head Office: File No. District:

DRF ☒ Proposed DRF ☐ Priority Species No. ☐ Geog. Restr. ☐

New Population ☐ Routine Inspection ☐ Re-survey ☐ Opportunistic Survey ☐

FROM: G.F. Craig **TITLE:** **SURVEY DATE:** 4/2/04

REGION: South Coast - **DISTRICT:** Esperance **SHIRE:** Ravensthorpe

District Site Ref.: MAP REF.:

LAND STATUS: Nature Res. ☐ Water Res. ☐ Gravel Res. MRD ☐ Gravel Res. Shire ☐

National Park ☐ Railway Res. ☐ Rd. Verge MRD ☐ Rd. Verge Shire ☐

State Forest ☐ Private ☐ VCL ☐ Shire Reserve ☐

Other ☐ State:

LOCALITY: 3.6 km south of Cartwright Rd gate on east side of Rabbit Proof Fence 15.5 km NE of Mt Desmond

LATITUDE: 33°30'22" **LONGITUDE:** 120°15'11" **ALTITUDE:** AGD 84 **ASPECT:** N. facing

LANDFORM: Hilltop ☐ Flat ☐ Drainageline ☒ Swamp ☐ Ridge ☐

Outcrop ☐ Breakaway ☒ Slope (lower) ☒ Gully ☐ Valley ☐

Riverbank ☐ Lake Edge ☐ Low Plain ☐ Sand Dune ☐ Cliff ☐

Firebreak ☐ Other: South side of weak drainage line

ROCK TYPE: Laterite ☐ Granite ☐ Dolerite ☐ Limestone ☐ Other: Conglomerate

ROCK FORM: Sheet ☐ Boulder ☐ Fluviatile Gravel ☐ Concretionary gravel ☐ Quartz rubble/grit

SOIL TYPE: Sand ☒ Loam ☒ Clay ☐ Peat ☐ Gravel ☐

SOIL COLOUR: Red ☐ Brown ☐ Yellow ☐ White ☐ Grey ☒

SOIL CONDITION: Perm. wet ☐ Moist ☐ Dry ☒ Saline ☐ Other:

VEGETATION CLASSIFICATION (Muir's): Mallee - heath, chained & burnt c. 2 years ago

ASSOCIATED SPECIES: Gastrolobium parvifolium, Gompholobium scabrum, Grevillea paniculata, Acacia heterochroa, Chorizema rerosum

No. OF PLANTS:

Estimated ☒ Actual ☐ Mature: c. 36,000 Seedlings: Dead: Area Occupied: 2.65 ha

REPRODUCTIVE STATE: in bud ☐ flower ☐ immature fruit ☐ dehisced ☒ vegetative ☐

POLLINATORS: Native bees ☐ honey bees ☐ mammals ☐ birds ☐ insects ☐

Other observations:

CONDITIONS OF POPULATION: Recently burnt ☐ diseased ☐ disturbed ☐ undisturbed ☐

Other ☐ State: Chained & burnt c. 2 years ago

POTENTIAL THREATS: Firebreaks ☒ mining ☐ recreational activities ☐ 'disease' ☐ weeds ☐

grazing ☐ clearing ☐ prescribed burning ☒ Other ☐ State

FIRE HISTORY: Not known ☐ Burnt in 19 Summer ☐ Autumn ☐ Winter ☐ Spring ☐

Next control burn: Year: Month:

VOUCHER SPECIMEN: Retained ☐ W.A. Herb. ☐ Other ☐ State:

ATTACHED: Map ☐ Mudmap ☐ Illustration ☐ Photo ☒ plant & habitat Field Notes ☐

ACTION: Taken:

Required: by District ☐ S.O.H.Q. ☐ State:

FENCING REQUIREMENT:

ROADSIDE MARKERS: (J. Hill 2, 2/12/98)

OTHER COMMENTS: NB. Julianne Hill's collection coincides with POP1A & her GPS coordinates are in WGS84 datum (pers.comm.); however her locality description is way off !!

COPY SENT TO: Regional Office ☐ District Office ☐ Other ☐ State:

SOHQ TO SEND COPY TO: Regional Office ☐ District Office ☐ Other ☐ State:

Signed: GF Craig Date: 23/2/04

NOTE: More than one box, in any section, may be ticked.

RECORDS: PLEASE FORWARD TO ADMINISTRATIVE OFFICER, FLORA, WILDLIFE ADMINISTRATION

Marianthus villosus
POPULATION 1A
Vermin Proof Fence

Young plants with dehisced fruits

Chained January 2001; burnt May/June 2001

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

RARE FLORA REPORT FORM

TAXON: Mariarthus villosus **POPULATION No.:** 1D

File No. Head Office: File No. District:

DRF ☒ Proposed DRF ☐ Priority Species No. ☐ Geog. Restr. ☐

New Population ☐ Routine Inspection ☐ Re-survey ☐ Opportunistic Survey ☐

FROM: Gf Craig **TITLE:** Consultant **SURVEY DATE:** 4/2/04

REGION: South Coast **DISTRICT:** Esperance **SHIRE:** Ravensthorpe

District Site Ref.: MAP REF.:

LAND STATUS: Nature Res. ☐ Water Res. ☐ Gravel Res. MRD ☐ Gravel Res. Shire ☐

National Park ☐ Railway Res. ☐ Rd. Verge MRD ☐ Rd. Verge Shire ☐

State Forest ☐ Private ☐ VCL ☐ Shire Reserve ☐

Other ☐ State:

LOCALITY: 1.9 km SE of Cowrijup Road gate on E side of Rabbit Proof fence & along 0.8 km // firebreak

LATITUDE: 33°29'30" **LONGITUDE:** 120° 14' 10" **ALTITUDE:** AGD 84 **ASPECT:**

LANDFORM: Hilltop ☐ Flat ☐ Drainageline ☒ Swamp ☐ Ridge ☐

Outcrop ☐ Breakaway ☐ Slope ☐ Gully ☐ Valley ☐

Riverbank ☐ Lake Edge ☐ Low Plain ☐ Sand Dune ☐ Cliff ☐

Firebreak ☐ Other: Weak drainage ca. 20m wide

ROCK TYPE: Laterite ☐ Granite ☐ Dolerite ☐ Limestone ☐ Other: Quartz grit

ROCK FORM: Sheet ☐ Boulder ☐ Fluviatile Gravel ☐ Concretionary gravel ☐

SOIL TYPE: Sand ☒ Loam ☒ Clay ☐ Peat ☐ Gravel ☐

SOIL COLOUR: Red ☐ Brown ☐ Yellow ☐ White ☐ Grey ☒

SOIL CONDITION: Perm. wet ☐ Moist ☐ Dry ☒ Saline ☐ Other:

VEGETATION CLASSIFICATION (Muir's): Mallee - heath. Euc. incrassata, E. phaenophylla

ASSOCIATED SPECIES: Melaleuca societatis, Agonis spathulata, M. rigidifolia, Beaufortia schaueri, Gompholobium scabrum, Acacia gerophylla

No. OF PLANTS:

Estimated ☐ Actual ☒ Mature: Seedlings: 54 Dead: Area Occupied: 40m x 8m

REPRODUCTIVE STATE: in bud ☐ flower ☐ immature fruit ☐ dehisced ☐ vegetative ☒

POLLINATORS: Native bees ☐ honey bees ☐ mammals ☐ birds ☐ insects ☐

Other observations:

CONDITIONS OF POPULATION: Recently burnt ☒ diseased ☐ disturbed ☐ undisturbed ☐

Other ☐ State:

POTENTIAL THREATS: Firebreaks ☒ mining ☐ recreational activities ☐ 'disease' ☐ weeds ☐

grazing ☐ clearing ☐ prescribed burning ☒ Other ☐ State

FIRE HISTORY: Not known ☐ Burnt in ~~19~~ Feb'03 Summer ☒ Autumn ☐ Winter ☐ Spring ☐

Next control burn: Year: Month:

VOUCHER SPECIMEN: Retained ☐ W.A. Herb. ☐ Other ☐ State:

ATTACHED: Map ☐ Mudmap ☒ Illustration ☐ Photo ☐ Field Notes ☐

ACTION: Taken:

Required: by District ☐ S.O.H.Q. ☐ State:

FENCING REQUIREMENT:

ROADSIDE MARKERS:

OTHER COMMENTS:

COPY SENT TO: Regional Office ☐ District Office ☐ Other ☐ State:

SOHQ TO SEND COPY TO: Regional Office ☐ District Office ☐ Other ☐ State:

Signed: Gf Craig Date: 23/2/04

NOTE: More than one box, in any section, may be ticked.

RECORDS: PLEASE FORWARD TO ADMINISTRATIVE OFFICER, FLORA, WILDLIFE ADMINISTRATION

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

RARE FLORA REPORT FORM

TAXON: Marianthus villosus **POPULATION No.:** 1E

File No. Head Office: File No. District:

DRF ☒ Proposed DRF ☐ Priority Species No. ☐ Geog. Restr. ☐

New Population ☐ Routine Inspection ☐ Re-survey ☒ Opportunistic Survey ☐

FROM: G.F. Craig **TITLE:** Consultant **SURVEY DATE:** 4/2/04

REGION: South Coast **DISTRICT:** Esperance **SHIRE:** Ravensthorpe

District Site Ref.: MAP REF.:

LAND STATUS: Nature Res. ☐ Water Res. ☐ Gravel Res. MRD ☐ Gravel Res. Shire ☐
National Park ☐ Railway Res. ☐ Rd. Verge MRD ☐ Rd. Verge Shire ☐
State Forest ☐ Private ☐ VCL ☐ Shire Reserve ☐
Other ☐ State:

LOCALITY: 2.2 km SE of Carlingup gate along Vermin Proof Fence, then east along firebreak to // firebreak, then 550 m SE along firebreak // to VPF, ie 2.9 km SE of Carlingup Road gate.

LATITUDE: 33°29'55" **LONGITUDE:** 120°14'50" **ALTITUDE:** (AGD84) **ASPECT:**

LANDFORM: Hilltop ☐ Flat ☐ Drainageline ☐ Swamp ☐ Ridge ☐
Outcrop ☐ Breakaway ☐ Slope Centre ☒ Gully ☐ Valley ☐
Riverbank ☐ Lake Edge ☐ Low Plain ☐ Sand Dune ☐ Cliff ☐
Firebreak ☐ Other:

ROCK TYPE: Laterite ☒ Granite ☐ Dolerite ☐ Limestone ☐ Other: + Quartz
ROCK FORM: Sheet ☐ Boulder ☐ Fluviatile Gravel ☐ Concretionary gravel ☐
SOIL TYPE: Sand ☒ Loam ☒ Clay ☐ Peat ☐ Gravel ☒
SOIL COLOUR: Red ☐ Brown ☒ Yellow ☐ White ☐ Grey ☐
SOIL CONDITION: Perm. wet ☐ Moist ☐ Dry ☒ Saline ☐ Other:

VEGETATION CLASSIFICATION (Muir's): Mid-dense mallee & heath (burnt)

ASSOCIATED SPECIES: Cooperookia strophi, Canna arcuisphylla, Mel. hamata, Acacia heterochroa, Grevillea paterisloba

No. OF PLANTS:
Estimated ☐ Actual ☐ Mature: ✓ 100s on trail W side Seedlings: ✓ burnt in 1000s E side Dead: Area Occupied: 0.3 ha

REPRODUCTIVE STATE: in bud ☐ flower ☐ immature fruit ☐ dehisced ☒ vegetative ☒

POLLINATORS: Native bees ☐ honey bees ☐ mammals ☐ birds ☐ insects ☐
Other observations:

CONDITIONS OF POPULATION: Recently burnt ☐ diseased ☐ disturbed ☐ undisturbed ☐
Other ☐ State: West side of firebreak burnt May/June 2001 → 1000s of mature plants.
East side " " burnt Feb 2003 → 1000s seedlings

POTENTIAL THREATS: Firebreaks ☒ mining ☐ recreational activities ☐ 'disease' ☐ weeds ☐
grazing ☐ clearing ☐ prescribed burning ☒ Other ☐ State

FIRE HISTORY: Not known ☐ Burnt in ~~19~~ '01/'03 Summer ☒ '03 Autumn ☐ Winter ☒ '01 Spring ☐
Next control burn: Year: Month:

VOUCHER SPECIMEN: Retained ☐ W.A. Herb. ☐ Other ☐ State:
ATTACHED: Map ☐ Mudmap ☒ Illustration ☐ Photo ☐ Field Notes ☐
ACTION: Taken:
Required: by District ☐ S.O.H.Q. ☐ State:

FENCING REQUIREMENT:
ROADSIDE MARKERS:
OTHER COMMENTS:

COPY SENT TO: Regional Office ☐ District Office ☐ Other ☐ State:
SOHQ TO SEND COPY TO: Regional Office ☐ District Office ☐ Other ☐ State:

Signed: GF Craig Date: 23/2/04

NOTE: More than one box, in any section, may be ticked.

RECORDS: PLEASE FORWARD TO ADMINISTRATIVE OFFICER, FLORA, WILDLIFE ADMINISTRATION

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

RARE FLORA REPORT FORM

TAXON: Mariathus villosus **POPULATION No.:** 1G, 1H, 1I, 1J

File No. Head Office: File No. District:

DRF [X] Proposed DRF [ ] Priority Species No. [ ] Geog. Restr. [ ]

New Population [X] Routine Inspection [ ] Re-survey [ ] Opportunistic Survey [ ]

FROM: G.F. Craig **TITLE:** Consultant **SURVEY DATE:** 4/2/04

REGION: South Coast **DISTRICT:** Esperance **SHIRE:** Ravensthorpe

District Site Ref.: MAP REF.:

LAND STATUS:

	Nature Res. [ ]		Water Res. [ ]		Gravel Res. MRD [ ]		Gravel Res. Shire [ ]
	National Park [ ]		Railway Res. [ ]		Rd. Verge MRD [ ]		Rd. Verge Shire [ ]
	State Forest [ ]		Private [ ]		VCL [ ]		Shire Reserve [ ]
	Other [ ]		State:				

LOCALITY: 2.2 km SE of Cavinigup Rd gate, then ca. 400 m E along track that joins 800 m // firebreak to RPF.

LATITUDE: 33°29'47" **LONGITUDE:** 120°14'25" **ALTITUDE:** (AGD84) **ASPECT:** N

LANDFORM:

Hilltop	[ ]	Flat	[ ]	Drainageline	[X]	Swamp	[ ]	Ridge	[ ]
Outcrop	[ ]	Breakaway	[ ]	Slope	[X]	Gully	[ ]	Valley	[ ]
Riverbank	[ ]	Lake Edge	[ ]	Low Plain	[ ]	Sand Dune	[ ]	Cliff	[ ]
Firebreak	[X]	Other:							

ROCK TYPE:	Laterite	[ ]	Granite	[ ]	Dolerite	[ ]	Limestone	[ ]	Other: Quartz grit
ROCK FORM:	Sheet	[ ]	Boulder	[ ]	Fluviatile Gravel	[ ]	Concretionary gravel	[ ]	
SOIL TYPE:	Sand	[X]	Loam	[X]	Clay	[ ]	Peat	[ ]	Gravel [ ]
SOIL COLOUR:	Red	[ ]	Brown	[X]	Yellow	[ ]	White	[ ]	Grey [X]
SOIL CONDITION:	Perm. wet	[ ]	Moist	[ ]	Dry	[X]	Saline	[ ]	Other:

VEGETATION CLASSIFICATION (Muir's): Mallee (burnt regrowth)

ASSOCIATED SPECIES: Acacia gonophylla, Grevillea paterisobea, Melaleuca hamata

No. OF PLANTS:

Estimated [X] Actual [ ] Mature: Seedlings: 2,500 Dead: Area Occupied: 0.2 ha

REPRODUCTIVE STATE: in bud [ ] flower only [1] immature fruit [ ] dehisced [ ] vegetative [X]

POLLINATORS: Native bees [ ] honey bees [ ] mammals [ ] birds [ ] insects [ ]

Other observations: not yet flowered

CONDITIONS OF POPULATION: Recently burnt [X] diseased [ ] disturbed [ ] undisturbed [ ]

Other [ ] State:

POTENTIAL THREATS: Firebreaks [X] mining [ ] recreational activities [ ] 'disease' [ ] weeds [ ]

grazing [ ] clearing [ ] prescribed burning [X] Other [ ] State

FIRE HISTORY: Not known [ ] Burnt in ~~19~~ Feb '03 Summer [X] Autumn [ ] Winter [ ] Spring [ ]

Next control burn: Year: Month:

VOUCHER SPECIMEN: Retained [ ] W.A. Herb. [ ] Other [ ] State:

ATTACHED: Map [ ] Mudmap [X] Illustration [ ] Photo [X] Field Notes [ ]

ACTION: Taken: flowering seedling

Required: by District [ ] S.O.H.Q. [ ] State:

FENCING REQUIREMENT:

ROADSIDE MARKERS:

OTHER COMMENTS:

COPY SENT TO: Regional Office [ ] District Office [ ] Other [ ]. State:

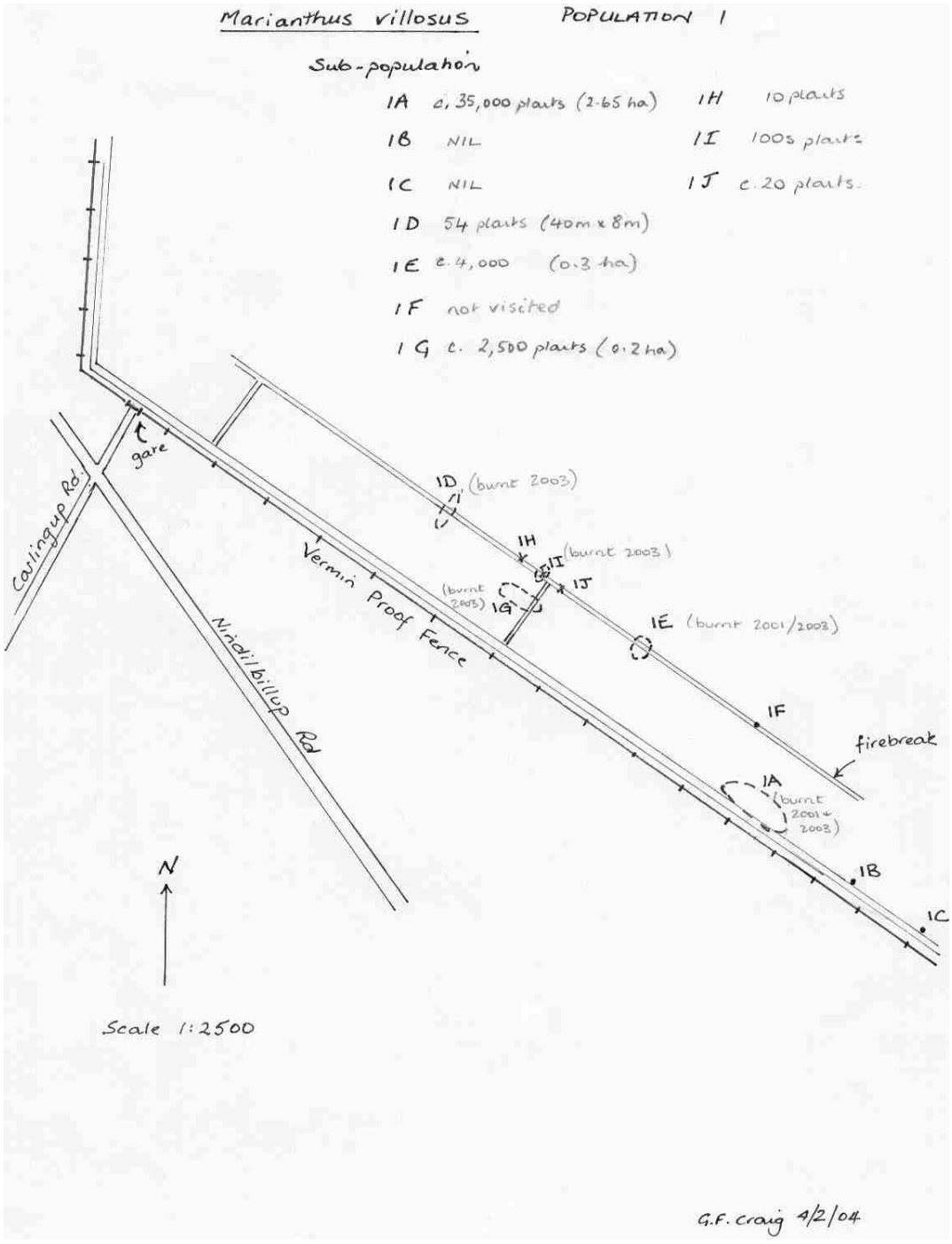
SOHQ TO SEND COPY TO: Regional Office [ ] District Office [ ] Other [ ] State:

Signed: GF Craig Date: 23/2/04

NOTE: More than one box in any section, may be ticked.

RECORDS: PLEASE FORWARD TO ADMINISTRATIVE OFFICER, FLORA, WILDLIFE ADMINISTRATION

Marianthus villosus POPULATION 1G: Vermin Proof Fence
First flower in population of seedlings
Burnt February 2003


Marianthus villosus
POPULATION 1
Sub-population
1A c. 35,000 plants (2.65 ha)
1B NIL
1C NIL
1D 54 plants (40m x 8m)
1E c. 4,000 (0.3 ha)
1F not visited
1G c. 2,500 plants (0.2 ha)
1H 10 plants
1I 100s plants
1J c. 20 plants.
gate
Caringup Rd
Vermin Proof Fence
Nindilbillup Rd
1D (burnt 2003)
1H
1I (burnt 2003)
1J
(burnt 2005) 1G
1E (burnt 2001/2002)
1F
firebreak
1A (burnt 2001 & 2003)
1B
1C
N
Scale 1:2500
G.F. Craig 4/2/04

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

RARE FLORA REPORT FORM

TAXON: Mariarthrus villosus **POPULATION No.:** 2

File No. Head Office: File No. District:

DRF ☐ Proposed DRF ☐ Priority Species No. ☐ Geog. Restr. ☐

New Population ☐ Routine Inspection ☐ Re-survey ☒ Opportunistic Survey ☐

FROM: G.F. Craig **TITLE:** Consultant **SURVEY DATE:** 6/2/04

REGION: South Coast **DISTRICT:** Albany **SHIRE:** Ravensthorpe

District Site Ref.: MAP REF.:

LAND STATUS:

	Nature Res. ☐	Water Res. ☐	Gravel Res. MRD ☐	Gravel Res. Shire ☐
	National Park ☐	Railway Res. ☐	Rd. Verge MRD ☐	Rd. Verge Shire ☐
	State Forest ☐	Private ☐	VCL ☒	Shire Reserve ☐
	Other ☐	State:		

LOCALITY: 1·2 km along ridgetop firebreak, then 0.05 km E to // firebreak; N of Mt Beamond

LATITUDE: 33°36'18" **LONGITUDE:** 120°08'47" **ALTITUDE:** (AGD84) **ASPECT:**

LANDFORM:

Hilltop ☐	Flat ☐	Drainageline ☐	Swamp ☐	Ridge ☐
Outcrop ☐	Breakaway ☐	Slope ☒	Gully ☐	Valley ☐
Riverbank ☐	Lake Edge ☐	Low Plain ☐	Sand Dune ☐	Cliff ☐
Firebreak ☐	Other:			

ROCK TYPE:	Laterite	☒	Granite	☐	Dolerite	☐	Limestone	☐	Other:	
ROCK FORM:	Sheet	☐	Boulder	☐	Fluviatile Gravel	☐	Concretionary gravel	☐		
SOIL TYPE:	Sand	☐	Loam	☒	Clay	☐	Peat	☐	Gravel	☒
SOIL COLOUR:	Red	☒	Brown	☒	Yellow	☒	White	☐	Grey	☐
SOIL CONDITION:	Perm. wet	☐	Moist	☐	Dry	☒	Saline	☐	Other:	

VEGETATION CLASSIFICATION (Muir's): Thicket + very Open Mallee (Euc. pleurocarpa, E falcata)

ASSOCIATED SPECIES: Dryandra quercifolia, Banksia lemanniana, Hakea ostusa, Taxandria spathulata, Sedges (Lepid brunonianum, + ?squamatum), Melaleuca sp.

No. OF PLANTS: NIL

Estimated ☐ Actual ☐ Mature: Seedlings: Dead: Area Occupied:

REPRODUCTIVE STATE: in bud ☐ flower ☐ immature fruit ☐ dehisced ☐ vegetative ☐

POLLINATORS: Native bees ☐ honey bees ☐ mammals ☐ birds ☐ insects ☐

Other observations:

CONDITIONS OF POPULATION: Recently burnt ☐ diseased ☐ disturbed ☐ undisturbed ☒

Other ☐ State: Very old growth >50 years

POTENTIAL THREATS: Firebreaks ☐ mining ☐ recreational activities ☐ 'disease' ☐ weeds ☐

grazing ☐ clearing ☐ prescribed burning ☐ Other ☐ State

FIRE HISTORY: Not known ☐ Burnt in 19 Summer ☐ Autumn ☐ Winter ☐ Spring ☐

Next control burn: Year: Month:

VOUCHER SPECIMEN: Retained ☐ W.A. Herb. ☐ Other ☐ State:

ATTACHED: Map ☐ Mudmap ☐ Illustration ☐ Photo ☐ Field Notes ☐

ACTION: Taken:

Required: by District ☐ S.O.H.Q. ☐ State:

FENCING REQUIREMENT:

ROADSIDE MARKERS:

OTHER COMMENTS: This population could not be relocated, despite extensive search – the habitat appears wrong for the given lat/long. Also aspect is different to Em. Bennett's description.

COPY SENT TO: Regional Office ☐ District Office ☐ Other ☐ State:

SOHQ TO SEND COPY TO: Regional Office ☐ District Office ☐ Other ☐ State:

Signed: GF Craig Date: 23/2/04

NOTE: More than one box, in any section, may be ticked.

RECORDS: PLEASE FORWARD TO ADMINISTRATIVE OFFICER, FLORA, WILDLIFE ADMINISTRATION

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

RARE FLORA REPORT FORM

TAXON: Marianthus villosus. **POPULATION No.:** 3A

File No. Head Office: File No. District:

DRF [X] Proposed DRF [ ] Priority Species No. [ ] Geog. Restr. [ ]

New Population [ ] Routine Inspection [ ] Re-survey [X] Opportunistic Survey [ ]

FROM: GF Craig **TITLE:** Consultant **SURVEY DATE:** 10/2/04

REGION: South Coast **DISTRICT:** Albany **SHIRE:** Ravensthorpe

District Site Ref.: MAP REF.:

LAND STATUS:

Nature Res.	[ ]	Water Res.	[ ]	Gravel Res. MRD	[ ]	Gravel Res. Shire	[ ]
National Park	[ ]	Railway Res.	[ ]	Rd. Verge MRD	[ ]	Rd. Verge Shire	[ ]
State Forest	[ ]	Private	[ ]	VCL	[ ]	Shire Reserve	[ ]
Other	[ ]	State:					

LOCALITY: 9.9 km SE of Mt Desmond, 0.4 km along left fork at Y junction ca. 11 km along road no. 8432 from Hopetoun - Ravensthorpe Rd. Immediately east of old 'Hecla' mine

LATITUDE: 33°40'23" **LONGITUDE:** 120°13'29" **ALTITUDE:** (AGD84) **ASPECT:**

LANDFORM:

Hilltop	[ ]	Flat	[ ]	Drainageline	[X]	Swamp	[ ]	Ridge	[ ]
Outcrop	[ ]	Breakaway	[X]	Slope	[X]	Gully	[X]	Valley	[ ]
Riverbank	[ ]	Lake Edge	[ ]	Low Plain	[ ]	Sand Dune	[ ]	Cliff	[ ]
Firebreak	[ ]	Other:							

ROCK TYPE:

Laterite	[ ]	Granite	[ ]	Dolerite	[ ]	Limestone	[ ]	Other:	
ROCK FORM: Sheet	[ ]	Boulder	[ ]	Fluviatile Gravel	[ ]	Concretionary gravel	[ ]		
SOIL TYPE: Sand	[X]	Loam	[X]	Clay	[ ]	Peat	[ ]	Gravel	[ ]
SOIL COLOUR: Red	[ ]	Brown	[ ]	Yellow	[ ]	White	[ ]	Grey	[ ]
SOIL CONDITION: Perm. wet	[ ]	Moist	[ ]	Dry	[X]	Saline	[ ]	Other:	

Pink loamy sand with quartz + gneiss rubble/gravel

VEGETATION CLASSIFICATION (Muir's): Open mallee + mid-dense heath (0.5-2m)

ASSOCIATED SPECIES: Euc. pleurocarpa, E. suggrandis, Melaleuca hamata M. rigidifolia, E. phaenophylla, Taxandria spathulata, Beaufortia schaueri, Acacia geraphylla

No. OF PLANTS:

Estimated [X] Actual [ ] Mature: 300+ Seedlings: Dead: Area Occupied: 1 ha

REPRODUCTIVE STATE: in bud [ ] flower [ ] immature fruit [ ] dehisced [X] vegetative [ ]

POLLINATORS: Native bees [ ] honey bees [ ] mammals [ ] birds [ ] insects [ ]

Other observations:

CONDITIONS OF POPULATION: Recently burnt [ ] diseased [ ] disturbed [ ] undisturbed [X]

Other [ ] State:

POTENTIAL THREATS: Firebreaks [ ] mining [ ] recreational activities [ ] 'disease' [ ] weeds [ ]

grazing [ ] clearing [ ] prescribed burning [ ] Other [ ] State

FIRE HISTORY: Not known [X] Burnt in 19 Summer [ ] Autumn [ ] Winter [ ] Spring [ ]

Next control burn: Year: Month:

VOUCHER SPECIMEN: Retained [ ] W.A. Herb. [ ] Other [ ] State:

ATTACHED: Map [ ] Mudmap [ ] Illustration [ ] Photo [ ] Field Notes [ ]

ACTION: Taken:

Required: by District [ ] S.O.H.Q. [ ] State:

FENCING REQUIREMENT:

ROADSIDE MARKERS:

OTHER COMMENTS: NB CALM report indicated this pop~ is "18.8 km SE of Mt Desmond" which is incorrect.

COPY SENT TO: Regional Office [ ] District Office [ ] Other [ ]. State:

SOHQ TO SEND COPY TO: Regional Office [ ] District Office [ ] Other [ ] State:

Signed: GF Craig Date: 23/2/04

NOTE: More than one box, in any section, may be ticked.

RECORDS: PLEASE FORWARD TO ADMINISTRATIVE OFFICER, FLORA, WILDLIFE ADMINISTRATION

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

RARE FLORA REPORT FORM

TAXON: *Marianthus villosus* POPULATION No.: *3C*

File No. Head Office: File No. District:

DRF [X] Proposed DRF [ ] Priority Species No. [ ] Geog. Restr. [ ]

New Population [?] Routine Inspection [ ] Re-survey [ ] Opportunistic Survey [ ]

FROM: *G.F. Craig* TITLE: *Consultant* SURVEY DATE: *10/2/04*

REGION: *South Coast* DISTRICT: *Albany* SHIRE: *Ravensthorpe*

District Site Ref.: MAP REF.:

LAND STATUS: Nature Res. [ ] Water Res. [ ] Gravel Res. MRD [ ] Gravel Res. Shire [ ]
National Park [ ] Railway Res. [ ] Rd. Verge MRD [ ] Rd. Verge Shire [ ]
State Forest [ ] Private [ ] VCL [ ] Shire Reserve [ ]
Other [ ] State:

LOCALITY: *9.4 km SE of Mt Desmond, 900m E of N-S track to 'Flag' Mine on Road No. 8432 then 600-750 m S on N-S grid.*

LATITUDE: *33°40'55"* LONGITUDE: *120°12'17"* ALTITUDE: *AGD84* ASPECT:

LANDFORM: Hilltop [ ] Flat [ ] Drainageline [X] Swamp [ ] Ridge [ ]
Outcrop [ ] Breakaway [ ] Slope [ ] Gully [ ] Valley [ ]
Riverbank [ ] Lake Edge [ ] Low Plain [ ] Sand Dune [ ] Cliff [ ]
Firebreak [ ] Other:

ROCK TYPE: Laterite [ ] Granite [ ] Dolerite [ ] Limestone [ ] Other:
ROCK FORM: Sheet [ ] Boulder [ ] Fluviatile Gravel [ ] Concretionary gravel [ ]
SOIL TYPE: Sand [ ] Loam [ ] Clay [ ] Peat [ ] Gravel [ ]
SOIL COLOUR: Red [ ] Brown [ ] Yellow [ ] White [ ] Grey [ ]
SOIL CONDITION: Perm. wet [ ] Moist [ ] Dry [ ] Saline [ ] Other:
Pink-brown clay loam with laterite + quartz rough stones.

VEGETATION CLASSIFICATION (Muir's): *Mallee + mid-dense to open heath.*
Euc. suggrandis, E. leptocalyx

ASSOCIATED SPECIES: *Eucalyptus astringens, E. pileata, Templetonia retusa, Microcorys glabra, Siegfriedia darwinioides, Daviesia nematophylla, Melaleuca laterifora, M. hamata*

No. OF PLANTS:
Estimated [X] Actual [ ] Mature: *700* Seedlings: Dead: Area Occupied: *1.4 ha*

REPRODUCTIVE STATE: in bud [ ] flower [ ] immature fruit [ ] dehisced [X] vegetative [ ]

POLLINATORS: Native bees [ ] honey bees [ ] mammals [ ] birds [ ] insects [ ]
Other observations:

CONDITIONS OF POPULATION: Recently burnt [ ] diseased [ ] disturbed [ ] undisturbed [X]
Other [ ] State:

POTENTIAL THREATS: Firebreaks [ ] mining [X] recreational activities [ ] 'disease' [ ] weeds [ ]
grazing [ ] clearing [ ] prescribed burning [ ] Other [ ] State

FIRE HISTORY: Not known [X] ~~>50 years~~ ~~Burnt in 19~~ ~~Summer~~ [ ] Autumn [ ] Winter [ ] Spring [ ]
Next control burn: Year: Month:

VOUCHER SPECIMEN: Retained [ ] W.A. Herb. [ ] Other [ ] State:

ATTACHED: Map * [X] Mudmap [ ] Illustration [ ] Photo [X] Field Notes [ ]

ACTION: Taken: *Habitat with Siegfriedia darwinioides*
Required: by District [ ] S.O.H.Q. [ ] State:

* *See 'DRF + Priority Map' in Tectonic Resources NL flora survey, Feb '04*

FENCING REQUIREMENT:

ROADSIDE MARKERS:

OTHER COMMENTS: *POP 3B does not occur at given Lat/Long 33°40'52" 120°12'45" which is at a Dryandra cirsioides / D. quercifolia boundary near a very old track. Wrong habitat. Believe above "POP 3C" is the correct location for POP 3B, as has similar habitat to Lewis (1982) + locality description Plate 9.*

COPY SENT TO: Regional Office [ ] District Office [ ] Other [ ]. State:

SOHQ TO SEND COPY TO: Regional Office [ ] District Office [ ] Other [ ] State:

Signed: *GF Craig* Date: *23/2/04*

NOTE: More than one box, in any section, may be ticked.

RECORDS: PLEASE FORWARD TO ADMINISTRATIVE OFFICER, FLORA, WILDLIFE ADMINISTRATION

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

RARE FLORA REPORT FORM

+ Boronia exyantha var. brevicalyx.
+ Acacia durabilis (5 only)

TAXON: Mariarthucs villosus (+ Acacia laricina var. crassifolia **POPULATION No.:** 4
+ Siegfriedia darwinia
File No. Head Office: **File No. District:**

DRF [X] Proposed DRF [ ] Priority Species No. [ ] Geog. Restr. [ ]
New Population [ ] Routine Inspection [ ] Re-survey [X] Opportunistic Survey [ ]
FROM: G.F. Craig **TITLE:** Consultant **SURVEY DATE:** 6/2/04
REGION: South Coast **DISTRICT:** Albany **SHIRE:** Ravensthorpe
District Site Ref.: MAP REF.:

LAND STATUS:

Nature Res.	[ ]	Water Res.	[ ]	Gravel Res. MRD	[ ]	Gravel Res. Shire	[ ]
National Park	[ ]	Railway Res.	[ ]	Rd. Verge MRD	[ ]	Rd. Verge Shire	[ ]
State Forest	[ ]	Private	[ ]	VCL	[ ]	Shire Reserve	[ ]
Other	[ ]	State:					

LOCALITY: 9.7 km SE of Mt Desmond; 20-200 m south-west of Y intersection on ridge OR 2.7 km north along ridgetop track from entrance gate to Mt Iron Mining;

LATITUDE: 33°38' 30"S **LONGITUDE:** 120° 11' 04" E **ALTITUDE:** AGD 84 **ASPECT:**

LANDFORM:

Hilltop	[ ]	Flat	[ ]	Drainageline	[X]	Swamp	[ ]	Ridge	[X]
Outcrop	[ ]	Below Breakaway	[X]	Slope N-S-facing	[X]	Gully	[X]	Valley	[ ]
Riverbank	[ ]	Lake Edge	[ ]	Low Plain	[ ]	Sand Dune	[ ]	Cliff	[ ]
Firebreak	[ ]	Other: Small dip							

ROCK TYPE:	Laterite	[X]	Granite	[ ]	Dolerite	[ ]	Limestone	[ ]	Other:
ROCK FORM:	Sheet	[ ]	Boulder	[ ]	Fluviatile Gravel	[ ]	Concretionary gravel	[ ]	
SOIL TYPE:	Sand	[ ]	Loam	[ ]	Clay	[ ]	Peat	[ ]	Gravel [X]
SOIL COLOUR:	Red	[ ]	Brown	[X]	Yellow Orange	[X]	White	[ ]	Grey [ ]
SOIL CONDITION:	Perm. wet	[ ]	Moist	[ ]	Dry	[X]	Saline	[ ]	Other:

VEGETATION CLASSIFICATION (Muir's): Very open mallee + thicket / heath - Euc. pleurocarpa E. phaenophylla

ASSOCIATED SPECIES: Banksia lemanniana Beaufortia schaueri, Dryandra cuneifolia D. quercifolia, Acacia laricina + crassifolia

No. OF PLANTS:
Estimated [X] Actual [X] 38 on track Mature: 500+ Seedlings: Dead: Area Occupied: 1 ha

REPRODUCTIVE STATE: in bud [ ] flower [X] immature fruit [X] dehisced [X] vegetative [ ]

POLLINATORS: Native bees [ ] honey bees [ ] mammals [ ] birds [ ] insects [ ]
Other observations:

CONDITIONS OF POPULATION: Recently burnt [ ] diseased [ ] disturbed [ ] undisturbed [X] > 90 %
Other [ ] State:

POTENTIAL THREATS: Firebreaks [X] mining [ ] recreational activities [ ] 'disease' [ ] weeds [ ]
grazing [ ] clearing [ ] prescribed burning [X] Other [ ] State

FIRE HISTORY: Not known [X] > 30 years Burnt in 19 Summer [ ] Autumn [ ] Winter [ ] Spring [ ]
Next control burn: Year: Month:

VOUCHER SPECIMEN: Retained [ ] W.A. Herb. [X] Other [ ] State: GFC 6044
ATTACHED: Map [ ] Mudmap [ ] Illustration [ ] Photo [ ] Field Notes [ ]
ACTION: Taken:
Required: by District [ ] S.O.H.Q. [ ] State:

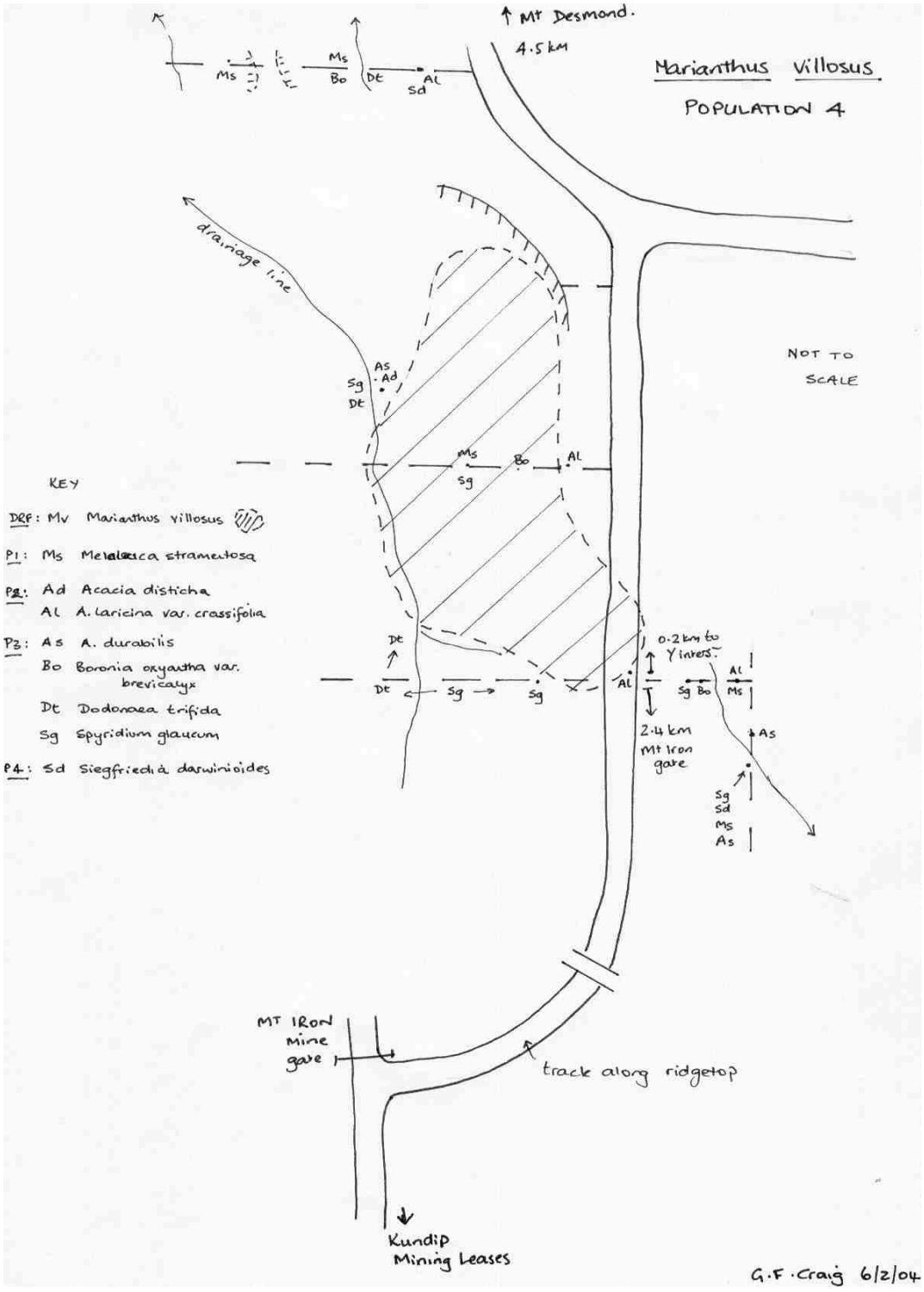
FENCING REQUIREMENT:
ROADSIDE MARKERS:
OTHER COMMENTS: This population is probably the same as JA Cochrane's JAC 1801 7/12/95 + S. Barrett 793 9/9/99

COPY SENT TO: Regional Office [ ] District Office [ ] Other [ ]. State:
SOHQ TO SEND COPY TO: Regional Office [ ] District Office [ ] Other [ ] State:

Signed: GF Craig Date: 23/2/04

NOTE: More than one box, in any section, may be ticked.

RECORDS: PLEASE FORWARD TO ADMINISTRATIVE OFFICER, FLORA, WILDLIFE ADMINISTRATION


Mt Desmond.
4.5 km
Marianthus Villosus
POPULATION 4
drainage line
NOT TO SCALE
KEY
DRF: Mv Marianthus villosus
P1: Ms Melaleuca stramentosa
P2: Ad Acacia disticha
Al A. laricina var. crassifolia
P3: As A. durabilis
Bo Boronia oxyantha var. brevicalyx
Dt Dodonaea trifida
Sg Spyridium glaucum
P4: Sd Siegfriedia darwinioides
0.2 km to Y inters.
2.4 km Mt Iron gate
MT IRON Mine gate
track along ridgetop
Kundip Mining Leases
G.F. Craig 6/2/04

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

RARE FLORA REPORT FORM

TAXON: Maraythus villosus **POPULATION No.:** 5

File No. Head Office: _____ File No. District: _____

DRF ☒ Proposed DRF ☐ Priority Species No. ☐ Geog. Restr. ☐

New Population ☒ Routine Inspection ☐ Re-survey ☐ Opportunistic Survey ☐

FROM: GF Craig **TITLE:** Consultant **SURVEY DATE:** 6/2/04

REGION: South Coast **DISTRICT:** Albany **SHIRE:** Ravensthorpe

District Site Ref.: _____ MAP REF.: _____

LAND STATUS:

	Nature Res. ☐	Water Res. ☐	Gravel Res. MRD ☐	Gravel Res. Shire ☐
	National Park ☐	Railway Res. ☐	Rd. Verge MRD ☐	Rd. Verge Shire ☐
	State Forest ☐	Private ☐	VCL ☐	Shire Reserve ☐
	Other ☐	State: _____		

LOCALITY: 7.9 km SE of Mt Desmond.
North of 'Western Gem' in NE sector of Kundip mining leases

LATITUDE: 33°08'40" **LONGITUDE:** 120°11'55" **ALTITUDE:** AGD84 **ASPECT:** NW

LANDFORM:

Hilltop ☐	Flat ☐	Drainageline ☒	Swamp ☐	Ridge ☐
Outcrop ☐	Breakaway ☐	Slope ☒	Gully ☐	Valley ☐
Riverbank ☐	Lake Edge ☐	Low Plain ☐	Sand Dune ☐	Cliff ☐
Firebreak ☐	Other: _____			

ROCK TYPE:	Laterite ☒	Granite ☐	Dolerite ☐	Limestone ☐	Other: _____
ROCK FORM:	Sheet ☐	Boulder ☐	Fluviatile Gravel ☐	Concretionary gravel ☐	
SOIL TYPE:	Sand ☒	Loam ☒	Clay ☐	Peat ☐	Gravel ☐
SOIL COLOUR:	Red ☐	Brown ☐	Yellow ☐	White ☐	Grey ☐
SOIL CONDITION:	Perm. wet ☐	Moist ☐	Dry ☐	Saline ☐	Other: _____

VEGETATION CLASSIFICATION (Muir's): Open to mid-dense mallee & dense to mid-dense heath

ASSOCIATED SPECIES: Euc. flocktoniae, E. leptocalyx, E. phaenophylla, Banksia lemanniana / Melaleuca stramentosa, Sieglingia decumbens.

No. OF PLANTS:
Estimated ☒ Actual ☐ Mature: 1,500 Seedlings: _____ Dead: _____ Area Occupied: 4.84 ha

REPRODUCTIVE STATE: in bud ☐ flower ☐ immature fruit ☐ dehisced ☒ vegetative ☐

POLLINATORS: Native bees ☐ honey bees ☐ mammals ☐ birds ☐ insects ☐

Other observations: _____

CONDITIONS OF POPULATION: Recently burnt ☐ diseased ☐ disturbed ☐ undisturbed ☒

Other ☐ State: 10-15% plants on old grid lines & tracks

POTENTIAL THREATS: Firebreaks ☐ mining ☒ recreational activities ☐ 'disease' ☐ weeds ☐

grazing ☐ clearing ☐ prescribed burning ☐ Other ☐ State _____

FIRE HISTORY: Not known ☒ >50 years Burnt in 19____ Summer ☐ Autumn ☐ Winter ☐ Spring ☐

Next control burn: Year: _____ Month: _____

VOUCHER SPECIMEN: Retained ☐ W.A. Herb. ☒ Other ☐ State: GFC 6000 (9/12/03)

ATTACHED: Map * ☒ Mudmap ☐ Illustration ☐ Photo ☒ Field Notes ☐

ACTION: Taken: _____

Required: by District ☐ S.O.H.Q. ☐ State: _____

* see 'DRF + Priority Flora Map' in Tectonic Resources NL flora survey report, Feb'2004

FENCING REQUIREMENT: _____

ROADSIDE MARKERS: _____

OTHER COMMENTS: _____

COPY SENT TO: Regional Office ☐ District Office ☐ Other ☐ State: _____

SOHQ TO SEND COPY TO: Regional Office ☐ District Office ☐ Other ☐ State: _____

Signed: GF Craig Date: 23/2/04

NOTE: More than one box, in any section, may be ticked.

RECORDS: PLEASE FORWARD TO ADMINISTRATIVE OFFICER, FLORA, WILDLIFE ADMINISTRATION

Tectonic Resources NL

KUNDIP MINING LEASES
Pultenaea and *Melaleuca*

November 2004

Cover photos: *Pultenaea* sp. Kundip (GF Craig 6008) flowers and fruits.

KUNDIP MINING LEASES
Pultenaea and *Melaleuca*

A report prepared for
Tectonic Resources NL
Suite 4, 100 Hay Street, Subiaco WA 6008

November 2004

Dr G F Craig
Environmental Consultant
ABN: 96 108 756 719
PO Box 130, Ravensthorpe 6346

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Summary

Two species, *Melaleuca* sp. Kundip (GF Craig 6020) and *Pultenaea* sp. Kundip (GF Craig 6008) have been nominated for inclusion on CALM's *Declared Rare and Priority Flora List* as Priority One. Both species occur in the southern sector of the Kundip mining leases, currently held by Tectonic Resources NL, and extend into Crown land to the south of these tenements.

In April 2004, the report *Kundip Mining Leases M74/41, 51, 53 & 135 and P74/153: Vegetation and Flora Survey* (Craig 2004), identified two species as being significant and apparently new. *Melaleuca* sp. Kundip (GF Craig 6020) has been confirmed by Brendan Lepschi (pers.comm.) as being new, and Lindy Orthia has yet to confirm the status of *Pultenaea* sp. Kundip (GF Craig 6008).

A survey in March 2004, found four sub-populations of *Melaleuca* sp. Kundip (Craig, 2004). The survey for *Pultenaea* sp. Kundip was delayed until flowering, so that the population boundary could be more easily identified. Subsequently, the current survey in November 2004, located the extent of *Pultenaea* sp. Kundip on the Kundip mining leases by marking with a GPS, while aerial photo interpretation was used to determine the perceived population boundary to the south of the tenements.

The highest density of *Pultenaea* sp. Kundip occurs in the mallet regrowth which was burnt in summer 1987/88. The total area is estimated to cover 41 ha which includes an estimated 158,500 plants.

During the survey for *Pultenaea* sp. Kundip, a fifth sub-population of *Melaleuca* sp. Kundip was found to the south of the Kundip mining leases. The combined five sub-populations cover 11.4 ha and include an estimated 27,800 plants.

As the extent of these two co-existing species is known to cover less than 2 km x 1 km, the recommendation of CALM to include both the *Pultenaea* and *Melaleuca* as Priority One on the *Declared Rare and Priority Flora List* remains valid.

Introduction

The Kundip mining leases M74/41, 51, 53 & 135 and P74/153 comprise approximately 664 ha, the majority of which is located east of the Hopetoun-Ravensthorpe Road, 16 km south east of Ravensthorpe and 34 km north of the coastal town of Hopetoun (Fig.1). The historical townsite of Kundip lies on the western margin of the leases.

In April 2004, the report *Kundip Mining Leases M74/41, 51, 53 & 135 and P74/153: Vegetation and Flora Survey* (Craig 2004), identified two species as being significant and apparently new. *Melaleuca* sp. Kundip (GF Craig 6020) has been confirmed by Brendan Lepschi (pers.comm.) as being new, and Lindy Orthia has yet to confirm the status of *Pultenaea* sp. Kundip (GF Craig 6008).

As a consequence of the April report, the Department of Conservation and Land Management's (CALM) Albany Rare Flora Recovery Team (meeting minutes 7/4/04, Appendix 1) recommended that *Melaleuca* sp. Kundip and *Pultenaea* sp. Kundip be nominated as Priority One on CALM's *Declared Rare and Priority Flora List.*

Both species occur near the southern boundary of tenement M74/51 and further surveys were recommended to identify their extent and density. This report provides an update on the current state of knowledge on the *Pultenaea* and *Melaleuca.*

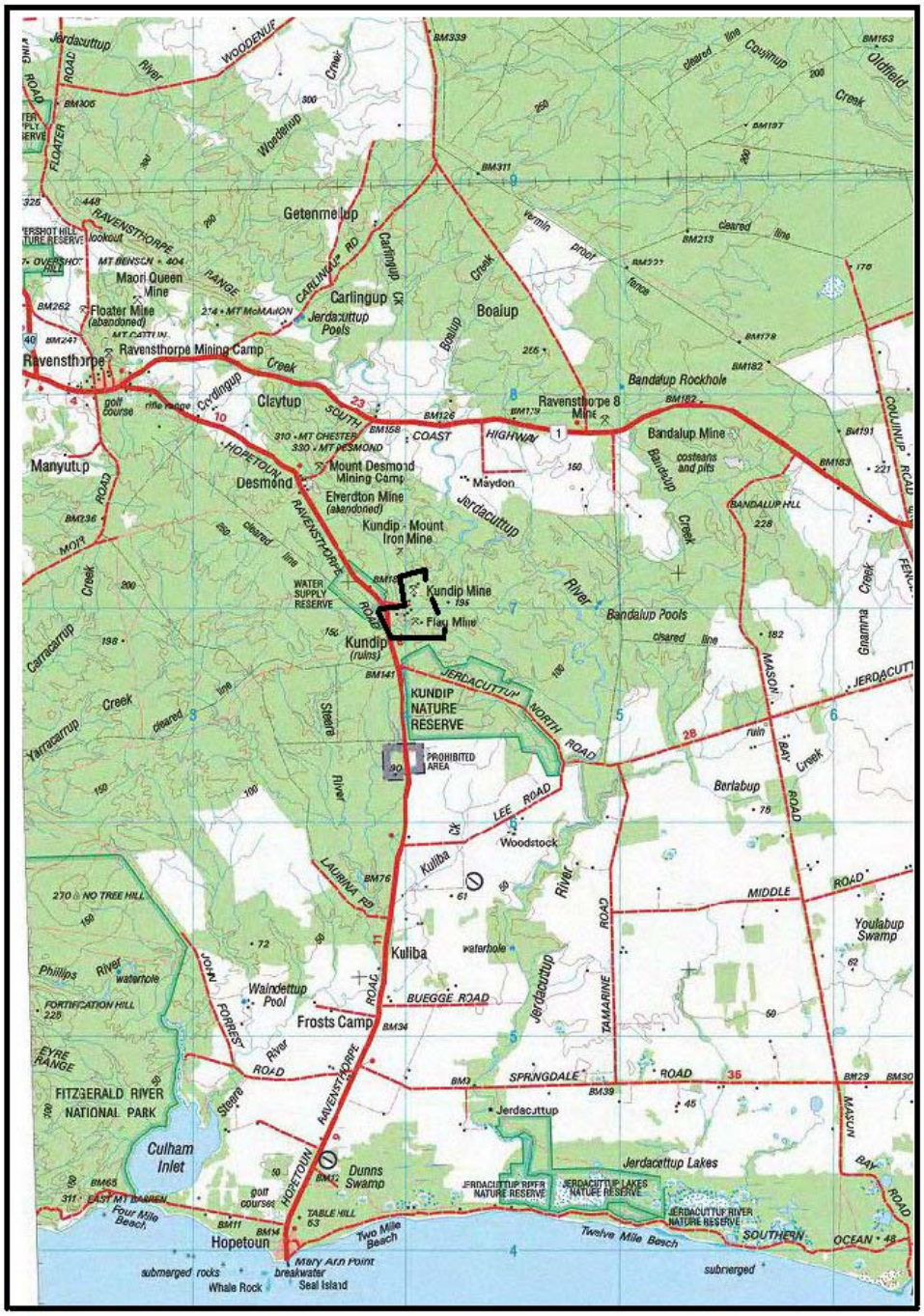

Fig.1 - Location of Kundip mining leases

Methods

Pultenaea sp. Kundip

On 5 November and 11 November 2004, the known sub-populations of *Pultenaea* sp. Kundip (GF Craig 6008) were surveyed by GPS marking of the boundaries. As the population appeared to extend for a significant distance south of Tectonic Resources' tenements, the southern extent of the population was determined from interpretation of a composite aerial photo (1:5 000 scale, 22 February 1988).

The area of the *Pultenaea* sp. Kundip within the Kundip mining leases was calculated from the average N-S and E-W distance of each sub-population. The density of the population was calculated counting the number of plants in 50 m x 1 m transects in dense vegetation (ie burnt regrowth of the *Eucalyptus cernua / E. clivicola* [En/Ec] vegetation community in the eastern sector, and in the *Melaleuca* sp. Kundip [Mx] vegetation community in the western sector) and 50 m x 4 m transects in more open vegetation (ie the *E. astringens* [Ea] vegetation community).

GPS waypoints were downloaded to *GPS Utility* software in WGS84 datum (which is compatible with Geocentric Datum Australia 1994 (GDA94)) and mapped using the same program.

Melaleuca sp. Kundip

On 17 March 2004, the four known sub-populations of *Melaleuca* sp. Kundip (GF Craig 6020) were surveyed. The area covered by each population was determined either by pacing its extent or marking the boundary with GPS points and calculating the area using ARCVIEW®. An estimate of the number of plants in each population was determined by counting the number of plants in at least 100 m x 1 m and calculating the number for the given area. These results were provided in the original report *Kundip Mining Leases M74/41, 51, 53 & 135 and P74/153: Vegetation and Flora Survey* (Craig, 2004).

On 5 November 2004, while surveying the *Pultenaea* sp. Kundip, another small sub-population of *Melaleuca* sp. Kundip was found. The boundary of this population was surveyed using GPS and density estimated using the average of the original four sub-populations.

Specimens of both *Pultenaea* and *Melaleuca* have been sent to the Australian National Herbarium, with duplicates to the Perth and Ravensthorpe herbaria.

Results

Pultenaea sp. Kundip

Pultenaea sp. Kundip (GF Craig 6008) is a low spindly shrub, to 60 cm tall. Leaves are 4 mm long, cylindrical with a groove in the upper side and recurved at the tip. The small, rounded pods are hairy. This species has affinity to *Pultenaea calycina* subsp. *proxena* which has been found on the proposed Kundip haul road (Craig 2004b) and elsewhere in the region. Flowering and fruiting material has recently been sent to Lindy Orthia (Canberra) to determine the status of the taxon on the Kundip leases.

a

b

c

Plate 1 – *Pultenaea* sp. Kundip
a- flowers
b- fruits
c- habit

The current known population of *Pultenaea* sp. Kundip is restricted to near the southern boundary of Tectonic Resources NL's tenement M74/51. Scattered plants, with occasional patches of higher density, are found shaded beneath shrubs in the *Melaleuca* sp. Kundip [**Mx**] vegetation unit and further to the east in the *Eucalyptus astringens* [**Ea**] low forest. In the regrowth of the *Eucalyptus cernua/ E.clivicola* [**En/Ec**] unit, which was burnt between 29 December 1987 and 6 January 1988, extremely dense, large patches of *Pultenaea* sp. Kundip are found.

The area of known *Pultenaea* sp. Kundip is given in Fig. 2 and the GPS boundary waypoints of plants within Kundip mining leases are given in Appendix 2. The location of the *Pultenaea* in relation to *Melaleuca* sp. Kundip (GF Craig 6020) is shown in Fig.3.

The currently known range of *Pultenaea* sp. Kundip is approximately 1.8 km x 0.6 km.

Table 1 – Estimate of area and number of plants in the *Pultenaea* sp. Kundip (GF Craig 6008) population

Vegetation Unit*	Area (ha)	Number of plants
Kundip mining leases:		
Mx	5	1,500
Ea	15	2,000
En/Ec (burnt 1987/88)	6	150,000
South of lease area:		
Mallee – scrub & woodland	20	5,000
TOTAL	**41**	**158,500**

* refer to Craig (April 2004) for a description of the vegetation units

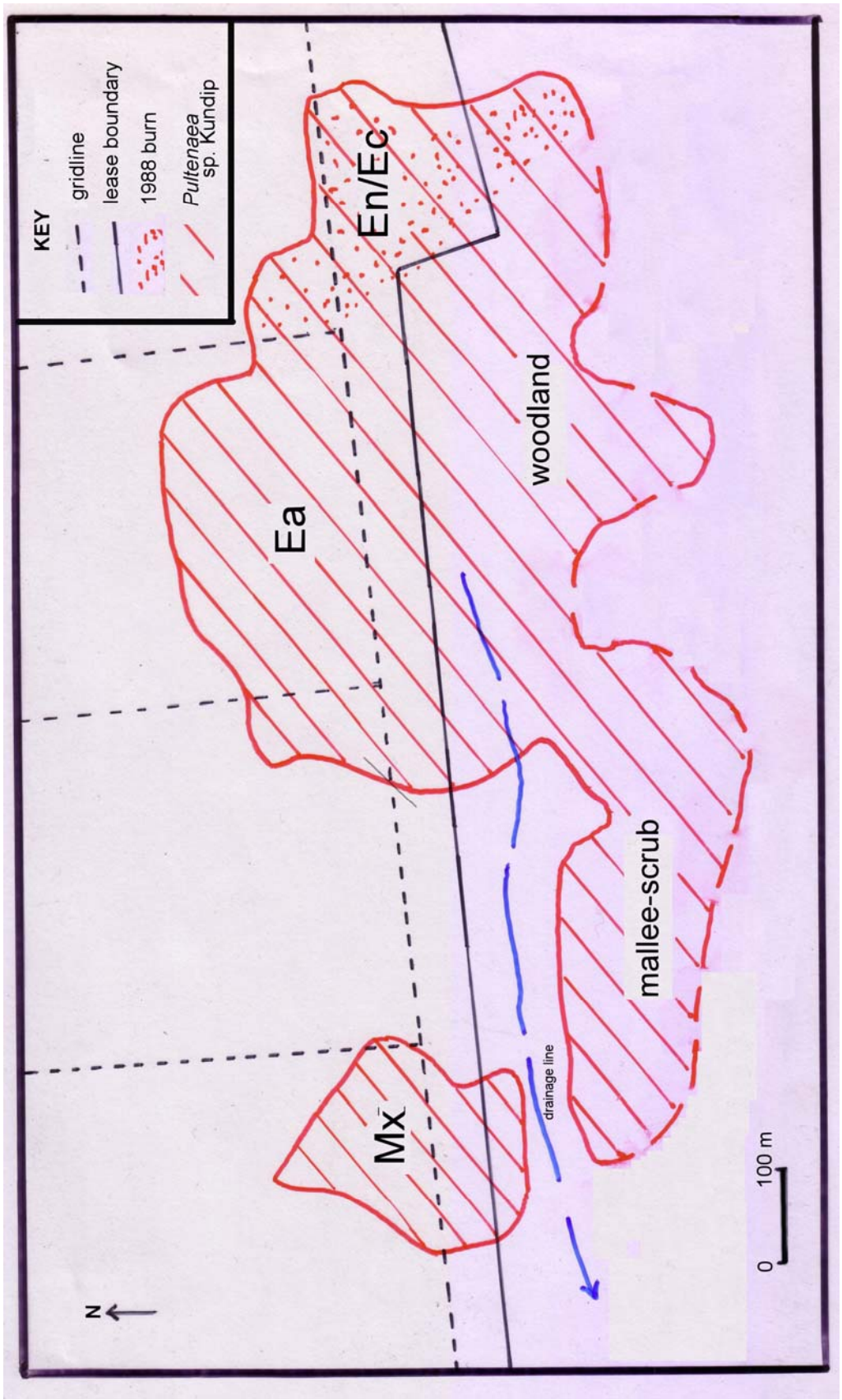

Fig. 2 – Location of *Pultenaea* sp. Kundip (GF Craig 6008) within and to the south of the Kundip mining leases.

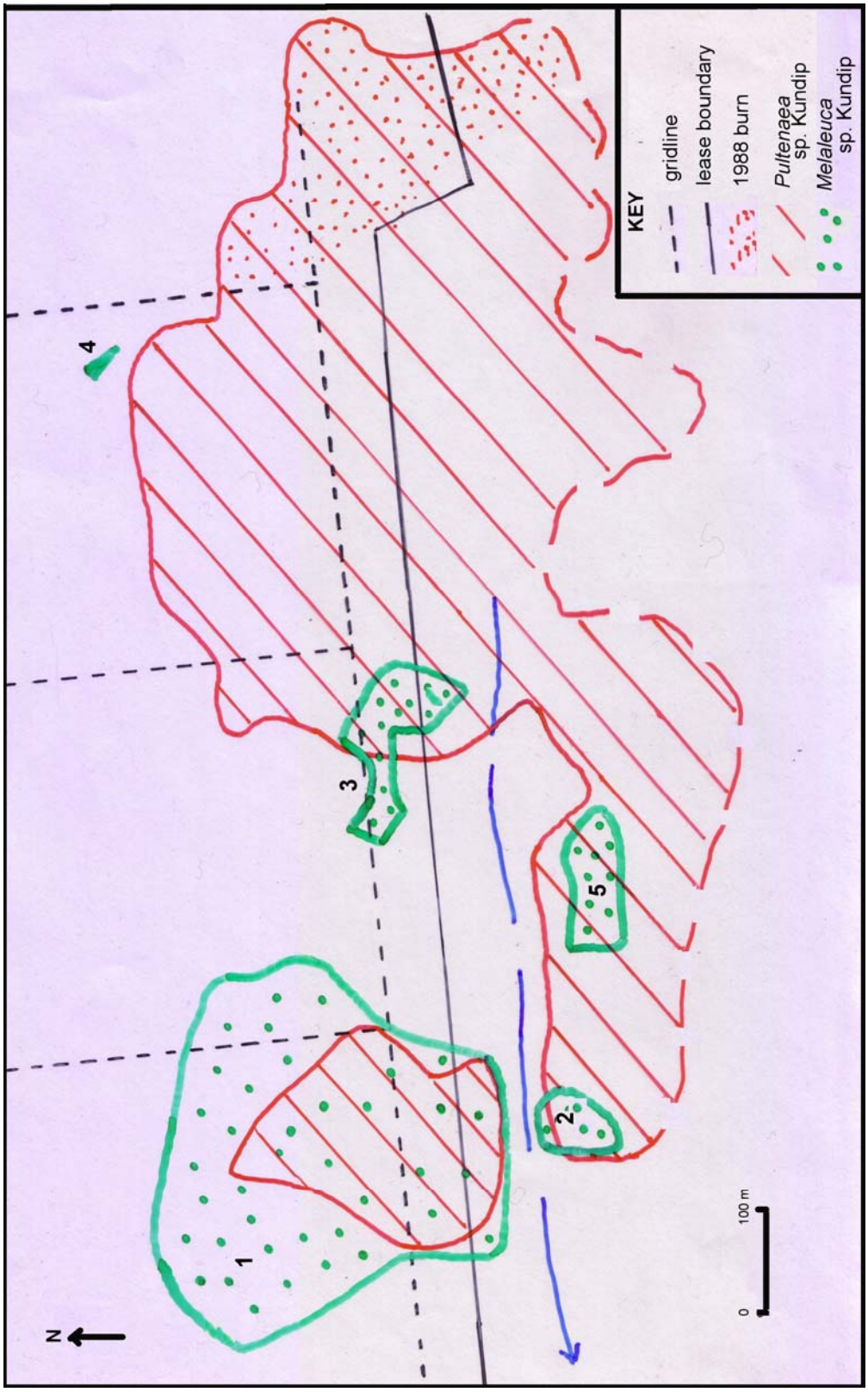

Fig. 3 – Location of *Pultenaea* sp. Kundip (GF Craig 6008) in relation to *Melaleuca* sp. Kundip (GF Craig 6020)

***Melaleuca* sp. Kundip**

Melaleuca sp. Kundip (GF Craig 6020) is an erect, robust shrub, 1-2 m tall with recurved leaves, and white flowers. This species is new and undescribed (Lepschi, pers.comm.). It is restricted to the south-western sector of the Kundip mining leases, growing on pale grey sandy loam with quartzite rubble.

a

b

c

Plate 2 – *Melaleuca* sp. Kundip, a- flowers, b- fruits, c- habit

Craig (2004) mapped *Melaleuca* sp. Kundip as dominant in the [**Mx**] vegetation unit. Three sub-populations were found on Tectonic Reources' tenements and one to the south of the lease area. During survey of *Pultenaea* sp. Kundip in November 2004, another sub-population was found to the south of tenements (Fig.4 – population 5). All the currently known sub-populations are shown in Fig.4 and Table 2. The currently known range of the species remains approximately 1.1 km x 0.5 km.

Table 2 – Estimated number of plants in *Melaleuca* sp. Kundip (GF Craig 6020) sub-populations

Sub-population	Area (ha)	Number of plants
Kundip mining leases:		
1 – (west)	10	25,000
3 – (centre)	1	1,200
4 – (east)	0.03	100
South of lease area:		
2 – (south)	0.4	500
5 – (centre)	0.8	1,000
TOTAL	**11.43**	**27,800**

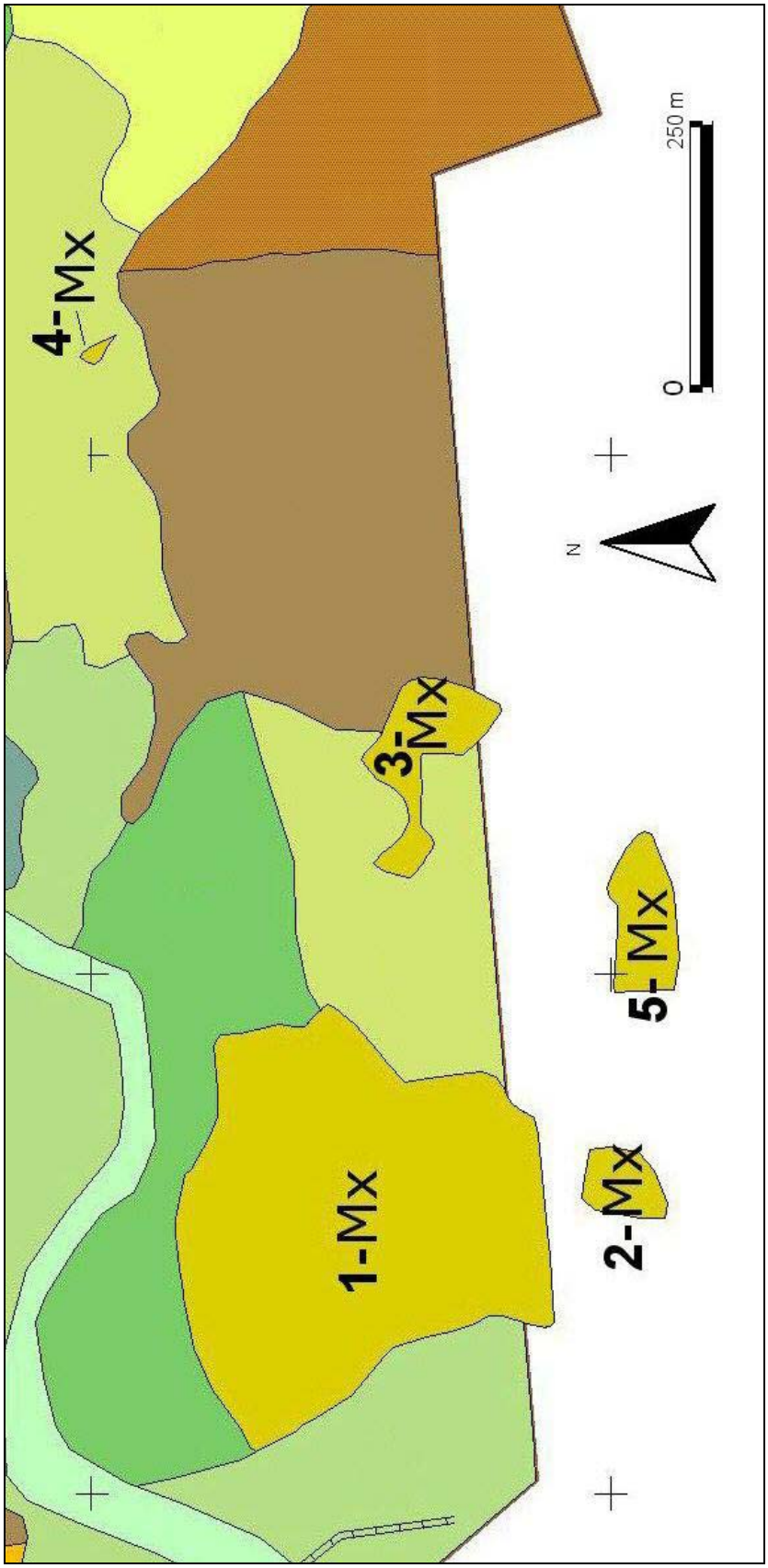

Fig 4 – Location of *Melaleua* sp. Kundip (GF Craig 6020) populations within and to the south of the Kundip mining leases.

Discussion

The known ranges of both *Pultenaea* sp. Kundip and *Melaleuca* sp. Kundip remain extremely restricted. They co-exist at the southern limit of the Kundip mining leases and extend into Crown land to the south of the Tectonic Resources' tenement (M74/51), covering an area of about 100 ha or 1 km^2.

At this stage, Tectonic Resources NL have no plans to disturb this sector of their tenements with mining or exploration activities (K.Bennett, pers.comm.). Consequently, the populations of these two species are not immediately threatened. However, considering the known extent of the populations is very restricted, the recommendation by CALM's Albany Rare Flora Recovery Team (meeting minutes 7/4/04) to nominate *Melaleuca* sp. Kundip and *Pultenaea* sp. Kundip as Priority One on CALM's *Declared Rare and Priority Flora List* remains valid.

It is recommended that opportunistic surveys for these two species continue in the Ravensthorpe region.

Acknowledgements

The on-going assistance of taxonomic specialists, Brendan Lepschi (*Melaleucai)* and Lindy Orthia (*Pultenaea),* at the Australian National Herbarium, Canberra is gratefully acknowledged.

References

Craig GF 2004 *Kundip Mining Leases M74/41, 51, 53 & 135 and P74/153: Vegetation and Flora Survey*. Unpublished report for Tectonic Resources NL, Subiaco. April 2004.

Craig GF 2004b *Kundip Haul Road: Declared Rare & Prioirity Flora Survey.* Unpublished report for Tectonic Resources NL, Subiaco. May 2004,

Appendix 1

Excerpts from Albany Rare Flora Recovery Team meeting minutes (7/4/04)

Present: S. Barrett, S. Comer, A.Brown, D. Coates, A. Cochrane, L. Sandiford, M. Bennett, S. Leighton, S. Oborne, L. Oborne, A. Burchell, S. Maciejewsld, G. Freebury, S. Gilfillan.
Apologies: L. Anderson, B. Miller, M. Grant. W. Bradshaw
Chairperson: S. Comer

4. **Review of Bandalup Hill flora**

Geoff Cockerton Consultant to Ravensthorpe Nickel Operation / BHP Billiton was unable to attend the meeting as RNO requested that he defer his presentation. Threatened flora issues were discussed. Twenty-two priority taxa and 10 previously unknown undescribed species have been recorded from with RNP tenements. Sarah Barrett and Mal Grant attended a site visit 25/4/04 along with Daniel Coffey (Environmental Protection Branch) and Rosemarie Rees (TECs WATSCU). In the afternoon a visit was made to another proposed mine site - Tectonic Resources. Potential DRF candidates re Geoff Cockerton include *Kunzea similis,* which requires further genetic study, *Eucalyptus purpurata, Allocasuarina scleroclada ssp echinata* ms and *Beyeria sp* Dwarf. Rosemarie Rees is considering nomination of potential TECs *(Eucalyptus purpurata* woodland on magnesite, Heath on Komatiite). Magnesite mallee-shrublands are also very limited in their distribution (G. Cockerton pers. com). Gill Craig consultant to Tectonic Resources has suggested that a community on Tectonic Resources may be a potential TEC *(*Melaleuca sp X* community on Kundip quartzite) and several new undescribed species require listing as Priority taxa (**Kunzea acicularis, Pultenaea sp* Kundip, *Melaleuca sp X).*

There is a clear need for a comprehensive survey of the Ravensthorpe range / Bandalup corridor to determine the conservation status of Priority and undescribed flora and to identify plant communities, including potential TECs in view of the likelihood of ongoing mining activities. Sarah reported that Norm Caporn (EPB) had said that BHP Billiton was unwilling to fund a comprehensive survey of the Ravensthorpe Range.

Action 9. Nominate Bandalup Hill flora *Eucalyptus purpurata, Kunzea similis, Allocasuarina scleroclada ssp echinata* and *Beyeria sp* Dwarf as DRF, *Kunzea acicularis, Pultenaea sp* Kundip, *Melaleuca sp X* as Priority 1 taxa (S. Barrett).

Action 10. Sarah Barrett and Sarah Comer to negotiate with Adrian Lee (BHP Billiton) re flora and vegetation survey of the Ravensthorpe Range / Bandalup corridor in conjunction with CALM (?SCRIPT funding), specific areas that could be targeted are the `banded ironstone formations' which are common to both areas.

*NB. *Kunzea acicularis* does not occur on Tectonic Resources' lease.
Melaleuca sp. X refers to *Melaleuca* sp. Kundip (GF Craig 6020)

Appendix 2

GPS Locations of* Pultenaea *sp. Kundip (GF Craig 6008)

Datum: WGS84 (compatible with Geocentric Datum Australia 1994 (GDA94))

WPT	Zone	Easting	Northing
1	51H	240277	6268869
3	51H	240238	6268870
4	51H	240207	6268845
5	51H	240225	6268813
7	51H	240190	6268716
10	51H	240188	6268614
11	51H	240247	6268540
13	51H	240094	6268531
14	51H	240157	6268470
17	51H	240372	6268939
18	51H	240571	6268966
19	51H	240627	6268948
20	51H	240647	6268867
22	51H	240723	6268871
24	51H	240773	6268848
25	51H	240794	6268796
26	51H	240947	6268804
27	51H	239893	6268697
29	51H	239845	6268641
31	51H	239867	6268582
32	51H	239883	6268518
33	51H	239761	6268489
34	51H	239765	6268450
36	51H	239727	6268565
37	51H	239677	6268593
39	51H	239664	6268667
40	51H	239873	6268753
42	51H	239744	6268848
43	51H	239734	6268778

Appendix 3

GPS Locations of* Melaleuca *sp. Kundip (GF Craig 6020)

Datum: WGS84 (compatible with Geocentric Datum Australia 1994 (GDA94))

SUB-POPULATION	WPT	ZONE	EASTING	NORTHING
Kundip mining leases:				
4- East	1	51H	240609	6268983
	2	51H	240590	6268998
	3	51H	240597	6269007
	4	51H	240618	6268976
3 - Centre	5	51H	240188	6268725
	6	51H	240206	6268740
	7	51H	240277	6268702
	8	51H	240287	6268682
	9	51H	240258	6268606
	10	51H	240240	6268615
	11	51H	240213	6268642
	12	51H	240213	6268682
	13	51H	240179	6268682
	14	51H	240143	6268683
	15	51H	240127	6268670
	16	51H	240094	6268693
	17	51H	240109	6268728
	18	51H	240124	6268711
	19	51H	240146	6268695
	20	51H	240171	6268700
	21	51H	240182	6268713
1 - West	22	51H	239898	6268699
	23	51H	239905	6268648
	24	51H	239902	6268611
	25	51H	239876	6268595
	26	51H	239870	6268584
	33	51H	239764	6268563
	34	51H	239663	6268557
	35	51H	239671	6268621
	36	51H	239655	6268661
	37	51H	239642	6268710
	38	51H	239594	6268752
	39	51H	239569	6268795
	40	51H	239552	6268851
	41	51H	239641	6268902
	42	51H	239667	6268936
	43	51H	239753	6268918
	44	51H	239813	6268905
	45	51H	239864	6268879
	46	51H	239944	6268876
	47	51H	239953	6268822

	48	51H	239951	6268796
	49	51H	239971	6268772
	50	51H	239927	6268725
	51	51H	239900	6268677
South of tenements:				
2 - West	27	51H	239831	6268521
	28	51H	239832	6268474
	29	51H	239780	6268446
	30	51H	239767	6268448
	31	51H	239772	6268497
	32	51H	239789	6268529
5 - Centre	M51	51H	240067	6268494
	M54	51H	239984	6268496
	M55	51H	240139	6268468
	M56	51H	239986	6268439
	M57	51H	240089	6268442
	M58	51H	240084	6268504

Pop.	Site	Collection/s	Datum	Latitude/ Easting	Longitude/ Northing	Location Description	Site Description	Date surveyed	No. of Plants	Area searched	Tenement/ Reserve
	Marianthus villosus	**DRF**									
1	Vermin Proof Fence	J Lewis sn ?J Hill 2	GDA94	244963	6289376	1.9-3.6 km south of Carlingup Rd gate on east side of Vermin Proof Fence (7 sub-populations)	Mallee heath. Sandy loam with quartz grit. Some sub-populations burnt Feb 2003	4/2/2004 (GF Craig)	est. 42,000	3.5 x 0.5 km	UCL
2	North of Mt Desmond	EM Bennett 16979	AGD84	33 36'18"	120 08'47"	NE slope of southern ridge of Ravensthorpe Range	Massive laterite boulders.	collected 16/9/1979	not relocated 6/2/04		PNR
3A	9.9 km SE of Mt Desmond; Hecla Mine	KR Newbey 11803	GDA94	242829	6270767	c. 11 km along Road No.8432 from Hopetoun-Ravensthorpe Rd. Immediately east of old Hecla mine.	Open mallee and mid-dense heath. Pink loamy sand with quartz and gneiss rubble.	10/2/2004 (GF Craig)	est. 300	1 ha	Gazetted Road/ PNR
3C (?3B)	9.4 km SE of Mt Desmond; NE of Flag mine	-	GDA94	240999	6269623	900 m east of track to Flag mine on Road No.8432 then 600-750 m south on gridline	Tall mallee and heath. Pink-brown clay loam with laterite and quartz stones.	10/2/2004 (GF Craig)	est. 700	1.4 ha	Tectonic
4	4.7 km SE of Mt Desmond; N of Mt Iron mine	JA Cochrane 1801; S Barrett 793; GF Craig 6044	GDA94	239035	6274214	2.4 km north along ridgetop track from entrance to Mt Iron mine; or 20-200 m south and west of Y-intersection of firebreaks	Open mallee and thicket/heath. Gravelly loamy sand over laterite.	6/2/2004 (GF Craig)	c. 500	1 ha	PNR
5	7.9 km SE of Mt Desmond; N of Western Gem mine	GF Craig 6000	GDA94	240393	6271164	North of Western Gem mine in NE sector of Kundip Mining Leases	Mallee heath. Sandy loam over laterite.	6/2/2004 (GF Craig)	est. 1,500	4.84 ha	Tectonic
								TOTAL ESTIMATED	**45,000**		

Collated by GF Craig (May 2005) from flora surveys and CALM's Florabase/ database searches.

Table 3.6.1 Population Distribution of Marianthus villosus

Pop.	Site	Collection	Datum	Latitude/ Easting	Longitude/ Northing	Location Description	Site Description	Date surveyed	No. of Plants	Area searched
Melaleuca stramentosa **Priority 1**										
1A	Sand/gravel pit	M Bennett 1		33 39'54"	120 10' 8"	15 km S of Ravensthorpe on Hopetoun Rd	Heath/thicket. Yellow sand over ?granite.	18/10/1997	Occasional	
1B	Sand/gravel pit	M Bennett 718		33 39' 35"	120 10' 46"	15 km S of Ravensthorpe on Hopetoun Rd, 0.8 km along track ENE from gravel pit	Red gravel over clay. Shrubland-mallee.	11/10/2002	Frequent	
1B	Sand/gravel pit	GF Craig 5812		33 39' 35"	120 10' 46"	15 km S of Ravensthorpe on Hopetoun Rd, 0.8 km along track ENE from gravel pit	Red gravel over clay. Shrubland-mallee.	11/10/2002	Frequent	
2	Hopetoun-Ravensthorpe Rd	KR Newbey 1611		33 41' 16"	120 6' 59"	18 miles N of Hopetoun	Clay.	25/10/1964		
3	Hopetoun-Ravensthorpe Rd	LA Craven, BJ Lepschi, IG Holli 9604		33 42' 00"	120 11' 00"	21 km S of South Coast Hwy	Dense mallee shrubland. Laterite.	5/11/1994		
4	Jerdacuttup Nth Rd	MG Corrick 8787		33 43' 00"	120 14' 00"	Jerdacuttup North Rd between Lee Rd and Hopetoun-Ravensthorpe Rd	Low heathland with slender mallees.	18/10/1983		
5A	Kundip E	GF Craig 6149	WGS84	240402	6268966	1 km east of Kundip townsite	Dense shrub heath. Pale loam with stony schist and quartz.	5/11/2004	many 1,000s	
5B	Kundip NE	GF Craig 6001	WGS84	240430	6270817	C. 2.4 km NE of Kundip townsite	Mid-dense mallee and shrub heath. Laterite gravel, orange sandy loam. Upper slope.	8/12/2003	many 1,000s	
5C	Kundip ENE	-	WGS84	240400	6270050	Road No. 8432 through Kundip Mining Leases.	Skeletal soils, W-facing slope.	5/5/2004 (GF Craig)	common	
6	Mt Iron mine	GF Craig 1985				North-east of Kundip		21/8/1992	dominant	
7A	N of Mt Iron mine	-	WGS84	238894	6274193	2.4 km north along ridgetop track from entrance to Mt Iron mine; old gridlines to east and west of firebreak.	Open mallee and thicket/heath. Gravelly loamy sand over laterite.	6/2/2004 (GF Craig)	abundant	

Pop.	Site	Collection	Datum	Latitude/ Easting	Longitude/ Northing	Location Description	Site Description	Date surveyed	No. of Plants	Area searched
Melaleuca stramentosa	**Priority 1**									
7B	N of Mt Iron mine	-	WGS84	238710	6274288	2.7 km north along ridgetop track from entrance to Mt Iron mine; old gridline to west of firebreak.	Open mallee and thicket/heath. Gravelly loamy sand over laterite.	6/2/2004 (GF Craig)	abundant	
							TOTAL ESTIMATED		**???**	

Collated by GF Craig (October 2005) from flora surveys and CALM's Florabase/ database searches

Table 3.6.2 Population Distribution of Melaleuca stramentosa

Pop.	Site	Collection	Datum	Latitude Easting	Longitude Northing	Location Description	Site Description	Date surveyed	No. of Plants	Area searched	Tenement Reserve
***Acacia disticha*: Priority 2**											
	Ravensthorpe district	CA Gardner sn				Ravensthorpe district		Nov-44			
1	Ravensthorpe Range	GF Craig 6154	AGD84	33o34'40	120°09'19"	10 km E of Ravensthorpe, 500 m N of Cordingup Creek/ South Coast Hwy.	Mid-dense woodland and sparse understorey. Pale brown calcareous loam. Low ridge.	16/11/2004	Rare, widely scattered, <10 plants		Traka E74/144
2	Ravensthorpe Range	GF Craig 6051	AGD84	33 38' 30"	120 10' 58"	4.7 km SE of Mt Desmond, 2.8 km N along ridgetop track from entrance to Mt Iron mine	Dense mallee and sparse shrubs. Drainage line. Grey-brown sandy loam.	2/06/2004	10		UCL
3	Ravensthorpe Range	GF Craig 2011	AGD84	33 38' 30"	120 13' 00"	c. halfway between Kundip Mine and Elverton Mine, creekline in tributary of Steere River	Creekline.	9/08/1992	Common		Mt Iron E74/63
4	Ravensthorpe Range	GF Craig 3380	AGD84	33 39' 17"	120 09' 59"	c. 5 km SSE of Mt Desmond	Creekline.	2/11/1997	Occasional		Mt Iron PL74/204
5	NE of Kundip	GF Craig 5996-1; GF Craig 5997	AGD84	33 40' 17"	120 11' 57"	c. 2.4 km NE of old Kundip townsite	Disturbed area on N side of dam and immediately downstream from dam in creekline.	12/07/2003	Occasional/scattered		Tectonic
6	Road Eleven	M Bennett 397	AGD84	33 42' 14"	120 10' 18"	1.4 km west along track leaving Hopetoun-Ravensthorpe Rd, 20.6 km from Ravensthorpe	Shrub mallee. Creek margin. Moist light brown sandy clay.	22/11/1998	Uncommon		UCL
7A	FRNP - Thumb Peak	KR Newbey 4894	GDA94	34 3' 9"	119 42'31"	2 km SW of Thumb Peak	Closed scrub. Narrow seasonal creek. Variable drained sand and silt.	11/01/1975	frequent in patches		National Park
7B	FRNP - Thumb Peak	KR Newbey 3419	GDA94	34 2' 00"	119 43' 00"	Thumb Peak, Fitzgerald River National Park.	Mallee. Rocky sandy loam.	9/10/1971	dominant undershrub		National Park
7C	FRNP - Thumb Peak	KR Newbey 2726	GDA94	34 2' 23"	119 43' 23"	Thumb Peak	Rocky loam.	27/10/1967			National Park

Pop.	Site	Collection	Datum	Latitude Easting	Longitude Northing	Location Description	Site Description	Date surveyed	No. of Plants	Area searched	Tenement Reserve
***Acacia disticha*: Priority 2**											
7D	FRNP-Thumb Peak	BR Maslin 5553	GDA94	34 3' 9"	119 42' 29"	1 km N of Twin Bay, in gully leading from SW slopes of Thumb Peak.	Dense vegetation with Acacia myrtifolia.	31/12/1983	few		National Park
8	FRNP - Middle Mt Barren	AS George 10588	GDA94	33 3' 00"	119 40' 00"	Middle Mt Barren	Low heath. Among quartzite rocks.	20/12/1970			National Park
9	FRNP	S Barrett 1053				[?Woolbernup Hill - Mid Mt Barren]	Mallee-heath. Slope. Red clay, quartzite.	27/11/2002	100+		National Park
10	"Corackerup Creek"	ET Bailey sn				Corackerup Creek	Salt river.	Feb-34			
							ESTIMATED TOTAL		**???**		

Collated by GF Craig (May 2005) from flora surveys and CALM's Florabase/ database searches

Table 3.6.3 Population Distribution of Acacia disticha

Pop.	Site	Collection	Datum	Latitude/ Easting	Longitude/ Northing	Location Description	Site Description	Date surveyed	No. of Plants	Area searched	Tenement/ Reserve
Acacia laricina var. crassifolia : Priority 2											
1	Mt Short	AS George 5713				Mt Short, N of Ravensthorpe	Lateritic soil.	30/8/1963			PNR
2	Hayes Rd	M Bennett 614	GDA94	33 19' 04"	120 04' 21"	Hayes Rd, 4.6 km from junction with Nindilbilup Rd [N of Ravensthorpe]	Mallet with sparse understorey. Plain. Red brown clayey sand.	10/08/2000	common		?Nature Reserve
3A	Mt Desmond	CA Gardner 13693	GDA94	-33.6167	120.1500	Mount Desmond					PNR
3B	Mt Desmond	BR Maslin 3902	GDA94	-33.6131	120.1464	Mount Desmond, 9.8 km S of Ravensthorpe		10/09/1975			PNR
4A	Ravensthorpe Range	GF Craig 3387	GDA94	-33.6464	120.1625	c. 4 km SSE of Mount Desmond,	Mallee heath. 2 m upslope of old shaft.	2/11/1997	2		Mt Iron PL74/205
4B	Ravensthorpe Range		GDA94	239035	6274214	4.7 km SE of Mt Desmond; 2.4 km north along ridgetop track from entrance to Mt Iron mine; or 40 m north to 200 m south of Y-intersection of firebreaks on ridgetop	Open mallee and thicket/heath. Gravelly loamy sand over laterite. Disturbed gridlines E and W of track.	6/2/04 (GF Craig)	frequent in patches		PNR
5A	Kundip	GF Craig 6006	GDA94	-33.6728	120.1964	Ca. 2.7 km NE of old Kundip townsite; east of Kaolin mine	Open mallee and dense heath. Upper slope. Gravelly sandy clay loam.	12/08/2004			Tectonic
5B	Kundip	KR Newbey 9525A-1	GDA94	-33.6833	120.2000	Ravensthorpe Range, 2 km NE of Kundip	Open shrub mallee. Well drained loamy sand; ridge of low range.	9/02/1982	frequent in patches		Tectonic
5C	Kundip	GF Craig 5991	GDA94	-33.6871	120.2059	Ca. 2 km E of old Kundip townsite	Mixed mallee and shrubs. Clay loam, mid- to upper- slopes.	30/12/04			Tectonic
5D	Kundip	MH Simmons 1374	GDA94	-33.6333	120.1167	Kundip Mine road (S of Ravensthorpe)		1/09/1979			Tectonic
5E	Kundip	BR Maslin 4783	GDA94	-33.6833	120.1833	Ravensthorpe Range, near Kundip, ca 18 km S of Ravensthorpe township	Rocky W slopes of range.	31/8/1980			?Tectonic

Pop.	Site	Collection	Datum	Latitude/ Easting	Longitude/ Northing	Location Description	Site Description	Date surveyed	No. of Plants	Area searched	Tenement/ Reserve
5F	Kundip	KR Newbey 8054	GDA94	-33.6833	120.1833	Ravensthorpe Range, near Kundip,	Very open shrub mallee. Well drained, stony shallow sand over clay; moderately exposed stony ridge.	19/11/1980	rare		?Tectonic
5G	Kundip	KL Bradby 87	GDA94	-33.6897	120.1764	E of Kundip		8/11/1988			?Tectonic
6	Dunn Rock NR	GJ Keighery & N Gibson 4763				c. 33 km SSW of Lake King, 9.3 km NW of Mallee Rd junction; on N side of track that leaves road near Mallee and Aerodrome Rd junction.	Low woodland over shrub mallee over scrub and sedges. Upland flat. Gravelly yellow sand over gravel at 30 cm.	17/10/1999			Nature Reserve
6	Dunn Rock NR	GJ Keighery & N Gibson 7005				c. 33 km SSW of Lake King, 9.3 km NW of Mallee Rd junction; on N side of track that leaves road near Mallee and Aerodrome Rd junction.	Low woodland over shrub mallee over scrub and sedges. Upland flat. Gravelly yellow sand over gravel at 30 cm.	13/5/1999			Nature Reserve
7	Twertup	ED Kabay 958	GDA94	34 01' 09"	119 21' 46"	Road out of Twertup, Fitzgerald River National Park	Heathland. Fine sandy soil to depth. Flat.	27/10/1994	locally common		National Park
							TOTAL ESTIMATED		**???**		

Collated by GF Craig (October 2005) from flora surveys and CALM's Florabase/ database searches

Table 3.6.4 Population Distribution of Acacia laricina var. crassifolia

Pop.	Site	Collection/s	Datum	Latitude Easting	Longitude Northing	Location Description	Site Description	Date surveyed	No. of Plants	Tenement Reserve
Acacia durabilis : Priority 3										
1A	Ravensthorpe Range	JG & MH Simmons 2608				N of Ravensthorpe, Ca. 0.5 m past lookout on Archer Road.	In stony gravel.	18/10/1991		UCL
1B	Ravensthorpe Range	KR Newbey 11799	AGD84	-33.5500	120.1042	Ravensthorpe Range, 7 km NE of Ravensthorpe	Low woodland. Well-drained, dull reddish sandy clay. Moderately-exposed, colluvial, lower hillslope	26/10/1987	scattered in patches	
1C	Ravensthorpe Range	E Tink 331	AGD84	-33.5500	120.1000	ca 5 km off Carlingup Road following firebreak of Range Road, NE of Ravensthorpe,	Very open tree mallee and low scrub. Hilltop. Plain, dry brown clay-peat over granite.	24	frequent	UCL
2	Ravensthorpe Range	E Tink 439	AGD84	33 31' 00"	120 7' 00"	On top of gravel pit base, 2nd turn to left from Esperance Rd (2 km)…	Low scrub. On top of gravel pit. Dry brown red gravel-clay over granite.	28/9/1999	1 only	
3A	Mt Desmond	CJ Robinson 1057	AGD84	-33.6131	120.1464	200 metres N of Mount Desmond, survey track on ridgeline	Mallee scrub. Ridgeline, slopes and lower slopes. Red loam over ironstone; gravelly clay over laterite.	15/12/1992	scattered but common	UCL
3B	Mt Desmond	BR Maslin 3903	AGD84	-33.6167	120.1500	Mount Desmond, 9.8 km S of Ravensthorpe		10/09/1975		UCL
3C	Mt Desmond	BR Maslin 4050	AGD84	-33.6167	120.1500	Mount Desmond, 10 km S of Ravensthorpe.		14/12/1975		UCL
3D	Mt Desmond	BR Maslin 2566	AGD84	-33.6167	120.1500	Near Mount Desmond, ca 11 km S of Ravensthorpe	In rocky clay on hillside.	20/12/1971		UCL
3E	Mt Desmond	AS George 3659	AGD84	-33.6167	120.1500	E side of Mount Desmond, ca 7 miles ESE of Ravensthorpe.	Mallee scrub. In laterite soil.	21/4/1962		UCL
3F	Mt Desmond	CA Gardner 13696	AGD84	-33.6167	120.1500	Mount Desmond.		20/10/1961		UCL
3G	Mt Desmond	MD Crisp 4954	AGD84	-33.6167	120.1500	11 km ESE of Ravensthorpe, 0.5 km E of Mount Desmond, Eyre district	Tall dense shrubland. Hills, moderate N slope. Gravelly laterite.	1/08/1979	rare	UCL
4	Ravensthorpe Range	EM Bennett sn	AGD84	-33.6167	120.1333	Ravensthorpe Range, behind Elverton [Elverdton] mine on lower track to Kundip,	Tall shrubs. Generally growing in clay soil or near creeks.	12/01/1981	quite widespread	

Pop.	Site	Collection/s	Datum	Latitude Easting	Longitude Northing	Location Description	Site Description	Date surveyed	No. of Plants	Tenement Reserve
Acacia durabilis : Priority 3										
5	Ravensthorpe Range	GF Craig 6046	AGD84	-33.6404	120.1859	4.7 km SE of Mount Desmond, 200 m S of Y-intersection on ridge or 2.4 km N along ridgetop track from entrance gate to Mount Iron mine	Open mallee and dense heath. Ridgetop and slopes. Orange-brown sandy clay loam, poorly laterised gravel.	2/06/2004	occasional; 5-10	UCL
6	Ravensthorpe Range	GF Craig 2012	AGD84	33o38'30"	120o13'00"	North of Kundip; mining lease M74/63	Mid-dense woodland and dense heath. Creekline.	9/04/1992	frequent	Mt Iron M74/63
7A	Kundip	MH Simmons 1373	AGD84	-33.6833	120.1833	N of Kundip Mine, S of Ravensthorpe		Sep-79		
7B	Kundip	GF Craig 6009	AGD84	-33.6732	120.2037	Ca. 2.5 km NE of old Kundip townsite (east of Beryl mine)	Woodland. Grey brown loam.	12/11/2003	few	Tectonic
7C	Kundip	GF Craig 5981	AGD84	-33.6899	120.1934	Ca. 0.8 km E of old Kundip townsite	Open mallee and dense heath. Pale grey sandy clay loam with quartzite rubble. [Mx] vegetation unit.	12/05/2003	1	Tectonic
8A	Kundip	KR Newbey 2494	AGD84	-33.6833	120.1833	Kundip	In red clay.	20/11/1966		
8B	Kundip	H Steedman sn	AGD84	-33.6833	120.1833	Kundip, near Ravensthorpe		Nov-32		
8C	Kundip	KR Newbey 8055	AGD84	-33.6897	120.1764	Ravensthorpe Range, near Kundip	Very open shrub mallee. Moderately-exposed, stony, sandy loam. Moderately exposed stony ridge.	19/11/1980	rare	
9	Jerdacuttup River	CA Gardner 13755	AGD84	33 56'00"	120 16'00"	Jercacuttup River		25/10/1961		
10	Mt Drummond	KR Newbey 11397	GDA94	33 54'45.6"	119 36'30.6"	Mt Drummond	Open shrub mallee. M/E lower slope; W/D pale brown loamy sand.	13/11/1986		
11	"Marra Bridge"	HE Daniels				[Marra Bridge, Pallinup River, South Coast Highway]		Oct-71		
							ESTIMATED TOTAL		**???**	

Collated by GF Craig (May 2005) from flora surveys and CALM's Florabase/ database searches

Table 3.6.5 Population Distribution of Acacia durabilis

Pop.	Site	Collection	Datum	Latitude/ Easting	Longitude/ Northing	Location Description	Site Description	Date surveyed	No. of Plants	Area searched	Tenement/ Reserve
***Boronia oxyantha var. brevicalyx* : Priority 3**											
		C.A. Gardner s.n. [976202] [976199] [976210]	AGD84	-33.5833	120.0500	Ravensthorpe district.		11/1944			
		F. Lullfitz L 5264 [976156]	AGD84	-33.5833	120.0500	Ravensthorpe area.		8/02/1966			
1	Ravensthorpe Range	P.G. Wilson 7103 [976180]	AGD84	33 30' 30"	120 03'00"	8 km N of Ravensthorpe on Ravensthorpe Range.		13/08/1968			?PNR
1	Ravensthorpe Range	P.G. Wilson 7987 [976164]	AGD84	33 30' 30"	120 03'00"	Ca 8 km N of Ravensthorpe, Ravensthorpe Ranges.		27/09/1968			?PNR
2A	Ravensthorpe Range	E.M. Bennett 2373 [976091]	AGD84	33 30' 00"	120 01'00"	Ravensthorpe Range		29/08/1968			?PNR
2B	Ravensthorpe Range	M. Carter 300 [1115936]	AGD84	33 30' 00"	120 01'00"	Ravensthorpe Range.		28 09 1985			?PNR
2C	Ravensthorpe Range	-	AGD84	235456	6281311	Ravensthorpe Range. Ca. 300 m west of southern boundary of Loc. 187.	Eucalyptus megacornuta woodland. Loam over ironstone.	16/11/2004 (GF Craig)			PNR 51/ Traka
3	Mt Desmond	C.A. Gardner 13689 [00962716]	AGD84	-33.6131	120.1464	Montem [Mount] Desmond.		20/10/1961			PNR

Pop.	Site	Collection	Datum	Latitude/ Easting	Longitude/ Northing	Location Description	Site Description	Date surveyed	No. of Plants	Area searched	Tenement/ Reserve
***Boronia oxyantha var. brevicalyx* : Priority 3**											
3	Mt Desmond	J.M. Fox 86 205 [03316297]	AGD84	-33.6167	120.1500	Summit and E slope of Mount Desmond, 1.5 km NE of junction of Ravensthorpe/ Hopetoun road and Elverdton road in the Ravensthorpe Range	Dense thicket on summit area bordered by E. megacornuta Low Forest A (Muir 1977) 300 m below summit. In orange-brown sandy clay over greenstone with ironstone outcrops.	08/02/1986			PNR
3	Mt Desmond	C.J. Robinson 1061 [03316475]	AGD84	-33.6131	120.1464	NE slope of Mount Desmond	Eucalyptus megacornuta. Steep slope, red loam over ironstone.	15/12/1992	scattered but common		PNR
4	SE Mt Desmond	GF Craig 6047 [06771947]	AGD84	-33.6404	120.1859	4.7 km SE of Mount Desmond, 200 m S of Y-intersection on ridge or 2.4 km N along ridgetop track from entrance gate to Mount Iron mine	Open mallee and dense heath. Ridgetop and slopes. Orange-brown sandy clay loam, poorly laterised gravel.	2/06/2004	rare, scattered		PNR
5A	Kundip	K.R. Newbey 2497 [976148]	AGD84	-33.6900	120.1767	Kundip, ca 12 miles SE of Ravensthorpe.	In gravel.	20/11/1966			UCL
5B	Kundip	GF Craig 5988 [06771513]	AGD84	-33.6893	120.2026	Ca. 0.9 km E of old Kundip townsite	Eucalyptus astringens woodland. Pale grey, fine powdery clay loam with quartzite/schist rubble. [Ea] vegetation unit.	12/05/2003	100s growing on E-W grid		Tectonic
6	SW Kundip	GF Craig 5183 [6453600]	AGD 84	33 45 12.0	120 6 11.0	2 km N of Oldfield Loc. 1336(Lintos), ca 12 km E from Moir Road on Road Eleven, then S and E along mining tracks; ca 10 km SW of Kundip	Adjacent to creekline, a tributary of Steere River.	16/04/2000	ca. J1350		PNR
7	Bandalup Hill	-				Bandalup Hill, 35 km E of Ravensthorpe	Laterite ridgetops of Halleys orebody	2/28/1994 (GF Craig)	50,000+		RNP BHP Billiton
8	Munglinup	M Bennett 232 [5216001]	AGD 84	33 38 0.0	120 49 12.0	Mills Road (near Munglingup), 5.8 km from Esperance- Ravensthorpe Road	Shrub mallee, scrub, low heath D. Slight slope. Moist with leaf litter. Grey-brown sandy clay.	12/07/1998	common		
9	FRNP	KM Allan 175 [976105]	AGD 84	33 56 0.0	119 46 0.0	22 miles W of Hopetoun	on laterite	07/11/1969			National Park

Pop.	Site	Collection	Datum	Latitude/ Easting	Longitude/ Northing	Location Description	Site Description	Date surveyed	No. of Plants	Area searched	Tenement/ Reserve
***Boronia oxyantha var. brevicalyx* : Priority 3**											
10	Mt Drummond	KR Newbey 2693 [976121]	AGD 84	33 55 0.0	119 37 0.0	Mount Drummond, SW of Ravensthorpe	in loam	13/08/1967			National Park
11A	Pallinup River	EJ Croxford 5618 [4421469]	AGD 84	34 20 36.0	118 40 35.0	SW side of Marra Bridge, Pallinup River, Hassell Highway.	Rocky loam soil.	15/08/1987			
11B	Pallinup River	KR Newbey 2825 [976172]	AGD 84	34 14 0.0	118 8 0.0	8 miles (13km) N of Chillinup Pool, Pallinup River, SSE of Ongerup.	on breakaway	27/07/1969			
11C	"Chillinup"	AS George 6889 [976636]						26/10/1965			
							ESTIMATED TOTAL		**???**		

Collated by GF Craig (May 2005) from Craig and Landcare Services flora surveys and CALM's Florabase/ database searches

Table 3.6.6 Population Distribution of Boronia oxyantha var. brevicalyx

Pop.	Site	Collection	Datum	Latitude/ Easting	Longitude/ Northing	Location Description	Site Description	Date surveyed	No. of Plants	Area searched	Tenement/ Reserve
***Dodonaea trifida* : Priority 3**											
1	Ravensthorpe E	T.C. Daniell s.n. [1106155]	AGD 84	33º 41' 0.0"	120º 38' 0.0"	40-70 km E of Ravensthorpe		8/05/1972			
2	Bandalup Hill	G.F. Craig 3661 [05116244]	AGD 84	33 38' 54"	120 22' 22"	Bandalup Hill, 31 km ESE of Ravensthorpe.	Dense mallet thicket (3 m). Knoll, 900 m SW of Bandalup Hill trig. Shallow red-brown loam over laterised dolerite. as understorey species.	20/2/1998	locally frequent		RNP BHP Billition
2	Bandalup Hill	Landcare Services LCS 7310	AGD 84	0256085	6273579	Bandalup Hill-EIA 1	Laterite Mallee Shrubland				RNP BHP Billition
3	RAV 8	GF Craig 5021 [6444105]	AGD 84	33º 59' 9.0"	120º 18' 2.0"	25km E of Ravensthorpe on N side of South Coast Highway and E of Nindilbillup Road. 'RAV 8' mining lease.	Mallee heath (open). Fine clay loam with stony surface.	10/05/1999	1		Tectonic
4A	Mt Desmond SE	GF Craig 6050 [6771955]	AGD 84	-33.64096	120.18539	4.7 km SE of Mount Desmond, 200 m S of Y-intersection on ridge or 2.4 km N along ridgetop track from entrance gate to Mount Iron mine	Mallee and dense heath (1-2 m). Drainage line and lower slopes, 50 m (along old grid) to W of ridge. Brown sandy clay loam, poorly laterised gravel.	6/02/2004	frequent, 100s		PNR
4B	Mt Desmond SE	M. Bennett 135 [5215137]	AGD 84	33º 37' 58"	120º 11' 31"	0.3 km and ca 1-200m from main track, 5.5km from Elverdton Road [?south] along firebreak, N of Range.	Dense Shrub Mallee, Open Scrub. Creek bed, moist red clayey sand.	16/5/1998	uncommon-rare		PNR
4C	Mt Desmond SE	G.F. Craig 3382 [4744438]	AGD 84	33º 39' 17.0"	120º 9' 59.0"	Ravensthorpe Range, ca 5km SSE of Mount Desmond.	Open mallee. N facing slope on E side of Ravensthorpe Range. In vicinity of row old shafts.	2/11/1997	occasional		Mt Iron PL74/204

Pop.	Site	Collection	Datum	Latitude/ Easting	Longitude/ Northing	Location Description	Site Description	Date surveyed	No. of Plants	Area searched	Tenement/ Reserve
***Dodonaea trifida* : Priority 3**											
5	Kundip NE	GF Craig 6002 [6771777]	AGD 84	-33.66722	120.19583	Ca. 2.7 km NE of old Kundip townsite. N boundary of Kundip Mining leases (ie north of Western Gem mine	Dense mallee and scrub. Drainage line. Rubbly orange clay loam.	8/12/2003	frequent		Tectonic/ PNR
6	Kundip	K.R. Newbey 2630 [1106201]	AGD 84	33° 41' 24.0"	120° 10' 36.0"	Kundip	In gravel.	11/12/1966			
7	Hopetoun N	Landcare Services LCS 7461	AGD 84	0239343	6257250	ca. 10 km north of Hopetoun	Mallee Heath, Clay over Komatiite				
8	FRNP - Cave Pt	KR Newbey 11175 [3711854]	AGD 84	33° 56' 0.0"	119° 57' 6.0"	3.8km NW of Cave Point (Fitzgerald River National Park)	Moderately exposed lower breakaway slope, well drained sandy loam.	10/02/1986			National Park
9	FRNP- Mt Drummond	KR Newbey 11391 [6108938]	AGD 84	33° 54' 24"	119° 34' 41"	3km W of Mount Drummond, Fitzgerald River National Park	Low forest. M/E gently undulating plain, W/D light grey loamy sand.	13/11/1986			National Park
10A	FRNP- Woolbernup Hill	S Barret 1050 [6684858]	AGD 84	34° 1' 20.0"	119° 40' 48"	800 m N of Woolbernup Hill. Fitzgerald River National Park.	Gully. Clay on spongelite.	26/11/2002	200+		National Park
10B	FRNP - Woolbernup Hill	JA Cochrane JAC 4294 [6466206]	AGD 84	34°1' 16"	119° 40' 49.0"	"Woolbernup Hill"	Mallee heath. Granitic/ quartz brown loam.	26/11/2002	1,000s		National Park
11	FRNP -Thumb Peak	KR Newbey 2729 [1106619]	AGD 84	34° 2' 0.0"	119° 43' 0.0"	Near Thumb Peak, E of Ongerup.	In rocky loam.	27/10/1967			National Park
12	FRNP	AS George sn [1106163]	AGD 84	33° 50' 0.0"	119° 56' 0.0"	Fitzgerald River National Park		1970			National Park

Pop.	Site	Collection	Datum	Latitude/ Easting	Longitude/ Northing	Location Description	Site Description	Date surveyed	No. of Plants	Area searched	Tenement/ Reserve
***Dodonaea trifida* : Priority 3**											
13	FRNP	KR Newbey 11511 [1106627]	AGD 84	34º 21' 15.0"	119º 20' 50.4"	5 km NNW of Bremer Bay (Fitzgerald River National Park)	Moderately exposed, grey loamy fine sand over sponolite. Moderately exposed, stony river slope.	18/9/1986	scattered plants		National Park
14	Beaufort Inlet	EJ Croxford 5073 [4118618]]	AGD 84	34º 27' 47"	118º 51' 6.0"	Track to lookout, Beaufort Inlet, Hassell Highway	Sandy gravel soil.	16/8/1986			
14	"Beaufort Inlet"	EJ Croxford 5088 [1953095]					Sandy loam.	16/8/1986			
14	"Beaufort Inlet"	JG West 3042 [1106643]					Very dense Melaleuca thicket. Gravelly and rocky loamy grey sand.	25/11/1978	Extensive population		
14	"Beaufort Inlet"	JG West 3035 [1106651]					Very dense Melaleuca thicket. Gravelly and rocky loamy grey sand.	25/11/1978	Extensive population		
14	"Beaufort Inlet"	JG West 3039 [1106635]					Very dense Melaleuca thicket. Gravelly and rocky loamy grey sand.	25/11/1978	Extensive population		
14	"Beaufort Inlet"	KR Newbey 1147 [1106198]					In grey clay.	18/10/1964			
14	"Beaufort Inlet"	CJ Robinson 1017 [3131920]					Eucalyptus newbeyi. Slope, red loam over spongolite.	17/11/1992	common		
15	Cape Riche	JA Cochrane JAC 4009 [6017592]	AGD 84	34º 35' 30.0"	118º 44' 1.0"	Behind and adjacent to Cape Riche rubbish tip.	Mallee over heath. NE facing slope. Pale yellow sandy loam over spongelite. Plants appear to be restricted to lower slopes.	1/02/2002	100+		
15	Cape Riche	R Davis RD 2261 [4586174]	GDA94	34 35' 29.6"	118 44' 3.5"	3 km NW of Mt Melville.	Scrub. Breakaway. Stoney litered grey clay over laterite.	21/1/1997	frequent		

Pop.	Site	Collection	Datum	Latitude/ Easting	Longitude/ Northing	Location Description	Site Description	Date surveyed	No. of Plants	Area searched	Tenement/ Reserve
***Dodonaea trifida* : Priority 3**											
15	Cape Riche	TR Lally & BJ Lepschi 904 [4406001]	GDA94	34 34' 55.6"	118 40' 5.5"	Cape Riche rubbish tip, ca. 17 km SE of Hassell Hwy on Sandelwood Rd	On shaly slope. Pale whitish-brown sandy clay.	15/11/1995			
15	Cape Riche	CJ Robinson 994 [4118634]	GDA94	34 35' 30"	118 43' 40"	Breakaway E of tip at Cape Riche, Gazetted Res 14943, just WNW of Mt Melville	Steep breakaway, red loam over spongolite subsurface.	11/03/1992	30+		
	?Cape Riche	KR Newbey 3046 [1106171] [2724332]	AGD 84	35º 1' 0.0"	117º 53' 0.0"	Mount Melville [?] Albany townsite	In granite soil.	22/11/1964			
								ESTIMATED TOTAL	**???**		

Collated by GF Craig (May 2005) from Craig and Landcare Services flora surveys and CALM's Florabase/ database searches

Table 3.6.7 Population Distribution of Dodonaea trifida

Pop.	Site	Collection	Datum	Latitude/ Easting	Longitude/ Northing	Location Description	Site Description	Date surveyed	No. of Plants	Area searched	Tenement/ Reserve
***Spyridium glaucum* : Priority 3**											
1	Mt Short	JW Wrigley WA68/5438 [1542400]	AGD 84	33 28' 17.0"	119 59' 48"	Mount Short, 10 miles N of Ravensthorpe		11/05/1968			PNR
1	Mt Short	JW Wrigley WA68/5451 [1542419]	AGD 84	33 28' 17.0"	119 59' 48"	Mount Short, 10 miles N of Ravensthorpe		11/05/1968			PNR
1	Mt Short	-		777231	6293946	Mt Short	Edge of laterised knoll.	Oct-1998 (G Craig & A Chapman)	ca. 20		PNR
2	Ravensthorpe Range	EM Bennett sn [1542397]	AGD 84	33 29' 41.0"	120 0' 42"	Ravensthorpe Range.	Clay	Sep-79			PNR
3	Ravensthorpe Range	-				3 km ENE of Archer Drive lookout (south of the northernmost firebreak)	Outcrop of very rock ironstone and quartzite.	Oct-2000 (M Bennett pers comm.)	ca. 100		PNR
4	Ravensthorpe Range	M Bennett 442 [5386586]	AGD 84	33 32' 20.0"	120 5' 21"	Crest of Ravensthorpe Range where firebreak drops down to old vineyard 5.2km E from Archer Drive lookout	Hill crest. Dry, rocky, pretty barren but some leaf litter. Red-brown clay-loam.	31/1/1999	occasional and localised small communities		PNR
4	Ravensthorpe Range	-				Ca. 2-3 km SE of Mt Benson, south of 'old vineyard block' (Loc 1243)		Oct-2000 (M Bennett pers comm.)	ca. 100		PNR
5	Ravensthorpe Range	GF Craig 6160	AGD 84	33 34'31"	120 08'57"	10 km E of Ravensthorpe, 600 m N of Cordingup Creek/ South Coast Hwy.	Grey brown loam. Woodland with sparse understorey.	16/11/2004	20+		Traka E74/144
6	Mt Desmond			235661	6276987	NNE of Mt Desmond.	Eucalyptus megacornuta woodland.	Oct-1998 (G Craig & A Chapman)	ca. 500		PNR

Pop.	Site	Collection	Datum	Latitude/ Easting	Longitude/ Northing	Location Description	Site Description	Date surveyed	No. of Plants	Area searched	Tenement/ Reserve
***Spyridium glaucum* : Priority 3**											
6	Mt Desmond	G Marsh 40 [4443128]	AGD 84	33 36' 47.0"	120 8' 47"	Mount Desmond, 10km SE of Ravensthorpe	Red gravelly soil.	4/05/1996			PNR
7	Elverdton	E Tink 78 [5095603]	AGD 84	33 37' 0.0"	120 8' 0"	Off Elverdton Road - Hopetoun Road, top of 1st rise,	On gravel hill, dry red-brown gravel over granite. Scrub.	12/06/1997	only one seen		PNR
8	N of Mt Iron mine	GF Craig 6049 [6771963]	AGD 84	33 38' 32"	120 11' 02"	2.7 km north along ridgetop track from entrance to Mt Iron mine; old gridline to west of firebreak.	Drainage line and lower sloopes, 50 m (along old grid) to W of ridge. Brown sandy clay loam, poorly laterised gravel. Mallee and dense heath (1-2 m).	2/06/2004	abundant, 1000s		PNR
9	Mt Iron mine	GF Craig 3383 [4740866]	AGD 84	33 39' 17.0"	120 9' 59"	Ravensthorpe Range, c 5 km SSE of Mount Desmond	N facing slopes on E side of Ravensthorpe Range. In vicinity of row of old shafts.	2/11/1997	2		Mt Iron PL74/204
10	Kundip NE	GF Craig 6010 [6771696]	AGD 84	33 40'28"	120 12'08"	Ca. 2.5 km NE of old Kundip townsite, east of 'Beryl' mine	Grey brown loam. Eucalyptus clivicola woodland.	12/11/2003	ca. 20		Tectonic
11	Road No.8432	GF Craig 6071 [6829910]	WGS 84	33 38'18"	120 15'30"	Road No.8432, Oldfield Loc.56; 11.3 km west of Bandalup Hill	Ridgetop, red brown loam, stony. Open mallee and open shrubs.	30/4/2004	occasional (<20); common on next low ridge to west		Gazetted Road
12	Bandalup Hill	GF Craig 3360 [5116287]	WGS 84	33 38'54"	120 22'22"	Bandalup Hill, ca. 31 km ESE of Ravensthorpe.	Knoll, 900 m SW of Bandalup Hill trig. Shallow, red-brown loam over laterised dolerite. Dense mallet thicket (3 m).	20/2/1998	locally abundant		RNP BHP-Billiton

Pop.	Site	Collection	Datum	Latitude/ Easting	Longitude/ Northing	Location Description	Site Description	Date surveyed	No. of Plants	Area searched	Tenement/ Reserve
***Spyridium glaucum* : Priority 3**											
12	Bandalup Hill	GF Craig 3684 [5116694]	WGS 84	33 38'54"	120 22'22"	Bandalup Hill, ca. 31 km ESE of Ravensthorpe.	Knoll. Shallow soil over laterised dolerite. Mallet thicket and heath understorey. Burnt 1980 wildfire.	20/2/1998	16,200	2.4 ha (Oct 1998 report to Kaiser)	RNP BHP-Billiton
12	Bandalup Hill	LCS 8411	AGD 84	0256085	6273579	Bandalup Hill Hale Bopp site 33	Laterite Hill Mallee Shrubland				RNP BHP-Billiton
12	Bandalup Hill	LCS 7263	AGD 84	0256085	6273579	Bandalup Hill-EIA 1 (duplicate of #8411)	Laterite Mallee Shrubland				RNP BHP-Billiton
	?	CA Gardner sn [1542443]	AGD 84	33 34' 47.0"	120 2' 36"	Ravensthorpe district		Nov-44			
								Total estimated:	**22,000**		

Collated by GF Craig (May 2005) from Craig and Landcare Services flora surveys and CALM's Florabase/ database searches

Table 3.6.8 Population Distribution of Spyridium glaucum

Spyridium sp. Mason Bay Rd (G Cockerton & A Kalotas 8151)

Pop.	Site	Collection	Datum	Latitude/ Easting	Longitude/ Northing	Location Description	Site Description	Date surveyed	No. of Plants	Area searched	Tenement/ Reserve
1	Mason Bay Rd	LCS 10177	WGS 84	262223	6243154	Site 17	Acacia shrubland (A. cyclops) on margin of small lake/wetland.	30-Nov-04			

Pop.	Site	Collection	Datum	Latitude Easting	Longitude Northing	Location Description	Site Description	Date surveyed	No. of Plants	Tenement Reserve
***Acacia pinguiculosa* subsp. *pinguiculosa*: Priority 3**										
[Populations east of the Ravensthorpe Range are assumed to be the '3-nerved variant' and are shown separately below]										
	Ravensthorpe	N Perry 650	GDA94	-33.5833	120.0500	Ravensthorpe		19/9/1978		
	Ravensthorpe	Goodwin 232	GDA94	-33.5833	120.0333	Ravensthorpe	Mallee. Laterite.	9/12/1964		
1	?Mt Desmond	R Davis 701	GDA94	-33.6521	120.1621	10 km ESE of Ravensthorpe	Mallee woodland. Hill, brown sand.	5/08/1996	occasional	
3A	Hopetoun Rd	J Binet 4	GDA94	-33.6667	120.1833	Hopetoun Road		23/6/1979		Shire
3B	Hopetoun Rd	BR Maslin 3896	GDA94	-33.5833	120.1333	7.4 km S of Ravensthorpe towards Hopetoun	Roadside in brown loam.	10/09/1975	not common	Shire
3C	Hopetoun Rd	PG Wilson 7059	GDA94	-33.6000	120.1333	8 km S of Ravensthorpe on the road to Hopetoun		13/8/1968		Shire
4A	Hopetoun Rd	-	WGS84	237167E	6272136N	3-6 km S of Elverdton Rd on Hopetoun-Ravensthorpe Rd; ca. 12-15 km S of Ravensthorpe.	Mallee heath. Orange-brown sandy loam.	11/2/2005 (GF Craig)	abundant, 1000s of plants particularly on west side of road burnt in Dec 1989.	Shire
4B	Hopetoun Rd	BR Maslin 4047	AGD84	33 45'23"	120 04'03"	15 km S of Ravensthorpe towards Hopetoun		14/12/1975		Shire
4B	Hopetoun Rd	BR Maslin 4780	GDA94	-33.6667	120.1833	15 km S of Ravensthorpe on the road to Hopetoun	Rocky hill but not in adjacent depressions. In exposed disturbed area.	31/8/1980	common in disturbed area	Shire
4C	Hopetoun Rd	MH Simmons 1376	GDA94	-33.6833	120.1833	Between Ravensthorpe and Hopetoun, near Kundip		Sep-79		Shire
4D	Hopetoun Rd	LCS 7619.1	AGD 84	0226269	6273358	1.9km south of Elverdton Rd on Hopetoun Rd	Mallee Shrubland on weathered komatiite	11/07/1998		

Pop.	Site	Collection	Datum	Latitude Easting	Longitude Northing	Location Description	Site Description	Date surveyed	No. of Plants	Tenement Reserve
***Acacia pinguiculosa* subsp. *pinguiculosa*: Priority 3**										
[Populations east of the Ravensthorpe Range are assumed to be the '3-nerved variant' and are shown separately below]										
5A	N Kundip	GF Craig 6037	GDA94	-33.6801	120.1854	1.1 km WNW of old Kundip townsite, west side of Hopetoun-Ravensthorpe Road	Mallee heath. Lower margin of old gravel pit. Orange-brown sandy loam, gravelly. [Mh] vegetation unit.	20/12/2003	localised patch, c. 20	Tectonic
5B	N Kundip	CJ Robinson 1060	GDA94	-33.6844	120.1764	0.6 km N of Kundip, burnt and chained firebreak	Mallee scrub. Slope to E, sandy white quart over quartzite.	15/12/1992	common	
6A	Kundip	LCS 7459	AGD 84	0236282	6273327	Kundip, approximately 30 km south of Ravensthorpe	Heath on Granite (granite outcrop)	28/05/1998	> 1000	2ha
6A	Kundip	BR Maslin 4784	AGD84	33 44'30"	120 02'36"	Ravensthorpe Range, near Kundip	Mallee. Light brown clay.	31/8/1980		
6B	NE Kundip	KR Newbey 9691	GDA94	-33.6833	120.2167	Ravensthorpe Range, 3 km NE of Kundip	Very open shrub mallee. Moderately exposed hills. Well-drained, loamy sand.	12/01/1982	common in patches	
6C	NE Kundip	KR Newbey 9524A	GDA94	-33.6708	120.1986	Ravensthorpe Range, 3 km NE of Kundip	Very open shrub mallee. Well-drained, loamy sand. Moderately exposed slope of low range.	Dec-82	common in patches	
6D	NE Kundip	GF Craig 6015	GDA94	-33.6851	120.2157	Ca. 2.7 km ENE of old Kundip townsite	Mallee scrub. Lateritic breakaway.	12/12/2003	common	Tectonic
7A	Road Eleven	M Bennett 165	GDA94	-33.6985	120.1321	5.6 km along track W from Hopetoun Road turn off to track 20.6 km from Ravensthorpe,	Shrub mallee and heath. Plain, dry with leaf litter. Grey-brown sandy clay.	6/03/1998	frequent	UCL
7B	Road Eleven	GF Craig 5694	AGD84	33o44'42"	120o01'22"	ca. 16 km WSW of Kundip, 15.6 km west of Ravensthorpe-Hopetoun Rd on Road Eleven (or 7.2 km east of Moir Rd)	Low mallee and scrub thicket. Skeletal orange-brown sandy loam over quartz diorite. Stony.	30/6/2002	Locally common; occurs in patches of 100s to 1000s of plants.	UCL

Pop.	Site	Collection	Datum	Latitude Easting	Longitude Northing	Location Description	Site Description	Date surveyed	No. of Plants	Tenement Reserve
***Acacia pinguiculosa* subsp. *pinguiculosa*: Priority 3**										
[Populations east of the Ravensthorpe Range are assumed to be the '3-nerved variant' and are shown separately below]										
7C	Road Eleven	-				8.1 km east of Moir Rd on Road Eleven		30/6/2002 (GF Craig)		UCL
7D	Road Eleven	-				9.8 km east of Moir Rd on Road Eleven		30/6/2002 (GF Craig)		UCL
7E	Road Eleven	GF Craig 5187	AGD84	33 44'17"	120 02'31"	ca. 9 km east of Moir Rd along Road Eleven, ca. 14 km WSW of Kundip	Mallee heath. East facing slope, last hollow before catchment boundary between Phillips and Steere Rivers.	16/4/2000		UCL
7F	Road Eleven	GF Craig 5634	AGD84	33o42'06"	120o06'15"	15 km SSE of Ravensthorpe, 0.7 km N of Road Eleven on Laurina Rd (track), then west ca. 1 km on track	Heath. Undulating, upper catchment, south-facing slope, sandy clay loam.	3/10/2002	abundant, 1000s of plants	Kundip Talc E74/193
8	Laurina Rd	-				7.7 km south of Road Eleven on Laurina Rd.		30/6/2002 (GF Craig)		UCL
9	No Tree Hill	KL Bradby 40	AGD84	33 46' 00"	120 00' 00"	NW of No Tree Hill on John Forrest track	Scrub. Undulating topography, brown laterite soil.	14/12/1984	frequent/dominant over 500 sq.m area	UCL
							ESTIMATED TOTAL		**???**	
***Acacia pinguiculosa* subsp. '3-nerved variant': Priority 3**										
NB A variant of *Acacia pinguiculosa* subsp. *pinguiculosa*, the '3-nerved variant', occurs in the Bandalup Creek/ Jerdacuttup River catchment.										
RRN4	Bonnymidgup track	Landcare Services LCS 9341	WGS 84	0229475	6287758	approx 4.5km north then east of Ravensthorpe Range near Bonnymidgup Creek via well maintained fire break.	lower slopes of Ravensthorpe Range	5/11/1999	4	30 x 40m
RRN6	Bonnymidgup track	Landcare Services LCS 9337	WGS 84	0227999	6289017	6.7km East of Woodenup Rd along Bonnymidgup fire break track - 0.2 km east of Ravensthorpe Range access track		6/11/1999	1500	200x150

***Acacia pinguiculosa* subsp. '3-nerved variant': Priority 3**

NB A variant of *Acacia pinguiculosa* subsp. *pinguiculosa*, the '3-nerved variant', occurs in the Bandalup Creek/ Jerdacuttup River catchment.

RRN7	Bonnymidgup track	Landcare Services LCS 9338	WGS 84	0228692	6287897	Bonnymidgup fire break track approx 1km west of previous site	granite outcrop on lower slopes of Ravensthorpe Range	6/11/1999	40	100 x 20m
RRN8	Bonnymidgup track	-	WGS 84	0228814	6288192	Bonnymidgup fire break track approx 1km west of previous site	granite outcrop on lower slopes of Ravensthorpe Range	6/11/1999	50	100 x 40m
RRN9	Bonnymidgup track	-	WGS 84	0228930	6298030	Bonnymidgup fire break track approx 1km west of previous site	granite outcrop on lower slopes of Ravensthorpe Range	6/11/1999	40	100 x 40m
	Woodenup Creek	BR Maslin 4778	AGD 84	33 26'00"	120 03'00"	About 16 km due NNE of Ravensthorpe, between Woodenup Creek and the Jerdacuttup River	Low dense scrub. Grey-brown loam near granite outcrops.	30/8/1980	common	
	Woodenup Creek	BR Maslin 4774	AGD 84	33 26'00"	120 03'00"	About 18 km due NE of Ravensthorpe, near Woodenup Creek	In grey loam	30/8/1980	dense populations	
	Woodenup Creek	BR Maslin 4772	AGD 84	33 26'00"	120 06'00"	About 17 km due NE of Ravensthorpe, near Woodenup Creek	Scrub. Grey-brown loam.	30/8/1980		
CS1	Carlingup Rd	Landcare Services LCS 9339	AGD 84	0237425	6284335	southeast of Carlingup Rd along old property boundary	Weathered Ultramafic ridge	21/09/1999	750+	300 x 150m
CS5	Carlingup Rd	Landcare Services LCS 9340	AGD 84	0237209	6285293	approx. 300m west of Carlingup Rd		21/09/1999	50+	
CS6	Carlingup Rd	Landcare Services LCS 9342	AGD 84	0236422	6286124	Carlingup Rd, western road verge		21/09/1999		
CS3	Carlingup Rd	Landcare Services LCS 9343	AGD 84	0238711	6283264	200m west of Carlingup Creek		21/09/1999	3000+ plants	approx 5ha
	South Coast Hwy	E Tink 246	GDA94	-33.6167	120.1500	Not far from Ethel Daw Drive in old gravel pit W side, ca 12 km E of Ravensthorpe,	Open scrub and open low sedges. NE slope. Dry brown clay-gravel over granite.	8/02/1998	frequent	

***Acacia pinguiculosa* subsp. '3-nerved variant': Priority 3**

NB A variant of *Acacia pinguiculosa* subsp. *pinguiculosa*, the '3-nerved variant', occurs in the Bandalup Creek/ Jerdacuttup River catchment.

	E Ravensthorpe	E Tink 408	GDA94	-33.5500	120.2000	21 km along Esperance Road, left at Maydon Road, 2.4 km through paddocks to quarry (Jerdacutup Pastoral Company),	Low scrub. On top of hill. Dry grey-light brown sandy clay over granite.	21/8/1999	few	Freehold
	Bandalup Creek	GF Craig 4038	WGS84	33 36'21"	120o21'09"	Mason Bay Rd proposed north realignment, ca. 7 km NNW of Bandulup Hill	Heath and sedges. North-facing slope. Grey brown clay sand with quartzite.	14/5/1999	Common, 200+ (extends for >50 m to east)	
	Bandalup Creek	GF Craig 4053	WGS84	33 36'21"	120o21'09"	Mason Bay Rd proposed north realignment, ca. 7 km NNW of Bandulup Hill	Heath and sedges. North-facing slope. Grey brown sand with quartzite.	14/5/1999	Common, 200+	
	Bandalup Creek	BR Maslin 3913	AGD 84	33 39'00"	120 28'00"	33.5 km E of Ravensthorpe towards Esperance	Granitic hill.	10/10/1975	not common	
-	Bandalup Creek	Landcare Services LCS 7554	AGD 84	0257700	6277342	north of Bandalup Hill, South Coast Hwy near Mason Bay Rd intersection	Heath on Granite (granite sheet)	12/06/1998	1000	
-	Bandalup	Landcare Services LCS 7485	AGD 84	0255447	6277837	Bandalup East Magnesite Pits	Magnesite Mallee Shrubland with soils of weathered carbonates	29/05/1998		
	Jerdacuttup	MH Simmons 1390	AGD 84	33 39'00"	120 27'00"	Turn to Jerdacuttup along the Rabbit proof fence (SE of Ravensthorpe)		Sep-79		
-	Mason Bay Rd	Landcare Services LCS 7573	AGD 84	0257858	6276287	Mason Bay Rd, near SC Highway intersection	Heath on Granite (granite sheet)	11/06/1998	300	
-	Mason Bay Rd	-	AGD 84	0256921	6275926	Mason Bay Rd, 650m E of Halleys access track then 50m S into scrub (Baseline 9)	Low heath on felsic volcanic rock	Landcare Services data		
		Landcare Services LCS 7672				???		(Landcare Services)		
		Landcare Services LCS 9336				???		(Landcare Services)		
								ESTIMATED TOTAL	**???**	

Collated by GF Craig (May 2005) from Craig and Landcare Services flora surveys and CALM's Florabase/ database searches

Table 3.6.9 Population Distribution of Acacia pinguiculosa subsp pinguiculosa

Pop.	Site	Collection	Datum	Latitude/ Easting	Longitude/ Northing	Location Description	Site Description	Date surveyed	No. of Plants	Area searched	Tenement/ Reserve
***Siegfriedia darwinioides* : Priority 4**											
1	?Esperance	Esperance Land & Dev Co sn [1123890]	AGD 84	33 51' 41.0"	121 53' 18.0"	Esperance		1/06/1964			
2	Munglinup	D Jessup 1 [6078591]	AGD 84	33 37' 38.0"	121 5' 44"	Oldfield Location 894, 3 km off Neds Corner Road	Plain. Moist, clay over gravel over granite.	10/09/2001	frequent		
3	Starvation Boat Harbour	Mrs Reynolds 1150 [1139347] [1138383] [1138391]	AGD 84	33 54' 24.0"	120 33' 42.0"	Starvation Boat Harbour		1/08/1925			
4	Rabbit Proof Fence E	MA Burgman & S McNee MAB 1570 [1070800] [3628973]	AGD 84	33 32' 30.0"	120 18' 10.2"	25.5km SSE of Coujinup Hill	Very open shrub mallee. Gravelly yellow-brown sandy clay. Flat.	27/06/1983			
5	Rabbit Proof Fence	M Bennett 144 [5215242]	AGD 84	33 32' 13.0"	120 18' 18.0"	8.7km N of gate in Rabbit Proof Fence	Shrub mallee, heath. Plain, dry fine sandy gravel. Grey clay sand.	17/05/1998	uncommon		UCL
6	N Bandalup Hill	Landcare Services LCS 4064		024 9917	6285872	Anaconda's Bandalup Leases		16/12/1997			Anaconda
7A	N Bandalup Hill	-	AGD 84	025 1030	6281200	Shoemaker-Levy	Mallee heath on komatiite / drainage line border.	(Landcare Services)	200+		RNP BHP Billiton
7B	N Bandalup Hill	-	AGD 84	025 1783	6280429	Shoemaker-Levy	Mallee Heath on Duplex soils.	(Landcare Services)	40		RNP BHP Billiton
7C	N Bandalup Hill	-	AGD 84	025 1669	6280531	Shoemaker-Levy	Mallee Heath Komatiite.	(Landcare Services)	1		RNP BHP Billiton
7D	N Bandalup Hill	Landcare Services LCS 7705	AGD 84	0251576	6280400	Shoemaker-Levy	Mallee Heath Komatiite.	9/07/2002	10		RNP BHP Billiton

Pop.	Site	Collection	Datum	Latitude/ Easting	Longitude/ Northing	Location Description	Site Description	Date surveyed	No. of Plants	Area searched	Tenement/ Reserve
***Siegfriedia darwinioides* : Priority 4**											
7E	N Bandalup Hill	Landcare Services LCS 7706	AGD 84	0251710	6280400	Shoemaker-Levy	Mallee Heath Komatiite.	9/07/2002	40		RNP BHP Billiton
7F	N Bandalup Hill	Landcare Services LCS 7768	AGD 84	0251750	6280400	Shoemaker-Levy	Mallee Heath on Komatiite.	17/07/2002	200	6 sub population	RNP BHP Billiton
8	Bandalup Hill	CJ Robinson 1137 [3321347]	AGD 84	33 38' 00"	120 22' 00"	Bandalup Hill, 8.5 km S of Highway 1 on Mason's Bay Rd	Cleared firebreaks - mallets. Slope to N, heavy gravelly loam - red.	8/09/1993	300+		RNP BHP Billiton
8	Bandalup Hill	GF Craig 3496 [5116716]	AGD 84	33 38' 16.0"	120 22' 29.0"	Bandalup Hill, 31 km ESE of Ravensthorpe	Mallee heath. Red brown loam, E slope of Hill.	16/02/1998	rare		RNP BHP Billiton
9	Mt Short	S Donaldson, GT Chandler & A Monro SD 2235 [5964954]	AGD 84	33 25' 26.0"	119 59' 12.0"	N base of Mount Short, Roe District	N aspect. Moderated slope. Laterite and metamorphised sediments.	18/09/1999	frequent		PNR
9	Mt Short	CA Gardner 16117 [4364236]	AGD 84	33 28' 17"	119 59' 48.0"	N of Mount Short		14/08/1965			PNR
9	Mt Short	CJ Robinson 1047 [3321363]	AGD 84	33 27' 0.0"	120 1' 0.0"	0.8km W of east end of Mount Short road, NE of Mount short, NW of Ravensthorpe	Shallow drainage line gully, red loams over ironstones.	16/12/1992	several 100		PNR
9	Mt Short	AS George 9305 [1071246]	AGD 84	33 28' 18"	119 59' 48"	Mount Short, N of Ravensthorpe		26/04/1969			PNR
9	Mt Short	F Lullfitz L 5037 [1071270]	AGD 84	33 28' 18"	119 59' 48"	Mount Short, N of Ravensthorpe		21/06/1966			PNR
9	Mt Short	CA Gardner 16141 [1070827]	AGD 84	33 28' 18"	119 59' 48"	Mount Short		1/08/1965			PNR

Pop.	Site	Collection	Datum	Latitude/ Easting	Longitude/ Northing	Location Description	Site Description	Date surveyed	No. of Plants	Area searched	Tenement/ Reserve
***Siegfriedia darwinioides* : Priority 4**											
9	Mt Short	AS George 5709 [1071289]	AGD 84	33 28' 18"	119 59' 48"	Mount Short, N of Ravensthorpe	Laterite.	30/08/1963			PNR
10	Ravensthorpe Range	TJ Alford 34 [5754666]	AGD 84	33 31' 12"	120 03' 59"	Archer Drive lookout, Ravensthorpe Range.	Laterite range. Brown gravel. Scrub and mallee.	28/05/2000	frequent		PNR
10	Ravensthorpe Range	E Tink 102 [5095409]	AGD 84	33 32' 0.0"	120 1' 0.0"	Archer Drive, Ravensthorpe Range	Gentle slope, red - brown gravel over granite.	10/12/1997	frequent		PNR
10	Ravensthorpe Range	KR Newbey 8275 [1071254]	AGD 84	33 29' 42.0"	120 1' 0.0"	Ravensthorpe Range, 5 km NNE of Ravensthorpe	Eucalyptus astringens low woodland. Well-drained sandy loam. Moderately exposed high ridge.	28/04/1981	frequent in patches		PNR
10	Ravensthorpe Range	EM Bennett sn [1071297]	AGD 84	33 29' 42"	120 01' 00"	Ravensthorpe Range	Clay.	1/10/1980	common		
10	Ravensthorpe Range	EM Bennett 2315 [1123904]	AGD 84	33 29' 42"	120 01' 00"	Ravensthorpe Ranges		29/08/1968			
11	Ravensthorpe Range	GF Craig 1927	AGD 84	33 32'29"	120 06' 18"	Ravensthorpe Range, near Mt McMahon, west of Carlingup Road.	Open mallet woodland. Loam over greenstone.	26/04/1992	common		
12	Ravensthorpe Range	-	AGD84	235456	6281259	Ravensthorpe Range. Ca. 300 m west of southern boundary of Loc. 187.	Eucalyptus megacornuta woodland. Loam over ironstone.	16/11/2004 (GF Craig)			PNR 51/ Traka
		AW Archer sn [1071319]	AGD 84	33 34' 48.0"	120 2' 36.0"	Ravensthorpe		15/08/1966			
		AS George sn [1070819] [1071262]	AGD 84	-33.5833	120.0333	Ravensthorpe district		1/08/1957			
13	Mt Desmond	CJ Robinson 1135 [3321355]	AGD 84	33 37' 0.0"	120 9' 0.0"	1.2 km N of Mount Desmond, ridgeline track	Hill top, gravel over ironstone.	8/09/1993	common		PNR

Pop.	Site	Collection	Datum	Latitude/ Easting	Longitude/ Northing	Location Description	Site Description	Date surveyed	No. of Plants	Area searched	Tenement/ Reserve
***Siegfriedia darwinioides* : Priority 4**											
14	SE Mt Desmond	-	AGD 84	33 38' 32"	120 11' 02"	2.4 km north along ridgetop track from entrance to Mt Iron mine; old gridline c. 200 m east and running parallel to firebreak.	Drainage line and lower sloopes, 50 m (along old grid) to W of ridge. Brown sandy clay loam, poorly laterised gravel. Mallee and dense heath (1-2 m).	6/2/2004 (GF Craig)	localised patch		PNR
15	NE Kundip	-	GDA94	240393	6271164	North of Western Gem mine in NE sector of Kundip Mining Leases	Mallee heath. Sandy loam over laterite.	6/2/2004 (GF Craig)	50+		Tectonic
16	ENE Kundip	-	GDA94	240999	6269623	900 m east of track to Flag mine on Road No.8432 then 600-750 m south on gridline	Tall mallee and heath. Pink-brown clay loam with laterite and quartz stones. Drainage line.	10/2/2004 (GF Craig)	frequent		Tectonic
17	FRNP - Eyre Range	AS George 7229 [1071238]	AGD 84	33 50' 54.0"	119 58' 6.0"	SW base of Eyre Range		2/11/1965			National Park
18	Chillinup	AS George 14285 [1311794]	AGD 84	34 24' 30.0"	118 27' 0.0"	5.3km NNW along Gnowellen Road from junction with Chillinup Road, E of Stirling Range	Tall shrubland dominated by mallee. In gravelly loam.	25/06/1976			
19	Corackerup	KR Newbey 4315 [1071300]	AGD 84	34 10' 0.0"	118 14' 0.0"	32km SE of Ongerup	Kaolin breakaway.	29/08/1974			
20	Pallinup River	EJ Croxford 6297 [3758060]	AGD 84	34 25' 0.0"	118 45' 0.0"	Burnt Hill above Pallinup River E, Highway 1	Rocky loam.	1/11/1988			
								ESTIMATED TOTAL	**???**		

Collated by GF Craig (May 2005) from Craig and Landcare Services flora surveys and CALM's Florabase/ database searches

Table 3.6.10 Population Distribution of Siegfriedia darwinioides

Pop.	Site	Collection	Datum	Latitude Easting	Longitude Northing	Location Description	Site Description	Date surveyed	No. of Plants	Area searched	Tenement Reserve
***Allocasuarina scleroclada subsp. echinata ms* : DRF**											
1	Helicopter Survey	Landcare Services LCS5016	AGD84	254056	6292307	Approx. 20 km north of Bandalup Hill.	Heath on granite	10/11/2000	est. 25	est. 500 sqm	UCL
2A	Bonnymidgup Track	Landcare Services LCS 8129	WGS 84	229307	6287623	8.9k east of Woodinup Road along Bonnymidgup Track, 6.4k east of range acsess track.	Lower slopes of Ravensthorpe Range, Heath on Granite.	11/06/2003	est. 14	est. 1200 sqm	UCL
2B	Bonnymidgup Track	Landcare Services LCS 10016	WGS 84	0229307	6287623	5.5km NE from Archer dve lookout, down first gridline and on to northern firebreak track "Bonnymidjup track"		7.11.2004			UCL
2C	Bonnymidgup Creek	Landcare Services RRN5	WGS 84	229374	6287598	Approx 4.5km north then east of Ravensthorpe Range near Bonnymidgup Creek via well maintained fire break.	Lower slopes of Ravensthorpe Range, Heath on Granite.	11/06/2003	est. 10	est. 900 sqm	UCL
3	Archer Drive lookout	Landcare Services LCS10023	AGD84	226325	6287310	700 m east of Archer Drive lookout, south side of track (burnt)	Small heath surrounded by mallee shrubland. Lateritic hilltop. [Burnt ?2002]	11/07/2004	489	0.24 ha	PNR
4	Ravensthorpe Range	GF Craig 6165	AGD84	236903	6281691	550 m east of Oldfield Loc 187	Mallee shrubland on red-brown loam near drainage line	22/11/2004	a=10 b=2+8 dead	a=0.1ha b=0.1ha	Traka E74/144
5	NW of Bandalup Hill	Landcare Services LCS7925	AGD84	254040	6278150	Silcrete deposits; NW of Bandalup Hill (Amalg Tenements)	Occurs with Melaleuca penicula, Heath on Silcrete (quartzite).	18/09/2002	est. 25	est. 500 sqm	Amalg
6	Bandalup Hill	Landcare Services LCS8124 & LCS 8128	AGD84	257600	6273035	Halleys-baseline 30 - Bandalup Hill, east of Hale-Bopp orebody outline, within wastedump footprint.	Heath on Felsic Volcanic	25/09/2002	est. 65	est. 100 sqm	RNP BHP-Billiton
7	Bandalup Hill	Landcare Services LCS7773	AGD84	257325	6272301	Hale-Bopp, Beyeria nana Hill - approx. 50m west of Hale-Bopp orebody outline.	Mid slope in Acacia ophiolithica, Mallee Heath on Komatiite	19/07/2002	est. 200	est. 1.0 ha	RNP BHP-Billiton

Pop.	Site	Collection	Datum	Latitude Easting	Longitude Northing	Location Description	Site Description	Date surveyed	No. of Plants	Area searched	Tenement Reserve
***Allocasuarina scleroclada subsp. echinata ms* : DRF**											
8	Tamarine Rd	Landcare Services LCS6151	AGD84	248542	6256364	Tamarine Road site 62.	Mallee Shrubland on Limestone/Calcrete.	10/11/2000			RNP BHP-Billiton
8	Tamarine Rd	GF Craig 5749	WGS 84	33 37 01	120 22 16	22 km NE of Hopetoun; ca. 1.5 km west of Tamarine Rd (opposite Middle Rd) on Oldfield Loc. 827	Open mallee and open low heath/ sedge. Limestone outcrop.	28/11/2002	52	0.25 ha	RNP BHP-Billiton
9	Middle Road	LCS 10530	AGD 84	0252135	6255713	2.7 km E of Tamarine Rd on Middle Rd, site 62	mallee shrubland, clay loam over limestone	14/2/2003	50	0.1 ha	Shire
9	Middle Road	GF Craig 5753	AGD84	252135	6255713	2.7 km east of Tamarine Road on Middle Road	Gently undulating plain. Orange –brown clay loam over limestone.	14/2/2003	Ca. 50 plants (juvenile to old/mature).	40 m x 25 m (0.1 ha)	Shire
10A	Mason Bay Rd	LCS 10532	WGS 84	0258493	6260951	Crown land reserve on Mason Bay Rd, population on track to the east.	Mallee heath over duplex soil (sand over clay)	20/1/2005	22		UCL
10B	Mason Bay Rd	LCS 10540	WGS 84	0257196	6264085	~ 600 km S of Jerdacuttup N Rd on Mason Bay Rd.	Sand over clay. Mallee over heath	20/1/2005	190+		Gazetted Road
10C	Mason Bay Rd	LCS 10529	WGS 84	0257450	6262726	Road reserve of Mason Bay Rd	Mallee heath over duplex soil (sand over clay)	09.12.2004	190+		Gazetted Road
10C	Mason Bay Rd	LCS 10469	WGS 84	0257431	6262843	2.0 km S of Jerdacuttup N Rd on Mason Bay Rd	Mallee heath over duplex soil (sand over clay)	08.12.2004	190+		Gazetted Road
11	Road No.8432	GF Craig 6078	WGS 84	244465	6274114	320 m west of Oldfield Loc.56	Mallee shrubland on calcareous loam	29/04/2004	est. 600	0.44 ha	Gazetted Road
12A	Near Road No. 8432	LCS 10539	WGS 84	0243790	6273872	Track/gridline running W of Hatfield track, approx 800 m W of Magnesite mound	Shrubland. Red stony clay loam with granite and magnasite expression. Also scattered through malle heath on other side of track (more recently burnt).	07.03.2005	1,000	1.23 ha	UCL

Pop.	Site	Collection	Datum	Latitude Easting	Longitude Northing	Location Description	Site Description	Date surveyed	No. of Plants	Area searched	Tenement Reserve
***Allocasuarina scleroclada subsp. echinata ms* : DRF**											
12B	Near Road No. 8432	LCS 10538	WGS 84	0243767	6273801	Gridline track West of Hatfield track, on top of hill	red stoney clay loam, with granite & magnesite stones	07.03.2005	80	1 ha	UCL
13	Hopetoun-Ravensthorpe Rd	GF Craig 6349	WGS 84	236456	6273352	3.2 km south of Elverdton Rd	Mallee shrubland on orange-brown sandy loam. Burnt Dec 1989	2/11/2005	ca. 25 plants (vegetative)	10 m x 5 m	Shire
							TOTAL ESTIMATED		**2,870**		

Collated by GF Craig (May 2005) from Craig and Landcare Services surveys and CALM's Florabase/ database searches. **Table 3.6.11 Population Distribution of Allocasuarina scleroclada subsp**

Pop.	Site	Collection	Datum	Latitude/ Easting	Longitude/ Northing	Location Description	Site Description	Date surveyed	No. of Plants	Area searched	Tenement/ Reserve
Beyeria sp. A Ravensthorpe **: Priority 1**											
1A	Ravensthorpe Range	-	WGS 84	0230216	6287124	10km east of Woodenup Road, on Bonnymidgup track(southern track)	mid to upper slope	11/6/1999 (LCS/ RRN10)	10,000+	250 x 50m	UCL
1B	Ravensthorpe Range	-	WGS 84	0232046	6286400	11.3Km east of Woodenup Road on Bonnymidgup Track	mid to upper slope	11/6/1999 (LCS/ RRN11)	est 10,000+	150 x 50m	UCL
1C	Ravensthorpe Range	-	WGS 84	0232493	6285921	12.8km east on Bonnymidgup Track	upper slope	11/6/1999 (LCS/ RRN13)	est 13 000	80 x 40m	UCL
1D	Ravensthorpe Range	-	WGS 84	0232628	6285744	13.1 km east on the Bonnymidgup track	ridge top, upper slope	11/6/1999 (LCS/ RRN14)	7000	70 x 200m	UCL
2A	Hatfield Rd	-	WGS 84	249711	6277995	c. 1.2 km along Hatfield Rd from South Coast Hwy		10/4/2004 (GF Craig)	c. 20		Shire
2B	Hatfield Rd	-	WGS 84	0249745	6276919	1.4km along Hatfield Rd from SC Hwy		9/18/1999 (LCS/ HR3)	19	50 x 20m	Shire
2B	Hatfield Rd	GF Craig 6084	WGS 84	249745	6276912	Hatfield Road, c. 300 m south of South Coast Hwy, near gate entrance; 7.5 km NW of Bandalup Hill	Open mallee and shrubs. Brown calcareous loam.	4/10/2004	c. 20	30 m along narrow road reserve	Shire
2C	Hatfield Rd	-	WGS 84	249781	6275644	Hatfield Rd		10/4/2004 (GF Craig)	c. 20		Shire
2D	Hatfield Rd		WGS 84	249811	6274393	SW cnr Hatfield Rd and Road No.8432		10/4/2004 (GF Craig)	100s		Reserve No. 31979
2D	Hatfield Rd	-	WGS 84	0249849	6274055	4.0 km south along Hatfield Rd from South Coast Hwy		9/18/1999 (LCS/ HR1)	4,100	450 x 20m	Reserve No. 31979
3A	Bandalup Hill	GF Craig 3626	WGS 84	33 39 53	120 24 01	Bandalup Hill, ca. 31 km ESE of Ravensthorpe	Forest with open understorey. SE facing slope of low ridge. Powdery, fine, pale grey magnesite influenced soils.	18/2/1998	frequent		RNP BHP-Billiton

Pop.	Site	Collection	Datum	Latitude/ Easting	Longitude/ Northing	Location Description	Site Description	Date surveyed	No. of Plants	Area searched	Tenement/ Reserve
Beyeria sp. A Ravensthorpe **: Priority 1**											
3A	Bandalup Hill	LCS 7329	AGD 84	0258811	6271792	Bandalup Hill Hale Bopp-EIA 4	Euc. purpurata ms Woodland	14/08/1996	381,696		RNP BHP-Billiton
3B	Bandalup Hill	LCS 7740	AGD 84	0259598	6270581	south of Hale-Bopp, Private Land	Magnesite Mallee Shrublands	10/07/1998	1,000		RNP BHP-Billiton
4	Road No.8432 (Hecla)	KR Newbey 11802	AGD 84	33 40 0	120 14 40	Ravensthorpe Range, 20km SE of Ravensthorpe	Tall shrubland. Moderately exposed undulating plain, well drained light brownish clayey sand.	24/10/1983	scattered in patches		Gazetted Road/ PNR
4	Road No.8432 (Hecla)	GF Craig 6093	WGS 84	33 39 56	120 13 32	1.7 km south of Jerdacuttup River on Road No. 8432 (between Kundip and Hatfield Rd)	Open mallee and heath. Pale grey calcareous loam.	5/02/2004	est. 6,000	ca. 1.5 ha	Gazetted Road/ PNR
5A	Road No.8432	-	WGS 84	244274	6274033	Road No. 8432		2/5/2004 (GF Craig)	1		Gazetted Road
5B	Road No.8432	-	WGS 84	244507	6274070	South of Road No.8432 and Allocasuarina scleroclada ssp. echinata population	Gently rising slope. Grey calcareous loam.	5/02/2004	100s		PNR
6	Lee Rd	AS George 9474	AGD 84	33 45 0	120 16 0	ca 7 miles E along Jerdacuttup Road from turnoff 13 miles S of Ravensthorpe on Hopetoun Road.	Among mallees. In clay	31/07/1965			Shire
6	Lee Rd	LCS 7565	AGD 84	0247221	6262370	Lee Rd, near Jerdacuttup Rd Intersection	Mallee on Limestone Outcrop (soil of limestone derived sandy loam)	13/06/1998			Shire
6	Lee Rd	GF Craig 5823	AGD 84	33 44 54	120 16 16	28 km SE of Ravensthorpe; 500 m south of Jerdacuttup Rd on Lee Rd, extending 60 m west into road reserve	N-facing slope. Calcareous loam.	6/09/2003	246		Shire
7A	South Coast Hwy	GF Craig 6248	WGS 84	234811	6280635	ca. 8.5 km east of Hopetoun Rd on South Coast Hwy; south side	Tall mallee. Calcareous grey loam.	3/02/2005	6		MRD
7B	South Coast Hwy	-	WGS 84	234842	6280614	ca. 8.6 km east of Hopetoun Rd on South Coast Hwy; south side	Tall mallee. Calcareous grey loam.	2/3/2005 (GF Craig)	50+		MRD
							Total Estimated		**433,500**		

Collated by GF Craig (May 2005) from Craig and Landcare Services surveys and CALM's Florabase/ database searches.

Table 3.6.12 Population Distribution of Beyeria sp A Ravensthorpe

Tectonic Resources NL

KUNDIP HAUL ROAD
DECLARED RARE & PRIORITY FLORA SURVEY

May 2004

Cover photo: Proposed Declared Rare *Allocasuarina scleroclada* subsp. *echinata* on Road No. 8432.

KUNDIP HAUL ROAD
DECLARED RARE & PRIORITY FLORA SURVEY

A report prepared for
Tectonic Resources NL
Suite 4, 100 Hay Street, Subiaco WA 6008

May 2004

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PO Box 130, Ravensthorpe 6346

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Summary

The proposed 17 km haul road to be constructed by Tectonic Resources NL between their Kundip mining leases to the RAV8 minesite was surveyed for declared rare and priority flora in early May 2004.

A known population of the Declared Rare *Marianthus villosus* is present on Road No. 8432 west of the Hecla mine. Upgrade of Road No. 8432 would require taking about 20% of the population along its western margin.

The largest known population (estimated 600 plants) of the proposed Declared Rare *Allocasuarina scleroclada* subsp. *echinata* is bisected by an old track on Road No. 8432.

Three Priority One, one Priority Two and two Priority Three species are present on the proposed haul road. It is recommended that three of these Priority species have their status changed to Priority Four, ie *Beyeria* sp. A Ravensthorpe, *Pultenaea calycina* subsp. *proxena* and *Spyridium glaucum.* Another species, *Acacia ophiolithica,* is recommened to be removed from the Priority flora list.

Two species, *Melaleuca stramentosa* (Priority One) and *Acacia laricina* subsp. *crassifolia* (Priority Two) are widespread on the Kundip mining leases and only a small proportion of plants would be impacted by the haul road.

Phebalium tuberculosum 'Maydon form' (GF Craig 6076) should be considered a significant species. It is present near the northern limit of Road No.8432 on Loc.56.

Weeds mainly occur in drainage lines from farmland Locations 249, 57 or 63, including two Declared Plants, narrow-leaf cotton bush (*Gomphocarpus fruticosus)* and Saffron thistle (*Carthamnus lanatus*). A Weed of National Significance, bridal creeper (*Asparagus asparagoides*) occurs near the Jerdacuttup River crossing.

Recommendations:

1. Request a permit from the Department of Conservation and Land Management to 'take' *Marianthus villosus* on Road No. 8432, or reroute the haul road to the east of the population so that it is avoided;

2. Realign the proposed haul road to avoid the *Allocasuarina scleroclada* subsp. *echinata* population and provide a 20 m buffer. Avoid construction of spur drains into this population;

3. If possible, align the haul road to avoid *Phebalium tuberculosum* 'Maydon form' (GF Craig 6076);

4. Liaise with the Shire of Ravensthorpe and the Department of Agriculture to implement a weed eradication/control program at current sites of weed invasion on Road No.8432 and Hatfield Road. Prevent further dispersal of weed seeds by minimising movement of soil out of drainage lines during road construction;

5. Operational procedures should be adopted to minimise the risk of dieback introduction and spread along the proposed haul road. This can be achieved by:
   - minimizing water runoff into communities with a high component of dieback susceptible, proteaceous species;
   - facilitating vehicle and machinery wash-down, and cessation of vehicle and machinery movement in extreme situations when high temperature and moisture conditions combine to spread the fungal spores.

Introduction

Tectonic Resources NL propose to construct a road to haul mineral ore from their Kundip mining leases to the RAV8 minesite (Fig.1). One option is for the proposed road to follow gazetted Road No. 8432 for approximately 12 km from Kundip north-east through Unallocated Crown Land (UCL) to Oldfield Loc. 56, through the southern sector of the latter location, then along the southern boundaries of Loc.57 & 63 to Hatfield Road. The haul road would continue for 3.6 km north along Hatfield Road to within about 300 m of the South Coast Highway, where it would cut through the north-east sector of Loc. 62 to the RAV8 minesite (Fig 2).

Currently, an old track follows the alignment of the gazetted road from the Kundip mining leases down the eastern slopes of the Ravensthorpe Range, crosses the Jerdacuttup River then, about 2 km east of the river, deviates onto a firebreak around the southern boundary of Loc. 56. The road alignment through Loc. 56 has never been cleared nor fenced. Along the southern boundaries of Loc. 57 & 63 a firebreak, approximately 10 m wide, has been cleared leaving a narrow strip of vegetation (c. 2 m wide) along the fenceline. Except for the southernmost 1.2 km which is a well-worn track, Hatfield Road is graveled (8-9 m width) with a 6 m road reserve on each side.

Gazetted Road No. 8432 is included within an area of the Ravensthorpe Range recommended by the EPA Red Book (Recommendation 3.8 (Figure 3.19)) to become a nature reserve (Fig.3). This remains the favoured outcome by the Department of Conservation and Land Management (CALM) in whom the area would be vested. Due to active mining and mineral prospecting activities, however, there remain numerous unresolved issues between the Department of Industry and Resources (DoIR), CALM and the Shire (EPA 1993, CALM 1992).

South-east of the intersection of gazetted Road No. 8432 and Hatfield Road lies Reserve No. 31979 for the purpose of parklands and recreation (Fig.2).

Under the Wildlife Conservation Act, CALM is responsible for the protection of flora and fauna of all lands and waters throughout the State. Section 23F of the ACT (Appendix 1) gives the Minister responsible for the Act statutory responsibility for the protection of those classes of flora declared to be rare.

CALM has ranked plant taxa considered to be threatened under a series of conservation codes, depending on their apparent degree of threat (see Appendix 1). Taxa listed as Declared Rare Flora require permission from the Minister responsible for the Wildlife Conservation Act 1950, if any portion of the plant is to be, or likely to be, disturbed.

Tectonic Resources NL have requested a survey for declared rare and priority flora be carried out along the proposed Kundip haul road along the alignment of Road No.8432. Vegetation and flora surveys have already been carried out for the Kundip mining leases (Craig 2004) and the RAV8 minesite (Craig 1999).

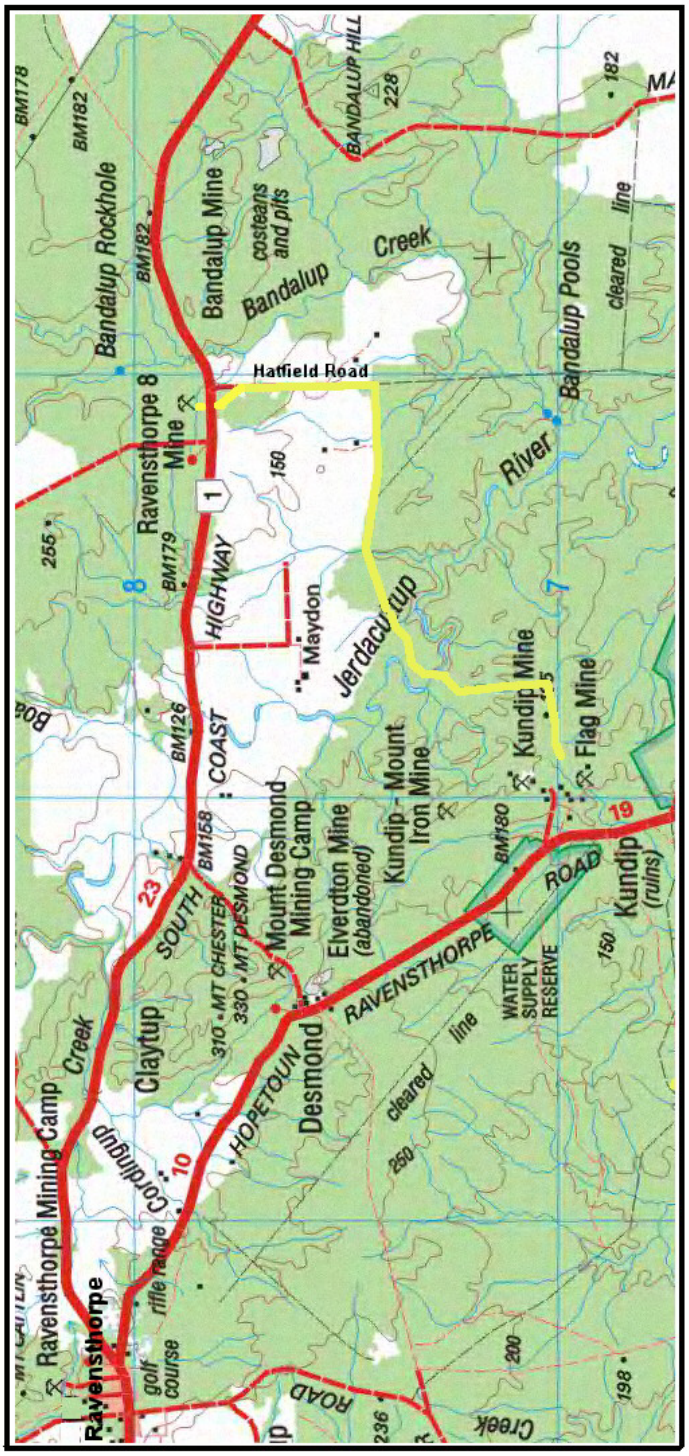

Fig.1 - Location of proposed Kundip haul road (indicated by yellow line)

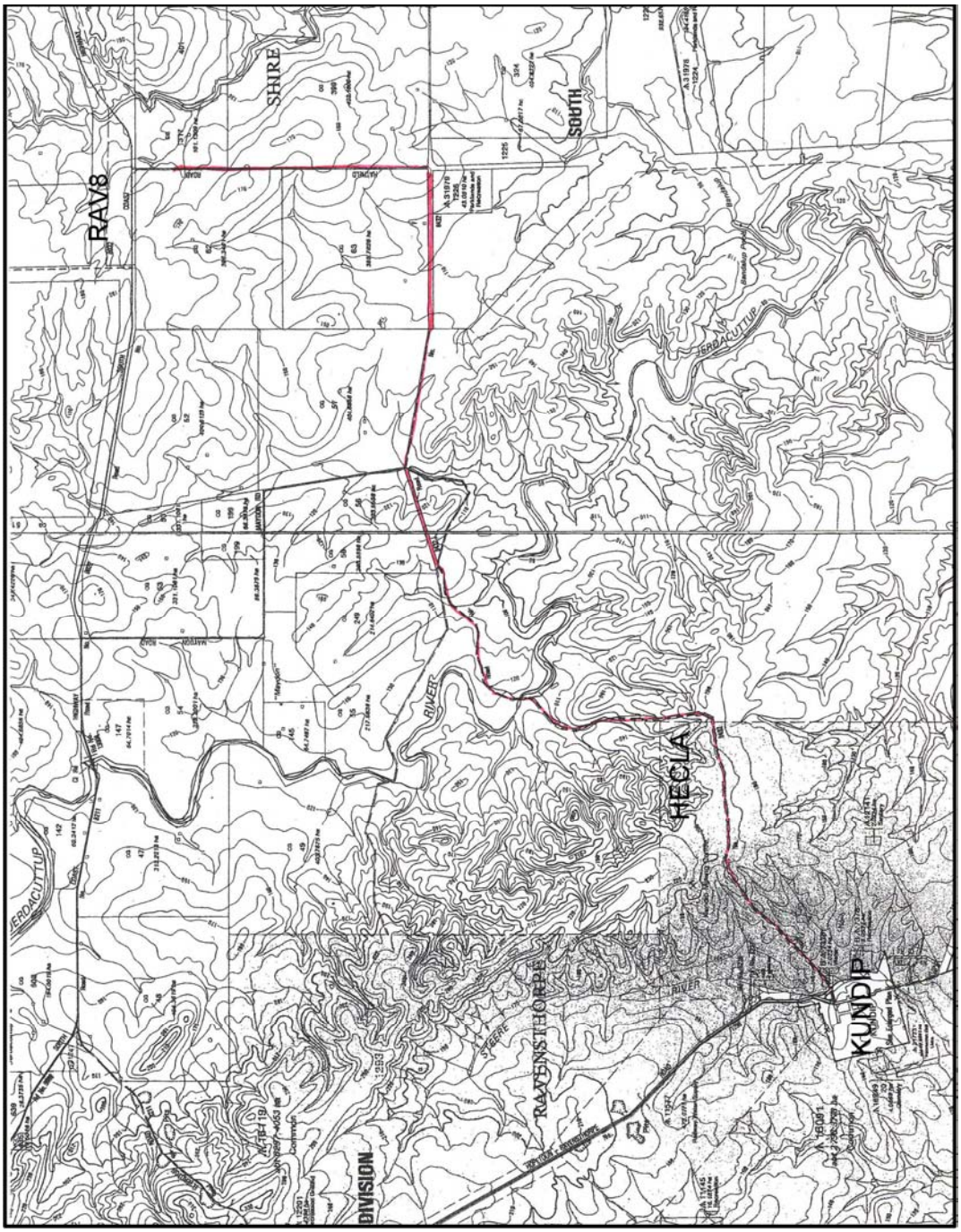

Fig. 2 – Location of Road No. 8432, the proposed haul road between Kundip mining leases and the RAV8 mine.

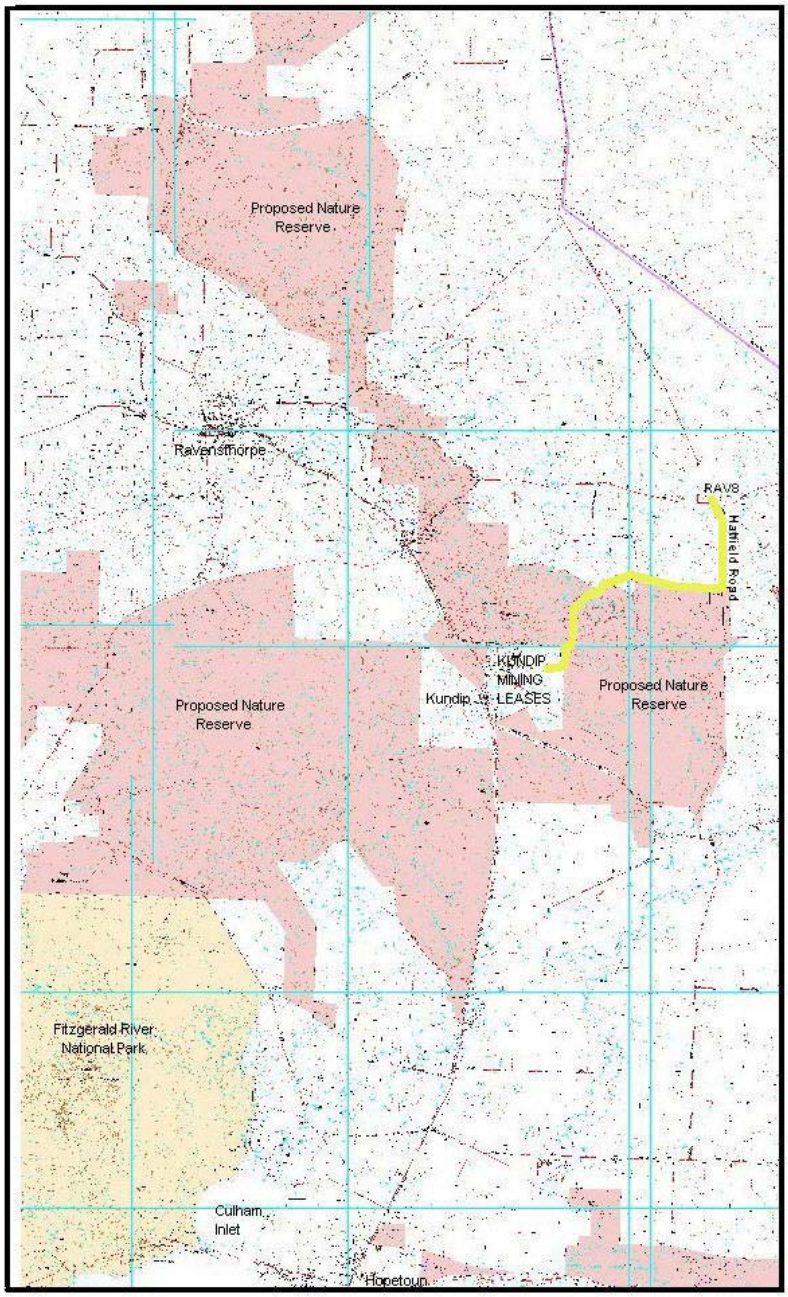

Fig.3 - Proposed Nature Reserves near the Kundip mining leases
(approximate location of proposed haul road indicated by yellow line)

Methods

A survey for declared rare and priority flora occurring on gazetted Road No. 8432 and Hatfield Road was carried out on 29 April and 4 & 5 May 2004. On 12 May, further survey of a proposed DRF population was made. The weather was cool to warm (16°C – 24°C), generally slightly overcast with little wind, except for the 12 May which was windy with sporadic rain showers.

The old track which follows Road No. 8432 east of the Kundip mining leases was traversed on foot and bicycle to the western boundary of Loc. 56, on foot through Loc. 56, and driven slowly with regular stops every 200-400 m along the firebreaks on the southern boundaries of Loc. 57& 63 and Hatfield Road.

The survey was carried out according to the *Guidelines for flora and fauna surveys of land vested in the National Parks and Nature Conservation Authority* obtained from CALM, and the Environmental Protection Authority's Draft Guidance No.51 (EPA 2003).

A search was made of CALM's databases for Declared Rare (DRF) and Priority Flora species which have the potential to occur in the area. The search co-ordinates were 33°30' – 34°0' S and 120°0' – 120°45' E on 16 May 2003. A list of the threatened species with the potential to occur in the Kundip to RAV8 area is given in Appendix 1.

During the survey, locations of DRF and Priority flora were mapped and their positions taken with a GPS (Garmin II) using the Geocentric Datum Australia 1994 (GDA94). The area covered by each DRF population was determined by marking the boundary with GPS points and calculating the area using ARCVIEW® or SURPAC®. An estimate of the number of plants in each population was determined by counting the number of plants in at least 100 m x 2 m and calculating the number for the given area.

It should be noted that following the discovery of two populations of the Declared Rare *Marianthus villosus* on the Kundip mining leases, further regional surveys of known populations of this species were carried out over three days between the 4 – 10 February 2004 (Craig 2004). One of the known populations occurs on Road No. 8432 near the Hecla mine.

Plant specimens were verified using the author's private herbarium or the Perth Herbarium; nomenclature follows that of PERTH (Paczkowska and Chapman 2000). Assistance with some taxa was provided by specialist botanists. Duplicate specimens of special interest have been lodged at both the Ravensthorpe and Perth herbaria.

Results

Declared Rare and Priority Flora

Localities of the Declared Rare and Priority flora are mapped (Fig. 4), GPS locations given in Appendix 2 and details of each taxon given below:

Declared Rare Flora

Marianthus villosus **(Turcz.) Benth**. – a low, spreading, mid-dense shrub which grows to 50 cm tall. The flat leaves are covered with long white hairs when young, but become hairless with age except along the midvein and margins. The solitary flowers are deep blue.

Plate 1 – *Marianthus villosus*

A known population, referred to by CALM as 'Population 3A' occurs immediately east of the old Hecla mine on and adjacent to Road No. 8432 (Figs. 4 & 5). It was resurveyed in February 2004 (Craig 2004) and estimated to have 300-400 mature plants occupying an area of 1 ha. The population is largely undisturbed, with >75% of *Marianthus villosus* plants occurring on the moderately steep slope to the west of Road No. 8432. The area is long undisturbed, except for Road No. 8432 along which 34 plants were counted over a distance of 180 m (0.04 plants/m^2), extending south from the intersection with the track to the Hecla mine (Fig.5).

Regional surveys of known populations of *Marianthus villosus* estimated over 40,000 plants east of the Vermin Proof Fence (Population 1), and about 500 plants in the Ravensthorpe Range to the north of the Kundip mining leases (Population 4). More than 2,000 plants are estimated to occur on the Kundip mining leases (Populations 3C and 5) (Craig 2004). A summary of the surveys of known populations is given in Appendix 4.

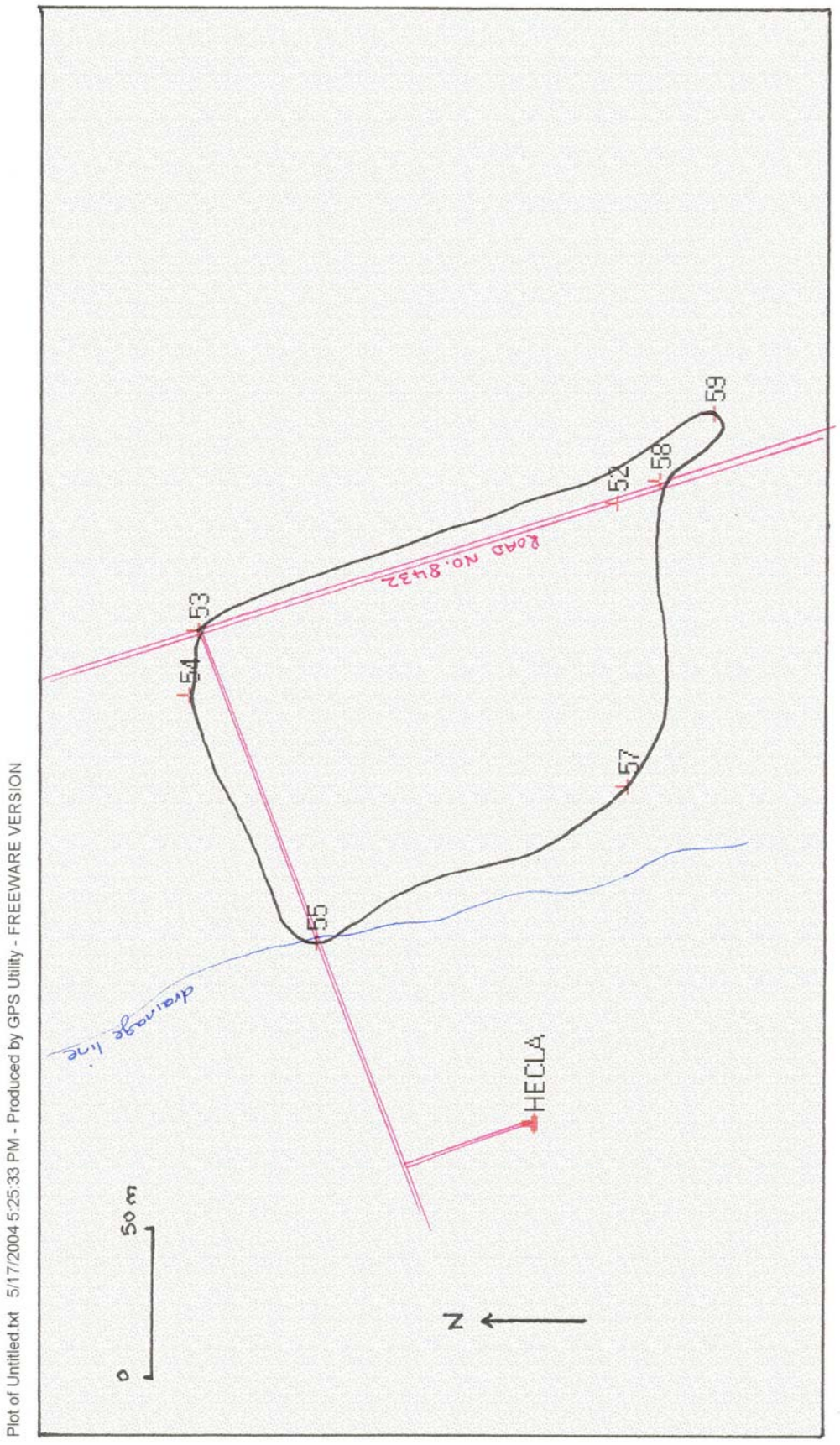

Fig 5. – *Marianthus villosus* Population 3A, 4 km NE of Kundip townsite.

***Allocasuarina scleroclada* subsp. *echinata* ms (G Cockerton 5016)** – a small tree or shrub to 4 m tall, branchlets are usually erect (cf. susp. *scleroclada* which droop in female plants), and internodes are 2 cm or more long. Subsp. *echinata* differs from the typical species by having a spinal appendage on the side of the cone valves. It resprouts after fire (G.Cockerton, pers.comm.).

A. scleroclada subsp. *echinata* grows in pale grey-brown calcareous loams over limestone in shrub-heath communities associated with *Melaleuca pauperiflora* and *Gahnia lanigera.*

This species has been proposed by CALM's Albany Rare Flora Recovery Team (meeting minutes 7/4/04) to be included on the Declared Rare flora list. It is very poorly known and, despite widespread regional surveys, only seven other populations totalling an estimated 430 plants are known - 74% of these occur on mining tenements (Cockerton, 2004). Appendix 5 gives the statistics for known populations.

On Road No. 8432, approximately 320 m west of Loc. 56 and immediately south of Loc.249 ('Maydon'), the largest known population of *A. scleroclada* subsp. *echinata*, covering 0.44 ha and estimated to include c.600 plants, was found during this survey. Road No. 8432 goes through the middle of the population, with the *Allocasuarina* extending along the track for 110 m and from 45 m north to 25-65 m south of the track (Fig. 6).

Plate 2 - *Allocasuarina scleroclada* subsp. *echinata*

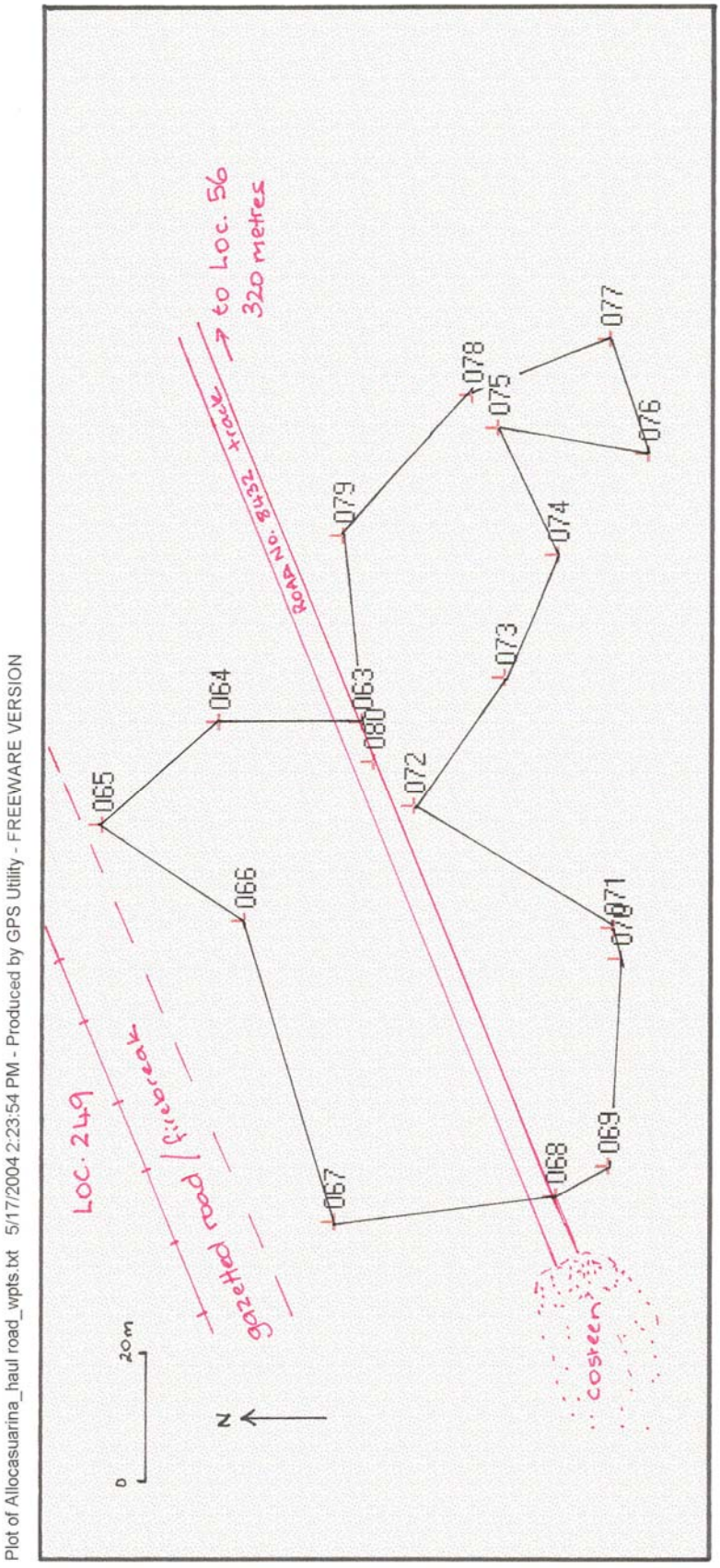

Fig.6 – *Allocasuarina scleroclada* subsp. *echinata* ms population, 7.5 km NE of Kundip townsite.

Priority One

***Beyeria* sp. A Ravensthorpe (AS George 9474)** pn - an erect shrub to 1 m tall with shiny, dark green leaves and small, insignificant flowers. It grows in powdery, pale brown-grey, calcareous loams, often associated with magnesite-influenced soils. Associated species include *Eucalyptus indurata, Melaleuca pauperiflora, M. cliffortioides, Halgania andromedifolia.* It appears to be restricted to the Jerdacuttup River catchment, with a known range of 18 km.

During the current survey, *Beyeria* sp. A Ravensthorpe was found in four areas:

1. Road No.8432 passes through a population of *Beyeria* sp. A Ravensthorpe for 125 m (Fig.4). It covers about 1.5 ha (aerial photo interpretation) and includes an estimated 6,000 plants (0.4 plants/m^2). This is probably the same population first noted by Ken Newbey in 1987 as '20 km SE of Ravensthorpe' (it actually occurs 19 km SE of Ravensthorpe).

2. Another population, with more than 200 plants occurs immediately south of the *Allocasuarina scleroclada* ssp. *echinata* population on Road No.8432. It could be impacted if the haul road alignment was moved to the south to avoid the latter species which is proposed DRF.

3. A large population (estimated 40,000 plants covering 10 ha) occurs in Reserve No. 31979, which abuts Road No. 8432 on its north boundary. Plants occur along the road alignment for 430 m west of Hatfield Road. The same vegetation type which includes *Beyeria* sp. A Ravensthorpe continues to the east of Reserve No. 31979 in unvested Crown land (aerial photo interpretation), so the overall population size could be much larger.

4. Hatfield Road has four small sub-populations of 20-50 plants each in the narrow (6 m wide) road reserves (Fig.4).

Plate 3 - *Beyeria* sp. A Ravensthorpe (AS George 9474)

At least three other populations are known in the region, ie Lee Road, magnesite pits north of Bandalup Hill, and on the Hale-Bopp tenement at Bandalup Hill. BHP-Billiton has carried out further surveys for this species in the region, although the extent and location of these is currently unknown by the author. A summary of known locations is given in Table 1.

Beyeria sp. A Ravensthorpe, although geographically restricted, is common and widespread on calcareous loams in the area between Kundip and Bandalup Hill and south to Lee Road.

It is recommended that the status of this species be changed to Priority Four, ie continue to have its populations monitored, as they are known to occur on a soil type which could be a target for mining in future.

Table 1 – Known populations of *Beyeria* sp. A Ravensthorpe (AS George 9474) and estimate of population size

Location	Size	Collector/ year
1) Kundip Road No. 8432	"scattered in patches" est. 6,000 (1.5 ha)	K.R.Newbey 1987 G.F Craig 2004
2) south of Road No. 8432 (west of Loc.56) and *Allocasuarina scleroclada* ssp. *echinata* population	200+	G.F Craig 2004
3) Reserve No. 31979 (south of Road No. 8432 and Loc.63)	est. 40,000 (10 ha)	G.F. Craig 2004
4) Hatfield Road road reserve (4 sub-populations)	c. 200 c. 150	Landcare Services 2003 G.F. Craig 2004
5) Lee Road	 246	A.S.George 1969 Landcare Services 2002 G.F.Craig 2003
6) Bandalup Hill (Hale-Bopp)	 est. 40,000+	G.F.Craig 1998 Landcare Services 2000-2002
7) Magnesite pits east (north of Bandalup Hill)	<100	G.F.Craig 2002 (for Landcare Services)

***Melaleuca stramentosa* Craven** - a robust shrub to 1 m tall with deep mauve flowers. This species is very common on the Kundip mining leases (Craig 2004) and prefers skeletal soils on the upper slopes on the west side of the divide between the Steere River and Jerdacuttup River catchments.

The proposed Kundip haul road intersects two sub-populations of *M. stramentosa* for 150 m and 350 m within the Kundip mining leases (Fig.4).

Although many thousands of plants occur on the leases, *M. stramentosa* is very poorly known and appears to be very geographically restricted, with a known range of only 8 km – the southern limit being Jerdacuttup Road. Large numbers of plants are known to occur about 2.5 km north of the Kundip mining leases.

It has been recommended (Craig 2004) that any further surveys for this species be carried out when it flowers in October.

Plate 4 – *Melaleuca stramentosa*

***Pultenaea calycina* subsp. *proxena* ms [ex. *Pultenaea* sp. Bandalup *(*GF Craig 3625)]** - a low shrub, usually less than 50 cm tall. The narrow leaves are about 1 cm long and folded inwards. It prefers pale grey-brown calcareous loams and is often associated with magnesite-influenced soils. Associated species include *Eucalyptus flocktoniae, E. indurata, Melaleuca pauperiflora* and *Pomaderris brevifolia.*

Four, relatively small populations (less than 100 plants) of *P. calycina* subsp. *proxena* were found on Road No. 8432. One occurs 200 m south of the Jerdacuttup River crossing, while the others occur from 100 m east of the crossing to about 500 m west of Loc.56.

P. calycina subsp. *proxena* is relatively common on calcareous loams in the Ravensthorpe region with a number of populations known in the Bandalup Hill and 'Road Eleven' areas (Appendix 6). BHP-Billiton have carried out surveys for this species through the Ravensthorpe region, however the outcome of their reseach is not currently known.

Plate 5 - *Pultenaea calycina* subsp. *proxena*

It is recommended that the status of this species be changed to Priority Four, ie continue to have its populations monitored, as they are known to occur on a soil type which could be a target for mining in future.

Priority Two

***Acacia laricina* Meisn. var. *crassifolia* Maslin** – a low, spreading shrub to 40 cm tall and 60 cm wide. Phyllodes ('leaves') are cylindrical, strongly ribbed and have a sharp point at the apex. It is often found growing in association with *Melaleuca stramentosa* in patches of 10-30 plants (Craig 2004).

The proposed Kundip haul road intersects two sub-populations of *A. laricina* var. *crassifolia* within the Kundip mining leases, ie coinciding with the *M. stramentosa* sub-populations (Fig.4). About 70 plants occur in the 150 m western sector, mainly on and beside the disturbed track, although numerous plants occur within the undisturbed vegetation as well. In the eastern sector, 350 m long, there is an average of 6 plants/100 m^2.

Acacia laricina var. *crassifolia* has a restricted distribution, being mainly collected from Mt Desmond to Kundip, and one collection from Mt Short, a range of 30 km.

Plate 6 – *Acacia laricina* var. *crassifolia*

Priority Three

Acacia ophiolithica **R.S.Cowan & Maslin** – a rounded shrub to 1.5 m tall with cylindrical, yellow-green phyllodes (leaf-like). It dominates dense heath communities on the eastern slopes of the Ravensthorpe Range between Kundip and Hatfield Road and is one of the most common plants occurring along Road No. 8432 from near the Hecla mine to Loc. 56 (Fig.4).

Plate 7 - *Acacia ophiolithica*

Acacia ophiolithica appears to be relatively common, although in localised patches, in the Jerdacuttup River catchment and elsewhere in the Ravensthorpe region with at least 12 locations recorded by the Perth herbarium. It is recommended that this species be removed from the Priority flora list.

Spyridium glaucum **Rye** - an inconspicuous shrub to 2 m tall, with small flower heads of 3-6 flowers. Leaves are dark, shiny green on the upper surface and densely hairy below.

On Road No. 8432, two sub-populations occur on low ridges through Loc. 56 in stony, red-brown loam in open mallee (*Eucalyptus flocktoniae, E. suggrandis, E. pilieata)* with open shrubs (*Gastrolobium parvifolium, Grevillea pectinata)*. The eastern sub-population is small (< 20 plants), with plants well scattered. The western sub-population has more than 100 plants with scattered occurences through the *E. clivicola* low forest which extends down the western slope for 300 m.

S. glaucum is also known from at least eight localities in the Ravensthorpe Range, from Mt Short to Kundip, a distance of 30 km. A large population of thousands of plants occurs in a gully c. 2.5 km north of the Kundip mining leases (Craig 2004). It is also known from Bandalup Hill where over 15,000 plants grow in three sub-populations covering over 2 ha (Craig 2000).

It is recommended that this species be changed to Priority Four status.

Plate 8 – *Spyridium glaucum*

Significant Species

Phebalium tuberculosum 'Maydon form' (GF Craig 6076) – a spreading shrub, 50-80 cm tall, with narrow leaves 10-15 mm long x 1 mm wide. Both stems and leaves are covered in tubercles. It grows in red-brown, stony loam amongst mid-dense to open shrubs of *Melaleuca thapsina* and *Gastrolobium parvifolium.*

Paul Wilson, the *Phebalium* specialist at the WA Herbarium, has identified all plants with tuberculate stems as *P. tuberculosum,* which is now a large group with many forms. The above specimen is different to the TYPE which has shorter leaves (P. Wilson, pers.comm.). The species requires taxonomic revision to determine the status of the many forms.

A population of more than 100 plants occurs on Loc.56, near the northern boundary of Road No. 8432.

Exotic Species

A number of weeds typical of farmland were found on Road No. 8432 and Hatfield Road reserves, principally in drainage lines that originate in Locations 249, 57 or 63. Two Declared Plants (narrow-leaf cotton bush and saffron thistle) and one Weed of National Significance (bridal creeper) were found.

Declared Plants

Two plants occur on Road No. 8432 that have been 'declared' under the Agriculture and Related Resources Act.

Narrow-leaf cotton bush (*Gomphocarpus fruticosus)* – an erect shrub to 3 m tall with creamy-white flowers in pendulous clusters. The fruits are yellow-green, inflated, thin-walled, 4-6 cm long and covered in long, soft spines. It prefers moist, disturbed sites.

Approximately 100 plants, with maturing fruits, are growing on Road No. 8432, near the south-west corner of Loc.57.

According to Julianne Hill (Department of Agriculture, Ravensthorpe) it is the Shire of Ravensthorpe's responsibility to eradicate this population as it occurs on a gazetted road vested with the Shire.

The Agricultural Protection Board Officer has liaised with the Shire and sprayed this weed population in early June (B.Donald, pers.comm., 15/6/04).

Plate 9 – Narrow-leaf cotton bush

Saffron thistle (*Carthamnus lanatus*) – an erect annual to 70 cm tall, with spiny, rigid leaves. The yellow 'daisy' flowers are present in spring and summer. The plant dies off in late summer or autumn, however the seeds can survive for many years in the soil. It is a serious weed of agricultural areas and disturbed bushland.

Small numbers (10-20 plants) of saffron thistle were found in three locations on Road No. 8432, ie in drainage lines south of Locations 249, 57 & 63 (Fig.4).

Plate 10 – Saffron thistle

Weed of National Significance

Bridal creeper (*Asparagus asparagoides*) – a twining, perennial plant introduced from southern Africa for floral arrangements. The red, fleshy fruits are relished by birds which spread the seeds in their droppings. It is extremely invasive and can rapidly spread in creeklines and undisturbed bushland. It usually dies down in summer, then shoots rapidly to climb and sprawl over other plants, eventually smothering them.

A few plants were found 50 m east of the Jerdacuttup River crossing on Road No. 8432 amongst shrub thicket.

Other Weeds

A number of weeds were found in drainage lines, including:

**Anagallis arvensis* (pimpernel)
**Carduus pycnocephalus* (slender thistle)
**Centaurea solstitialis* (St Barnaby's thistle)
**Chenopodium murale* (nettle-leaf goosefoot)
Chenopodium pumilio (clammy goosefoot)
**Cirsium vulgare* (spear thistle)
**Conyza bonariensis* (fleabane)
**Cucumis myriocarpus* (prickly paddy melon)
**Dittrichia graveolens* (stinkwort)
**Ehrhata* sp. (veldt grass)
**Lepidium africanum* (common peppergrass)
**Malva parviflora* (small flowered mallow)
**Rapistrum rugosum* (turnip weed)
**Solanum nigrum* (black berry nightshade)

A native plant which has seed heads blown from nearby pastures into undisturbed bushland for 5-15 m south of Locs.57 & 63 is *Chloris truncata* (windmill grass).

Discussion

The proposed Kundip haul road, between the Kundip mining leases and RAV8 minesite, along gazetted Road No. 8432 and Hatfield Road has a number of threatened plants along its route. A known population of the Declared Rare *Marianthus villosus* is present on Road No. 8432 west of the Hecla mine. Upgrade of Road No. 8432 would require taking about 20% of the population along its western margin.

The largest known population (estimated 600 plants) of the proposed Declared Rare *Allocasuarina scleroclada* subsp. *echinata* is bisected by an old track on Road No. 8432. This species is very poorly known and despite extensive searches through the region (Landcare Services, pers. comm.) remains rare, with only another 430 plants known. In this sector, aligning the haul road along Road No. 8432 would severely impact this population.

Three Priority One, one Priority Two and two Priority Three species are present on the proposed haul road. It is recommended that three of these Priority species which have restricted distributions, but are common in the region have their status changed to Priority Four, ie *Beyeria* sp. A Ravensthorpe, *Pultenaea calycina* subsp. *proxena* and *Spyridium glaucum.* Another species, *Acacia ophiolithica,* is recommened to be removed from the Priority flora list.

Two species, *Melaleuca stramentosa* (Priority One) and *Acacia laricina* subsp. *crassifolia* (Priority Two) are widespread on the Kundip mining leases (Craig 2004), and only a small proportion of plants would be impacted by the haul road. However, it is uncertain what the long-term impact of mining activies will be on these populations.

Phebalium tuberculosum 'Maydon form' (GF Craig 6076) has not been seen before by the author and should be considered a significant species. Until a taxonomic revision of the species is undertaken, it would be difficult to determine the true status of this form.

Numerous weeds were present on the proposed haul road, including two Declared Plants, narrow-leaf cotton bush (*Gomphocarpus fruticosus)* and Saffron thistle (*Carthamnus lanatus*), as well as a Weed of National Significance, bridal creeper (*Asparagus asparagoides*). The weeds mainly occur in drainage lines from farmland Locations 249, 57 or 63, except for the latter species which is near the Jerdacuttup River.

Recommendations

1. Request a permit from the Department of Conservation and Land Management to 'take' *Marianthus villosus* on Road No. 8432, or reroute the haul road to the east of the population so that it is avoided;

2. Realign the proposed haul road to avoid the *Allocasuarina scleroclada* subsp. *echinata* population and provide a 20 m buffer. Avoid construction of spur drains into this population;

3. If possible, align the haul road to avoid *Phebalium tuberculosum* 'Maydon form' (GF Craig 6076);

4. Liaise with the Shire of Ravensthorpe and the Department of Agriculture to implement a weed eradication/control program at current sites of weed invasion on Road No.8432 and Hatfield Road. Prevent further dispersal of weed seeds by minimising movement of soil out of drainage lines during road construction;

5. Operational procedures should be adopted to minimise the risk of dieback introduction and spread along the proposed haul road. This can be achieved by:
   - minimizing water runoff into communities with a high component of dieback susceptible, proteaceous species;
   - facilitating vehicle and machinery wash-down, and cessation of vehicle and machinery movement in extreme situations when high temperature and moisture conditions combine to spread the fungal spores.

Acknowledgements

The information provided by Geoff Cockerton (Landcare Services) with permission by Adrian Lee (BHP-Billiton) on the results of surveys for rare flora in the Ravensthorpe region is gratefully acknowledged. BIOTA Environmental Sciences calculated the area of the *Marianthus* population and Scott Williams (Tectonic Resources NL) the *Allocasuarina* population. Paul Wilson (WA Herbarium) kindly looked at and commented on the *Phebalium* specimen.

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Appendix 1

Department of Conservation and Land Managment's declared rare and priority flora list

Rare flora legislation and guidelines for gazettal

The State Conservation Strategy, Wildlife Conservation Act, 1950, and Conservation and Land Management Act 1984 provide the guidelines and legislative basis for the conservation of the State's indigenous plant and animal species. Under the Wildlife Conservation Act, the Department of Conservation and Land Management (CALM) is responsible for the protection of flora and fauna of all lands and waters throughout the State. Section 23F of the Act gives the Minister responsible for the Act statutory responsibility for the protection of those classes of flora declared to be rare.

The Wildlife Conservation Act (1950-1985) protects all classes of indigenous flora throughout the State. Protected flora includes:

Spermatophyta - flowering plants, conifers and cycads
Pteridophyta - ferns and fern allies
Bryophyta - mosses and liverworts
Thallophyta - algae, fungi and lichens

Section 23F of the Act provides special protection to those taxa (species, subspecies, varieties) considered by the Minister to be:

* in danger of extinction - the taxon is in serious risk of disappearing from the wild state within one or two decades if present land use and other factors continue to operate;
* rare - less than a few thousand adult plants of the taxon existing in the wild;
* in need of Special Protection - the taxon is not presently in danger of extinction but is at risk over a longer period through continued depletion, or occurs largely on sites likely to experience changes in land use which could threaten its survival in the wild;

  or

* presumed Extinct - taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently.

This is achieved by declaring them to be 'rare' by notice published in the Government Gazette. CALM's Policy Statement No.9 discusses the legislation relating to Declared Rare Flora and outlines the criteria for gazettal.

Under the provisions of Section 23F, the 'taking' of Declared Rare Flora is prohibited by any person on any category of land throughout the State without the written consent of the Minister. A breach of the Act is liable to a penalty of up to $10 000. The legislation refers only to wild growing populations and applies equally to Government officers and private citizens on Crown and private land.

To 'take' in relation to any flora includes 'to gather, pluck, cut, pull up, destroy, dig up, remove or injure the flora or to cause a permit the same to be done by any means'. This includes not only direct destruction or injury by human hand or machine but also such activities as allowing grazing by stock, introducing pathogens, altering water-tables so as to inundate or deprive the flora of adequate soil moisture, allowing air pollutants to harm foliage, and burning.

The schedule published in the Government Gazette is revised annually to accommodate additions and deletions to the Declared Rare Flora. To qualify for gazettal, plants must satisfy certain requirements as defined in Policy Statement No.9, namely:

* the taxon (species, subspecies, variety) must be well-defined, readily identifiable and represented by a voucher specimen in the State or National Herbarium. It need not be formally described under conventions in the International Code of Botanical Nomenclature, but such a description is preferred and should be undertaken as soon as possible after listing on the schedule;
* the taxon must have been thoroughly searched for in most likely habitats in the wild by competent botanists during the past five years;
* the searches have established that the plant in the wild is either rare, endangered or deemed to be threatened and in need of special protection.

Plants may be deleted from the Rare Flora schedule where:

* recent botanical survey has shown that the taxon is no longer rare, endangered or in need of special protection;
* the taxon is shown to be a hybrid;
* the taxon is no longer in danger of extinction because it has been adequately protected by reservation of land on which it occurs or because population numbers have increased beyond the danger point.

CALM's Priority Species List

CALM maintains a priority species list to determine for survey of plants of uncertain conservation status. The list comprises some 1000+ taxa that are poorly known and in need of high priority survey or are adequately surveyed but in need of monitoring. The poorly known taxa are possibly at risk but do not meet the survey requirements for gazettal as Declared Rare Flora (DRF), as outlined in Policy Statement No.9. Only those plants considered to be threatened on the basis of thorough survey or presumed extinct can be included on the DRF schedule.

The priority flora list is divided into the following categories according to the degree of threat.

Priority One - Poorly known Taxa
: Taxa which are known form one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat, e.g. road verges, urban areas, farmland, active mineral leases, etc., or the plants are under threat, e.g. from disease, grazing by feral animals, etc. May include taxa with threatened populations on protected lands. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

Priority Two - Poorly known Taxa
: Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

Priority Three - Poorly known Taxa
: Taxa which are known from several populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in need of further survey.

Priority Four - Rare Taxa
: Taxa which are considered to have been adequately surveyed and which, while being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5-10 years.

Table 2 - Declared Rare and Priority species potentially occurring between the Kundip Mining Leases and the RAV8 minesite.

Declared Rare:
Acacia rhamphophylla
Daviesia megacalyx
Eucalyptus bennettiae x
Eucalyptus burdettiana
Marianthus villosus

Priority One:
Astartea sp. Jerdacutttup (A.Strid 21898)
Beyeria sp. A Ravensthorpe (AS George 9497)
Dryandra corvijuga
Goodenia phillipsiae
Guichenotia anota
Guichenotia apetala
Melaleuca stramentosa
Microcorys pimeleoides
Pultenaea sp. Bandalup (GF Craig 3625)

Priority Two:
Acacia dictyoneura
Acacia disticha
Acacia laricina var. *crassifolia*
Acacia papulosa
Astroloma sp. Fitzgerald (GJ Keighery 8376)
Austrostipa exilis
Dryandra foliosissima
Eucalyptus petila
Hakea acuminata
Melaleuca penicula
Petrophile crispata
Thysanotus parviflorus

Priority Three:
Acacia bifaria
Acacia errabunda
Acacia ophiolithica
Acacia sp. Ravensthorpe (BR Maslin 5463)
Adenanthos glabrescens subsp. *exasperatus*
Boronia oxyantha var. *brevicalyx*
Dodonaea trifida
Grevillea fulgens
Micromyrtus tryptycha subsp. *carinata*
Spyridium glaucum

Priority Four:
Acacia argutifolia
Acacia dictyoneura
Acacia pinguiculosa subsp. *pinguiculosa*
Banksia laevigata subsp. *laevigata*
Dampiera deltoidea
Eucalyptus desmondensis
Eucalyptus stoatei
Goodenia stenophylla
Pimelea physodes
Siegfriedia darwinioides

Appendix 2

GPS Locations of Declared Rare & Priority Flora and Weeds

Datum: Geocentric Datum Australia 1994 (GDA94)

Species	Waypoint	Zone	Easting	Northing
Marianthus villosus POP 3A	52	51	242829	6270767
Marianthus villosus POP 3A	53	51	242786	6270907
Marianthus villosus POP 3A	54	51	242764	6270910
Marianthus villosus POP 3A	55	51	242680	6270867
Marianthus villosus POP 3A	57	51	242733	6270763
Marianthus villosus POP 3A	58	51	242836	6270753
Marianthus villosus POP 3A	59	51	242859	6270734
Hecla mine	Hecla	51	242619	6270794
Allocasuarina scleroclada ssp. echinata ms	63	51H	244465	6274114
Allocasuarina scleroclada ssp. echinata ms	64	51H	244465	6274136
Allocasuarina scleroclada ssp. echinata ms	65	51H	244449	6274154
Allocasuarina scleroclada ssp. echinata ms	66	51H	244434	6274132
Allocasuarina scleroclada ssp. echinata ms	67	51H	244387	6274118
Allocasuarina scleroclada ssp. echinata ms	68	51H	244391	6274084
Allocasuarina scleroclada ssp. echinata ms	69	51H	244396	6274076
Allocasuarina scleroclada ssp. echinata ms	70	51H	244428	6274074
Allocasuarina scleroclada ssp. echinata ms	71	51H	244433	6274075
Allocasuarina scleroclada ssp. echinata ms	72	51H	244452	6274106
Allocasuarina scleroclada ssp. echinata ms	73	51H	244472	6274092
Allocasuarina scleroclada ssp. echinata ms	74	51H	244491	6274084
Allocasuarina scleroclada ssp. echinata ms	75	51H	244511	6274093
Allocasuarina scleroclada ssp. echinata ms	76	51H	244507	6274070
Allocasuarina scleroclada ssp. echinata ms	77	51H	244525	6274076
Allocasuarina scleroclada ssp. echinata ms	78	51H	244516	6274097
Allocasuarina scleroclada ssp. echinata ms	79	51H	244494	6274117
Allocasuarina scleroclada ssp. echinata ms	80	51H	244459	6274112

	Waypoint	Zone	Easting	Northing	Notes
Priority One					
Beyeria sp. A Ravensthorpe	13	51H	244274	6274033	Road No. 8432 - 1 plant
Beyeria sp. A Ravensthorpe	23	51H	249711	6277995	Hatfield Rd - 20 plants
Beyeria sp. A Ravensthorpe	25	51H	249745	6276912	Hatfield Rd - 20 plants
Beyeria sp. A Ravensthorpe	27	51H	249781	6275644	Hatfield Rd - 20 plants
Beyeria sp. A Ravensthorpe	29	51H	249803	6274626	adjunct to Reserve, N limit on Hatfield Rd
Beyeria sp. A Ravensthorpe	30	51H	249811	6274393	cnr Hatfield Rd and Road No.8432 - 100s plants
Beyeria sp. A Ravensthorpe	31	51H	249382	6274393	W limit on Road No.8432
Beyeria sp. A Ravensthorpe	49	51H	242735	6271475	Road No.8432 - start (NE of Hecla)
Beyeria sp. A Ravensthorpe	50	51H	242756	6271350	Road No.8432 - end (NE of Hecla)
Melaleuca stramentosa	55	51H	240412	6270018	start (Kundip mining leases)
Melaleuca stramentosa	56	51H	240542	6270087	end (Kundip mining leases)
Melaleuca stramentosa	58	51H	240657	6270198	start (Kundip mining leases)
Melaleuca stramentosa	59	51H	240981	6270332	end (Kundip mining leases)
Pultenaea calycina ssp. proxena	15	51H	244366	6274073	Road No.8432 - small patch
Pultenaea calycina ssp. proxena	40	51H	243521	6273631	Road No.8432 - small patch
Pultenaea calycina ssp. proxena	43	51H	243037	6273406	Road No.8432 - start (c.20 m/>100 plants)
Pultenaea calycina ssp. proxena	44	51H	242975	6273248	Road No.8432 - end
Pultenaea calycina ssp. proxena	47	51H	242932	6272854	Road No.8432 - 50 plants
Priority Two					
Acacia laricina ssp. crassifolia	55	51H	240412	6270018	start (Kundip mining leases)
Acacia laricina ssp. crassifolia	56	51H	240542	6270087	end (Kundip mining leases)
Acacia laricina ssp. crassifolia	57	51H	240608	6270159	1 plant (Kundip mining leases)
Acacia laricina ssp. crassifolia	58	51H	240657	6270198	start (Kundip mining leases)
Acacia laricina ssp. crassifolia	59	51H	240981	6270332	end (Kundip mining leases)
Priority Three					
Acacia ophiolithica	4	51H	245539	6274458	Loc.56
Acacia ophiolithica	5	51H	245390	6274400	W limit/ Loc.56
Acacia ophiolithica	12	51H	244326	6274084	Road No. 8432 - costeen
Acacia ophiolithica	13	51H	244274	6274033	Road No. 8432 - c. 20 plants
Acacia ophiolithica	25	51H	249745	6276912	Hatfield Rd
Acacia ophiolithica	28	51H	249789	6275182	Hatfield Rd- c. 50 plants
Acacia ophiolithica	36	51H	244103	6273857	Road No. 8432 - start
Acacia ophiolithica	39	51H	243706	6273625	Road No. 8432 - end
Acacia ophiolithica	41	51H	243396	6273572	Road No. 8432 - start
Acacia ophiolithica	43	51H	243037	6273406	Road No. 8432 - end large patch
Acacia ophiolithica	46	51H	242943	6273008	Road No. 8432 - few
Acacia ophiolithica	47	51H	242932	6272854	Road No. 8432 - 50 plants
Acacia ophiolithica	48	51H	242805	6272767	Road No. 8432 - start large patch/ old track intersect.
Acacia ophiolithica	49	51H	242735	6271475	Road No. 8432 - end millions
Acacia ophiolithica	50	51H	242756	6271350	Road No. 8432 - start large patch
Acacia ophiolithica	51	51H	242772	6271143	track to Mosaic mine to East
Acacia ophiolithica	52	51H	242789	6270925	Road No. 8432 - end/ track to Hecla mine to west

Spyridium glaucum	2	51H	245708	6274574	Loc.56 - small population
Spyridium glaucum	6	51H	245258	6274356	Loc.56 - start
Spyridium glaucum	9	51H	244907	6274266	Loc. 56 - W limit

Significant species

Phebalium tuberculosum 'Maydon form' (GFC 6076)	7	51H	245168	6274391	Loc. 56

Weeds

bridal creeper	45	51H	242917	6273095	E side Jerdacuttup River
saffron thistle	14	51H	244150	6273890	firebreak/haul/drainage intersect.
saffron thistle/ narrow-leaf cotton bush	A1	51H	245856	6274575	W limit of weeds
saffron thistle/ narrow-leaf cotton bush	16	51H	246011	6274603	E limit of weeds
weeds	21	51H	247488	6274368	weeds
saffron thistle	32	51H	249086	6274370	weeds - saffron
weeds	24	51H	249729	6277359	weeds

Appendix 3

Marianthus villosus *POPULATION 3A: Rare Flora Report Form*

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT
RARE FLORA REPORT FORM

TAXON: Marianthus villosus. **POPULATION No.:** 3A
File No. Head Office: File No. District:
DRF [X] Proposed DRF [ ] Priority Species No. [ ] Geog. Restr. [ ]
New Population [ ] Routine Inspection [ ] Re-survey [X] Opportunistic Survey [ ]
FROM: GF Craig **TITLE:** Consultant **SURVEY DATE:** 10/2/04
REGION: South Coast **DISTRICT:** Albany **SHIRE:** Ravensthorpe
District Site Ref.: MAP REF.:
LAND STATUS: Nature Res. [ ] Water Res. [ ] Gravel Res. MRD [ ] Gravel Res. Shire [ ]
National Park [ ] Railway Res. [ ] Rd. Verge MRD [ ] Rd. Verge Shire [ ]
State Forest [ ] Private [ ] VCL [ ] Shire Reserve [ ]
Other [ ] State:
LOCALITY: 9.9 km SE of Mt Desmond., 0.4 km along left fork at Y junction ca. 11 km along road no. 8432 from Hopetoun - Ravensthorpe Rd. Immediately east of old 'Hecla' mine
LATITUDE: 33°40'23" **LONGITUDE:** 120°13'29" **ALTITUDE:** (AGD84) **ASPECT:**
LANDFORM: Hilltop [ ] Flat [ ] Drainageline [X] Swamp [ ] Ridge [ ]
Outcrop [ ] Breakaway [X] Slope [X] Gully [X] Valley [ ]
Riverbank [ ] Lake Edge [ ] Low Plain [ ] Sand Dune [ ] Cliff [ ]
Firebreak [ ] Other:

ROCK TYPE: Laterite [ ] Granite [ ] Dolerite [ ] Limestone [ ] Other:
ROCK FORM: Sheet [ ] Boulder [ ] Fluviatile Gravel [ ] Concretionary gravel [ ]
SOIL TYPE: Sand [X] Loam [X] Clay [ ] Peat [ ] Gravel [ ]
SOIL COLOUR: Red [ ] Brown [ ] Yellow [ ] White [ ] Grey [ ]
SOIL CONDITION: Perm. wet [ ] Moist [ ] Dry [ ] Saline [X] Other:
Pink loamy sand with quartz + gneiss rubble/gravel.
VEGETATION CLASSIFICATION (Muir's): Open mallee + mid-dense heath (0.5-2m)
ASSOCIATED SPECIES: Euc. pleurocarpa, E. suggrandis, Melaleuca hamata M. rigidifolia, E. pharopylla, Taxandria spathulata, Beaufortia schaueri, Acacia geraphylla
No. OF PLANTS:
Estimated [X] Actual [ ] Mature: 300+ Seedlings: Dead: Area Occupied: 1 ha
REPRODUCTIVE STATE: in bud [ ] flower [ ] immature fruit [ ] dehisced [X] vegetative [ ]
POLLINATORS: Native bees [ ] honey bees [ ] mammals [ ] birds [ ] insects [ ]
Other observations:
CONDITIONS OF POPULATION: Recently burnt [ ] diseased [ ] disturbed [ ] undisturbed [X]
Other [ ] State:

POTENTIAL THREATS: Firebreaks [ ] mining [ ] recreational activities [ ] 'disease' [ ] weeds [ ]
grazing [ ] clearing [ ] prescribed burning [ ] Other [ ] State

FIRE HISTORY: Not known [X] Burnt in 19 Summer [ ] Autumn [ ] Winter [ ] Spring [ ]
Next control burn: Year: Month:
VOUCHER SPECIMEN: Retained [ ] W.A. Herb. [ ] Other [ ] State:
ATTACHED: Map [ ] Mudmap [ ] Illustration [ ] Photo [ ] Field Notes [ ]
ACTION: Taken:
Required: by District [ ] S.O.H.Q. [ ] State:

FENCING REQUIREMENT:
ROADSIDE MARKERS:
OTHER COMMENTS: NB CALM report indicated this pop~ is "18.8 km SE of Mt Desmond" which is incorrect.
COPY SENT TO: Regional Office [ ] District Office [ ] Other [ ]. State:
SOHQ TO SEND COPY TO: Regional Office [ ] District Office [ ] Other [ ] State:

Signed: GF Craig Date: 23/2/04
NOTE: More than one box, in any section, may be ticked.

RECORDS: PLEASE FORWARD TO ADMINISTRATIVE OFFICER, FLORA, WILDLIFE ADMINISTRATION

Appendix 4

***Marianthus villosus* populations in the Ravensthorpe region (Craig 2004).**

(**Population numbers are those used by CALM).**

POP. NO.	LOCATION	STATUS	AREA (ha)	NO. OF PLANTS	CONDITION
1A	Vermin Proof Fence	resurvey	2.65	c. 35,000	burnt May/June 2001 ? and Feb 2003?
1B	Vermin Proof Fence	resurvey		nil	burnt May/June 2001
1C	Vermin Proof Fence	resurvey		nil	burnt May/June 2001
1D	Vermin Proof Fence	resurvey	0.03	54	burnt Feb 2003
1E	Vermin Proof Fence	resurvey	0.3	c. 4,000	burnt Feb 2003 east side; May/June 2001 west side of firebreak
1F	Vermin Proof Fence	not surveyed		(20+)	(26/11/81 survey)
1G	Vermin Proof Fence	new	0.2	c. 2,500	burnt Feb 2003
1H	Vermin Proof Fence	new	<0.01	10	burnt Feb 2003
1I	Vermin Proof Fence	new		100s	burnt Feb 2003
1J	Vermin Proof Fence	new	<0.01	c.20	burnt Feb 2003
2	1.2 km N of Mt Desmond	resurvey			not found; habitat wrong for given lat/long
3A	9.9 km SE of Mt Desmond; Hecla mine	resurvey	1	300-400	undisturbed, unburnt > 40 years
3B	9.3 km SE of Mt Desmond	resurvey			not found at given lat/long, although described locality seems equivalent to POP 3C
3C	9.4 km SE of Mt Desmond; NE of Flag mine (Kundip mining leases)	new (?= 3B)	1.4	c. 700	undisturbed, not burnt > 60 years
4	4.7 km SE of Mt Desmond; N of Mt Iron mine	resurvey	1.0	500+	undisturbed, not burnt > 60 years
5	7.9 km SE of Mt Desmond; N of Western Gem mine (Kundip mining leases)	new	4.84	c. 1,500	10-15% disturbed by old grids and tracks, remainder unburnt > 60 years

Appendix 5

Population statistics of* Allocasuarina scleroclada *subsp.* echinata *ms (G Cockerton 5016)

Populations 1 - 7 is data from Cockerton (2004), and Population 8 from the current survey by GF Craig.

Site	Date	Voucher Location	Location Description	Site Description	No. of Plants	Area searched
1 - Bonnymidgup Track (RRN3)	06/11/2003	0229307mE, 6287623mN (WGS 84)	8.9k east of Woodinup Road along Bonnymidgup Track, 6.4k east of range acsess track.	Lower slopes of Ravensthorpe Range, Heath on Granite.	est. 14	est. 1200 sqm
2 - Bonnymidgup Creek (RRN5)	06/11/2003	0229374mE, 6287598mN (WGS 84)	Approx 4.5km north then east of Ravensthorpe Range near Bonnymidgup Creek via well maintained fire break.	Lower slopes of Ravensthorpe Range, Heath on Granite.	est. 10	est. 900 sqm
3 - Halleys Baseline 30 (LCS8124)	25/09/2002	0257600mE, 6273035mN (AGD 84)	Halleys-baseline 30 - Bandalup Hill, east of Hale-Bopp orebody outline, within wastedump footprint.	Heath on Felsic Volcanic	est. 65	est. 100 sqm
4 - West of Hale-Bopp (LCS7773)	19/07/2002	0257325mE, 6272301mN (AGD 84)	Hale-Bopp, Beyeria nana Hill - approx. 50m west of Hale-Bopp orebody outline.	Mid slope in Acacia ophiolithica, Mallee Heath on Komatiite	est. 200	est. 1.0 ha
5 - NW of Bandalup Hill (LCS7925)	18/09/2002	0254040mE, 6278150mN (AGD 84)	NW of Bandalup Hill (Amalg Tenements)	Occurs with Melaleuca penicula, Heath on Silcrete (quartzite).	est. 25	est. 500 sqm
6 - Tamarine Rd (LCS6151)	11/10/2000	0248542mE, 6256364mN (AGD 84)	Tamarine Road site 62.	Mallee Shrubland on Limestone/Calcrete.	est. 52	est. 0.25 ha
7 - Helicopter Survey (LCS5016)	11/10/2000	0254056mE, 6292307mN (AGD 84)	Approx. 20 km north of Bandalup Hill.	Heath on Granite	est. 25	est. 500 sqm
8- Road No.8432 (GFC 6078)	29/04/2004	0244465mE 6274114mN (WGS84)	320 m west of Oldfield Loc.56	Mallee shrubland on calcareous loam	est. 600	0.44 ha

Appendix 6

Locations of **Pultenaea calycina *subsp.* proxena *ms***

[ex. *Pultenaea* sp. Bandalup *(*GF Craig 3625)] surveyed by G.F.Craig (unpub.data)

Bandalup Hill area:

Magnesite East Pits: estimated 7,500

Hale-Bopp tenement: estimated 20,000

'Road 11' (between Ravensthorpe-Hopetoun Rd and Moir Rd, south west of Kundip):

3.9 km west of Ravensthorpe-Hopetoun Rd
AGD84: 51 236048 E 626 7116 N
Occasional on north side of track burnt ?Dec 1990, which is more recent than old growth on south side of track. East facing slope, grey clay-loam with limestone nodules.
Open *Eucalyptus longicornis* ssp*. corvina, E. brachycalyx* and *Melaleuca ?pauperiflora* and heath including *Boronia*.
Vegetative.

4.6 km west of Ravensthorpe-Hopetoun Rd turn south (then west) on grid line for 0.8 km; west-facing slope, brown schist.
AGD84: 51 235019 E 626 6319N
< 10 plants in *Eucalyptus longicornis* ssp*. corvina* and *E. brachycalyx* low forest.

10.0 km west of Ravensthorpe-Hopetoun Rd
AGD84: 51 230710 E 626 5256N
Brown loam.
Occasional (100+ plants) in *Eucalyptus suggrandis* and *E. phenax* mallee.

13.6 km west of Ravensthorpe-Hopetoun Rd
AGD84: 51 227626 E 626 3714N
GF Craig Coll No: 5872
Brown/white calcareous clay loam. Open *Eucalyptus pleurocarpa* and dense proteaceous heath.
1,000s plants. Mainly in bud or vegetative. Occasional flowering, yellow.

Tectonic Resources NL

KUNDIP MINING LEASES

WASTE DUMPS & HAUL ROAD

DECLARED RARE & PRIORITY FLORA SURVEYS

October 2005

Cover photos:

Top left: *Melaleuca stramentosa* (Priority One)

Top right: *Acacia laricina* var. *crassifolia* (Priority Two)

Middle: Remnant *Eucalyptus indurata* woodland, Locs 62 & 63

Bottom: Remnant *Eucalyptus kessellii* mallee, Loc 63 looking north

KUNDIP MINING LEASES

WASTE DUMPS & HAUL ROAD

DECLARED RARE & PRIORITY FLORA SURVEYS

A report prepared for
Tectonic Resources NL
Suite 4, 100 Hay Street, Subiaco WA 6008

October 2005

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Summary

Tectonic Resources NL propose to mine for gold on the Kundip mining leases (tenements M74/41, 51, 53 & 135 and P74/153) located approximately 17 km south-east of Ravensthorpe and 31 km north of the coastal town of Hopetoun. A vegetation and flora survey of these tenements was carried out in December 2003 (Craig 2004a) and further surveys of two new plant species in March and November 2004 (Craig 2004b). The proposed Haul Road along Hatfield Road and gazetted Road No. 8432 was surveyed in May 2004 (Craig 2004c).

Additional surveys were required for two waste dumps on the Kundip Mining leases and five sections of the Haul Road:

1. Hopetoun – Ravensthorpe Road to Kundip Mining leases (240 m);
2. Kundip Mining Leases (1.1 km);
3. Hopetoun – Ravensthorpe Road to Trilogy Mining leases (100 m road reserve);
4. South Coast Highway to Loc 62 (6 m road reserve opposite RAV8 mine);
5. Loc 62 & 63 remnant vegetation (350 m & 500 m).

Waste Dumps

On the Northern Waste Dump, four plants of the Declared Rare *Marianthus villosus* were found in the east sector. Additional locations of *Acacia disticha* (P2), *Acacia durabilis* (P3), *Acacia laricina* var. *crassifolia* (P2), *Boronia oxyantha* var. *brevicalyx* (P3) and *Siegfriedia darwinioides* (P4) were found. Mature fruits are required to identify a species of *Hydrocotyle* to determine whether it is *Hydrocotyle decipiens* (P2).

On the Southern Waste Dump *Acacia laricina* var. *crassifolia* (P2) was found to be frequent and widespread. In addition, more *Boronia oxyantha* var. *brevicalyx* (P3), *Dodonaea trifida* (P3) and *Siegfriedia darwinioides* (P4) were found. A number of pockets of *Melaleuca stramentosa* (P1) were identified.

Haul Road

Within the Kundip Mining leases, the haul road will intersect significant populations of *Melaleuca stramentosa* (P1) and *Acacia laricina* var. *crassifolia* (P2).

The remaining four sections surveyed contain no Declared Rare or Priority flora. The road reserve opposite RAV8 is highly degraded and included the Pest Plant *Euphorbia terracina* (Geraldton carnation weed). The remnant vegetation on Locs 62 & 63 has been degraded by sheep grazing. Loc 63 has the Declared Plant *Carthamnus lanatus* (saffron thistle).

Recommendations

1. Apply for a permit to 'take' the few Declared Rare *Marianthus villosus* plants that occur in the eastern sector of the Northern Waste Dump.
2. Minimize disturbance, including firebreaks, of areas to the east and south-east of the waste dumps.
3. Collect seed of *Acacia laricina* var. *crassifolia* over a number of years, so that it can be used for waste dump and track rehabilitation.
4. In cooperation with CALM and other mining companies carry out regional surveys, particularly between Elverdton and Jerdacuttup Roads, for further populations of *Melaleuca stramentosa* (P1) in October, ie when this species is flowering, and *Acacia laricina* var. *crassifolia* (P2). High quality, ortho-corrected aerial photos at 1:5000 scale would greatly assist this project.
5. Collect mature specimens of *Hydrocotyle* in late October to confirm its identity.
6. Liaise with the Department of Agriculture, Ravensthorpe to determine the method of handling the topsoil along the northern alignment of the haul road which includes the Declared Plant, *Carthamnus lanataus* (saffron thistle) and Pest Plant *Euphorbia terracina* (Geraldton carnation weed).

Introduction

Tectonic Resources NL propose to mine for gold on the Kundip mining leases (tenements M74/41, 51, 53 & 135 and P74/153) which comprise approximately 664 ha, the majority of which is located east of the Hopetoun-Ravensthorpe Road, 17 km south east of Ravensthorpe and 31 km north of the coastal town of Hopetoun (Fig.1). A vegetation and flora survey of these tenements was carried out in December 2003 (Craig 2004a) and further surveys of two new plant species in March and November 2004 (Craig 2004b).

Waste Dumps

At the time of these surveys, the minesite design had not been finalized. During an on-site meeting on 8 September 2005 with representatives from Tectonic Resources, Outback Ecology, Department of Environment (DoE), Department of Conservation and Land Management (CALM) and Department of Industry and Resources (DOIR), it was recommended that a spring flora survey be carried out in those areas which would be heavily impacted by mining operations and which included large areas of relatively undisturbed vegetation. Essentially, these were the areas proposed for the Northern and Southern Waste Dumps (Fig.2).

Haul Road

The company intends to construct a road to haul mineral ore from their Kundip and Trilogy mining leases to the RAV8 minesite (Fig.1). In May 2004, the then proposed route along Hatfield Road and gazetted Road No. 8432 was surveyed for Declared Rare and Priority flora (Craig 2004c).

A number of sections of the Haul Road require additional survey where they pass through uncleared vegetation on or adjacent to the Kundip Mining leases, road reserves and remnant vegetation on private property, as either they were not included or have been modified since the original survey, ie:

1. 240 m from the Hopetoun – Ravensthorpe Road to the Kundip Mining leases (Fig.2);

2. 1.1 km through the Kundip Mining Leases (Fig.2), between the Hillsborough and Maydon Open Pits and north of the Southern Waste Dump where the proposed route deviates from an already cleared track referred as Road No. 8432;

3. the road reserve between the Hopetoun – Ravensthorpe Road and the Trilogy Mining leases;

4. the road reserve between the South Coast Highway and Loc 62 (opposite the RAV8 mine);

5. remnant vegetation on Loc 62 & 63, ie through the property of Mr A. Burton, which is the preferred route *in lieu* of Hatfield Road.

This report should be read in conjunction with earlier surveys by Craig (2004a, 2004c) as they provide detailed descriptions of the vegetation units and Declared Rare and Priority flora found on the Kundip Mining leases and haul road.

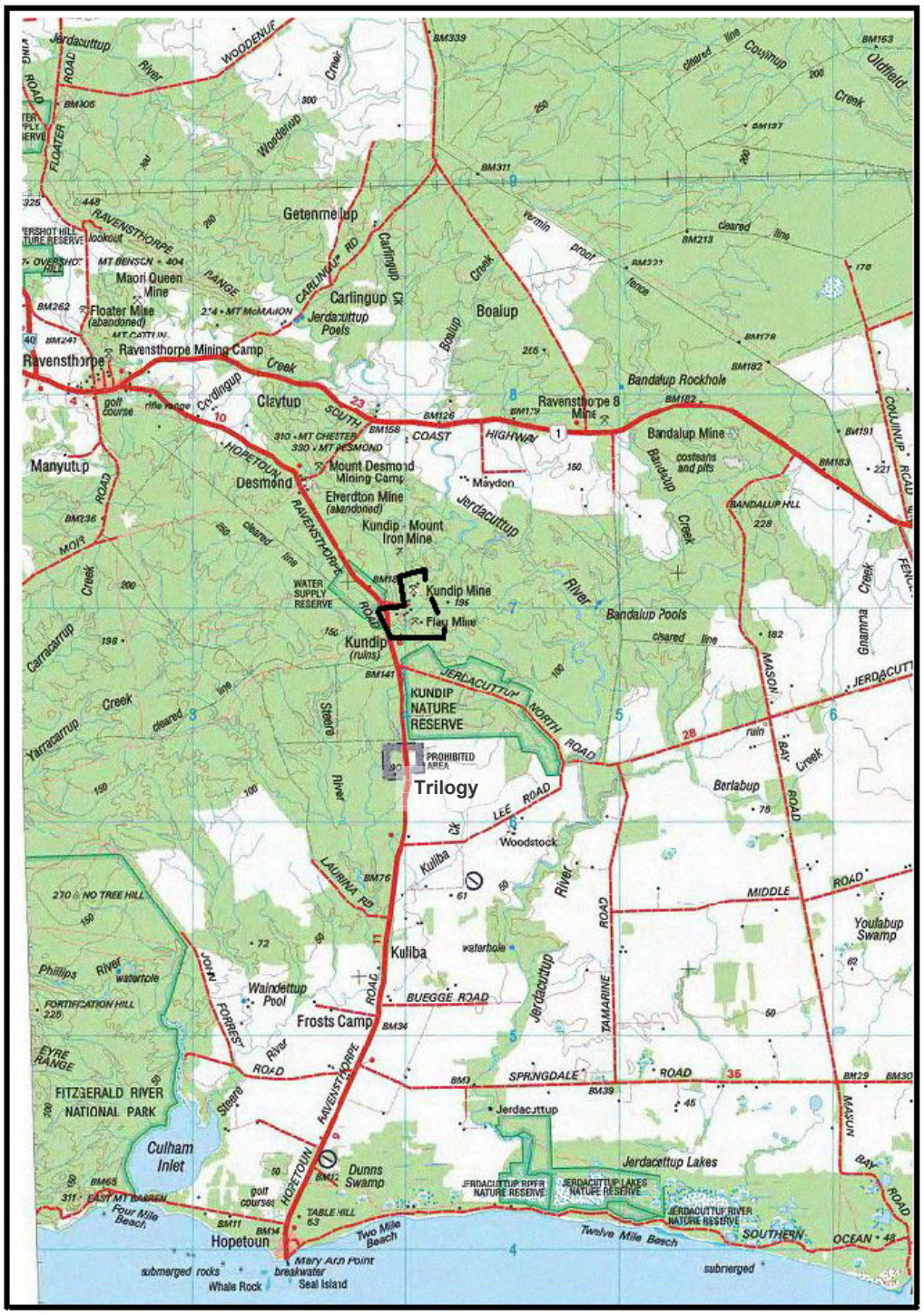

Fig.1 – Location of Kundip, RAV8 and Trilogy mining leases

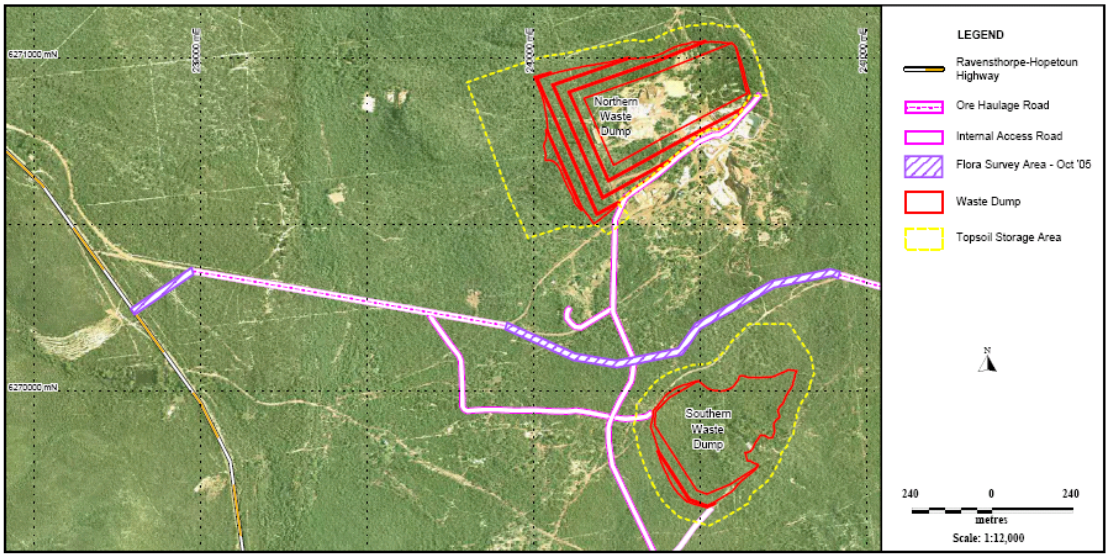

Fig.2 – Mid-section of Kundip Mining Leases showing location of proposed Northern and Southern Waste Dumps and Haul Road.

Methods

Transects through the Northern and Southern Waste Dumps were walked at approximately 150 m intervals in a north-south direction on 12 and 13 September 2005. Both days were warm (max. 17-18^{o}C), sunny with scattered clouds and slight breezes. Light showers were experienced late on the 12 September.

The Haul Road was surveyed by walking the alignment in the sector north of the Southern Waste Dump on 13 September, and the remaining sectors on 7 October 2005. The latter was an overcast day (max. 18^{o}C) with moderate winds. Locations of DRF and Priority flora were mapped and their positions taken with a GPS (Garmin II) (Appendix 3). A list of the DRF and priority flora which has the potential to occur on the leases is given in Craig 2004a.

During the surveys, plant taxa which had not been previously recorded were added to the plant species x vegetation unit matrix (Appendix 3, Craig 2004a). A specimen of each taxon not recognised by the author was taken for identification. Plant specimens were verified using the author's private herbarium and the Perth Herbarium; nomenclature follows that of PERTH (Paczkowska and Chapman 2000). Duplicate specimens of special interest will be lodged at both the Ravensthorpe and Perth herbaria.

Results

Species Diversity

A total of 249 native species were found on the Kundip Mining leases during the original survey in summer 2003 (Craig 2004a). An additional 31 species, including four orchids, were found on the waste dumps and haul road on the Kundip Mining leases during this survey. These species have been incorporated into the plant species x vegetation unit matrix (Appendix 1). The majority of the additional species were found in the *Banksia lemmaniana* open mallee-thicket [**BlI**] unit.

Declared Rare and Priority Flora

Northern Waste Dump

Four plants of the Declared Rare *Marianthus villosus* were found in two disturbed sites on a weak drainage line at the east end of the dump. No plants were found in the undisturbed vegetation.

A species of *Hydrocotylye* grows in the creekline immediately west of the current dams. Fruits were immature at the time of survey. Mature fruits are required to determine whether it is the Priority 2 *Hydrocotyle decipiens.*

Additional locations were identified for a number of Priority species (Fig.3), including *Acacia disticha* (P2) and *Acacia durabilis* (P3) at the west end of the proposed dump, mainly in drainage lines. At the east end, *Acacia laricina* var. *crassifolia* (P2), *Boronia oxyantha* var. *brevicalyx* (P3) and *Siegfriedia darwinioides* (P4) were found.

Southern Waste Dump

Acacia laricina var. *crassifolia* (P2) was found to be frequent and widespread throughout the site. In addition, more *Boronia oxyantha* var. *brevicalyx* (P3), *Dodonaea trifida* (P3) and *Siegfriedia darwinioides* (P4) were found (Fig.3). A number of pockets of *Melaleuca stramentosa* (P1) were identified throughout the site, however they are too small to individually map as 'vegetation units' (cf. Craig 2004a).

Haul Road

1. Hopetoun – Ravensthorpe Road to Kundip Mining leases (240 m)

The vegetation is Mid-dense Mallee (*Eucalyptus incrassata, E. leptocalyx, E. suggrandis, E. uncinata)* with Dense Heath (0.5-1.5 m tall) characterized by *Banksia media.* Species include those described for the [**Bm**] vegetation unit (Craig 2004a).

No Declared Rare or Priority flora was found.

2. Kundip Mining Leases (1.1 km)

The haul road intersects a number of vegetation units which are described in Craig 2004a.

No Declared Rare flora was found. Additional locations of *Melaleuca stramentosa* (P1) and *Acacia laricina* var. *crassifolia* (P2) were found, with the largest populations occurring in the sector north of the Southern Waste Dump (Fig.3, Appendix 3).

3. Hopetoun – Ravensthorpe Road to Trilogy Mining leases (100 m road reserve)

The vegetation is Very Open Mallee (*Eucalyptus pleurocarpa, E. leptocalyx, E. phaenophylla, E. suggrandis)* and Very Open Low Heath (< 1m) and Sedge. A high diversity of proteaceous and leguminous shrubs are present, including *Dryandra cirsioides.*

No Declared Rare or Priority flora was found.

4. South Coast Highway to Loc 62 (6 m road reserve opposite RAV8 mine)

A highly degraded site, exacerbated by the wildfire in February 2003, this section of the road reserve is infested with at least 15 species of weeds, mostly grasses and annuals. A few shrubs are struggling through the weeds, including *Senna artemisioides* and *Acacia cyclops.*

The Pest Plant *Euphorbia terracina* (Geraldton Carnation Weed) is present.

No Declared Rare or Priority flora was found, although an upright form of *Eremophila densifolia* is present which appears to have a distribution restricted to the RAV8 – Bandalup Hill area.

5. Loc 62 & 63 remnant vegetation (350 m & 500 m)

a) A low ridge of rocky, calcareous soil occurs between the boundaries of Loc 62 & 63. The open woodland *(Eucalyptus indurata, E. calycogona)* and tall shrubs (*Melaleuca pauperiflora, M. cucullata)* is degraded, with the understorey bared due to sheep grazing.

No Declared Rare or Priority flora was found.

b) A gently sloping to flat area at the southern limit of Loc 63 has a narrow degraded remnant of mallee (*Eucalyptus kessellii, E. phaenophylla, E. suggrandis, E. uncinata)* with a few tall shrubs (*Hakea laurina, H. lissocarpha, Melaleuca calycina, M. pulchella)* and sedge (*Gahnia aristata).* Weedy pasture species dominate the understorey.

The Declared Plant *Carthamnus lanatus* (saffron thistle) is present.

No Declared Rare or Priority flora was found.

Fig.3 – Declared Rare and Priority flora on Kundip Mining leases

Discussion

Kundip Mining Leases

Thirty-one species, including four orchids, were added to the plant list for the Kundip Mining leases as a result of spring surveys. This amounts to 11% of the 280 known native plants occuring on the lease, indicating that surveys during different seasons will find previously unrecorded species. Additional species may also be expected after major disturbances, such as fire.

None of the additional species, except the *Hydrocotyle* listed below, are listed on CALM's Declared Rare and Priority flora list (Atkins 2005), although new populations of a number of Priority flora were found. The majority of these had previously been recorded near of within the Waste Dump sites and Haul Road.

Four plants of the Declared Rare *Marianthus villosus* were found in a disturbed, weak drainage line at the east end of the Northern Waste Dump. It was difficult to determine whether they had been introduced from the known, large population about 300 m to the north, or whether they were naturally *in situ.* No plants were found in the adjacent, undisturbed vegetation. It should be noted, however, that further disturbance near these plants, may cause others to germinate.

With respect to DRF and Priority flora, the largest impact will be on *Acacia laricina* var. *crassifolia.* This species is frequent and widespread in the east end of the Northern Waste Dump, and throughout the Southern Waste Dump and areas to the north which will be intercepted by the Haul Road. It is also known to be frequent in the *Melaleuca stramentosa* [**Ms**] vegetation unit to the east and areas further to the south-east, which are proposed to remain undisturbed. Although *A. laricina* var. *crassifolia* is more widespread (Appendix 2) than indicated in Craig (2004a), the Kundip population is of a significant size and as much of its integrity should be maintained as possible.

Tectonic Resources NL have planned the Waste Dumps sites to minimise impact on the *Marianthus villosus* (DRF) and *Melaleuca stramentosa* (P1) populations, both of which are local endemics with restricted distributions. There is a concern that due to increased exploration and mining of the Ravensthorpe region, populations of these species may become increasingly disturbed and decimated over time, especially if a number of different companies become involved in these ventures. The populations of *Marianthus villosus* are relatively well known (Craig 2004a), however the distribution of *Melaleuca stramentosa* within the region remains poorly documented (Appendix 2).

A species of *Hydrocotyle* occurs in the creekline in the western sector of the Northern Waste Dump. Confirmation of the identitiy of this species, which is potentially *Hydrocotyle decipiens* (P2), requires mature fruits.

Haul Road

No Declared Rare or Priority flora was found on the four areas surveyed outside the Kundip mining leases.

The vegetation on the road reserves at the southern end of the alignment, ie adjacent to Trilogy and Kundip mining leases, is mostly in excellent condition, although old tracks are evident. No weeds were present.

The vegetation on the road reserve opposite RAV8 is highly degraded by weed invasion, including the Pest Plant *Euphorbia terracina* (Geraldton carnation weed). Declaration as a pest plant authorizes the Shire Council to enforce control of that plant within its boundaries.

The remnant vegetation in Locs 62 & 63 is unfenced and the understorey has been degraded by sheep grazing. The Declared Plant *Carthamnus lanatus* (saffron thistle) is present at the southern end of Loc 63. A plant formally 'declared' under the Agriculture and Resources Protection Act requires the landholder to control the plant at their own expense (Hussey et al., 1997).

Recommendations

1. Apply for a permit to 'take' the few Declared Rare *Marianthus villosus* plants that occur in the eastern sector of the Northern Waste Dump.
2. Minimize disturbance, including firebreaks, of areas to the east and south-east of the waste dumps.
3. Collect seed of *Acacia laricina* var. *crassifolia* over a number of years, so that it can be used for waste dump and track rehabilitation.
4. In cooperation with CALM and other mining companies carry out regional surveys, particularly between Elverdton and Jerdacuttup Roads, for further populations of *Melaleuca stramentosa* (P1) in October, ie when this species is flowering, and *Acacia laricina* var. *crassifolia* (P2). High quality, ortho-corrected aerial photos at 1:5000 scale would greatly assist this project.
5. Collect mature specimens of *Hydrocotyle* in late October to confirm its identity.
6. Liaise with the Department of Agriculture, Ravensthorpe to determine the method of handling the topsoil along the northern alignment of the haul road which includes the Declared Plant, *Carthamnus lanataus* (saffron thistle) and Pest Plant *Euphorbia terracina* (Geraldton carnation weed).

Acknowledgements

The assistance of Rosemary Jasper in confirming the identification of a number of species at the Perth herbarium, and of Alan and Andrew Burton (owners of Locs 62 & 63) for guiding me to the remnant vegetation, is greatly appreciated. Nancy Scherbarth (Tectonic Rescources NL) kindly prepared Figures 2 and 3, following early drafts of Figure 3 being prepared by BIOTA Environmental Sciences. Sarah Perry (Outback Ecology) coordinated various aspects of the survey.

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Appendix 1

Plant species x vegetation unit matrix

An updated list of the plant species occurring in each of the predominant vegetation units is depicted in the following table. Craig (2004a) should be referred to for a discussion and map of the vegetation units.

Vegetation Formations			Low Forest/Woodland			Open Woodland + Thicket/Heath				Mallee + Thicket/Heath									
Plant Associations		Priority Status	Ea	En/Ec/ Ea	Ep	Ma	Mc	Mx	Mp	Mh	Mm	Ms± Mb	Mg	My	Mr	Bl	Bm	Disturbed#	
GYMNOSPERMS																			
Cupressaceae	Callitris drummondii					x													1
	Callitris roei									x						x			2
MONOCOTYLEDONS																			
Agavaceae	*Agave americana CENTURY PLANT																	x	1
Anthericaceae	Laxmannia paleacea															x			
Arecaceae	*?Washingtonia filifera COTTON PALM																	x	1
Cyperaceae	Desmocladus flexuosus															x			
	Gahnia ancistrophylla					x									x	x	x		4
	Gahnia lanigera					x		x		x				x	x				5
	Gahnia trifida					x													1
	Lepidosperma brunonianum									x						x	x		3
	Lepidosperma leptostachyum									x						x	x		3
	Lepidosperma pubisquameum					x													1
	Lepidosperma squamatum																**X**		1
	Lepidosperma sp. A2 Island Flat (Keighery 7000)					x				x									2
	Lepidosperma sp. Kundip (GF Craig 6011)									x									1
	Lepidosperma sp. Ravensthorpe (GF Craig 5188)					x	x												2
	Lepidosperma sp. Z dark sheath					x				x							x		3
	Lepidosperma tuberculatum															x	x		2
	Mesomelaena stygia															x			1
Dasypogonaceae	Lomandra effusa					x				x							x		3
	Lomandra mucronata															x	x		2
Iridaceae	*?Iris sp.																	x	1
Haemodoraceae	Conostylis bealiana															x			1

Vegetation Formations			Low Forest/Woodland			Open Woodland + Thicket/Heath				Mallee + Thicket/Heath									
Plant Associations		Priority Status	Ea	En/Ec/ Ea	Ep	Ma	Mc	Mx	Mp	Mh	Mm	Ms± Mb	Mg	My	Mr	Bl	Bm	Disturbed#	
	Haemodorum discolor															x			1
Juncaceae	Juncus pallidus				x														1
Liliaceae	*Aloe sp. ALOE																	x	1
Orchidaceae	Cyanicula caerulea subsp. aperatala											x				x	x		
	Pterostylis turfosa															x			
	Pterostylis sanguinea															x			
	Thelymitra lachnophylla					x													
Phormiaceae	Dianella sp.										x								1
Poaceae	*Cynodon dactylon COUCH																	(x)	1
	*Eragrostis curvula AFRICAN LOVEGRASS																	(x)	1
	Neurachne alopecuroidea									x					x	x	x		4
	Spartochloa scirpoidea					x				x									2
Restionaceae	Lepidobolus chaetocephalus															x			
Xanthorrhoeaceae	Xanthorrhoea platyphylla															x			1
DICOTYLEDONS																			
Aizoaceae	Carpobrotus sp.									x	x								2
	Disphyma crassifolium					x													1
	*Mesembryanthemum crystallinum ICEPLANT																	x	1
Apiaceae	Hydrocotyle sp.															x			
Ascelpiadaceae	*Stapelia variegata STAR FLOWER																	x	1
Asparagaceae	*Asparagus asparagoides BRIDAL CREEPER																	**X**	1
Asteraceae	Angianthus tomentosus					x												x	2
	*Centaurea solstitialis ST BARNABY'S THISTLE																	x	1
	*Cirsium vulgare SPEAR THISTLE				x													x	2
	*Conyza bonariensis FLEABANE																	x	1

	Vegetation Formations		Low Forest/Woodland			Open Woodland + Thicket/Heath				Mallee + Thicket/Heath									
	Plant Associations	Priority Status	Ea	En/Ec/ Ea	Ep	Ma	Mc	Mx	Mp	Mh	Mm	Ms± Mb	Mg	My	Mr	Bl	Bm	Disturbed#	
	*Dittrichia graveolens STINKWORT																	x	1
	*Hypochaeris radicata FLATWEED																	(x)	1
	Olearia dampieri ssp. eremicola									x									1
	Olearia passerinoides					x													1
	Ozothamnus lepidophyllus									x							x		2
	*Sonchus oleraceus SOW THISTLE				x													x	2
	Vittadenia gracilis																	x	1
Boraginaceae	Halgania andromedifolia						x				x								2
Caesalpiniaceae	Labichea lanceolata					x													1
	Senna artemisioides										x					x			2
Campanulaceae	Wahlenbergia gracilenta					x													
Casuarinaceae	Allocasuarina campestris									x									1
	Allocasuarina humilis															x			1
	Allocasuarina thuyoides															x	x		2
Chenopodiaceae	Atriplex semibaccata				x														1
	Chenopodium pumilo																	x	1
	Enchylaena tomentosa				x	x					x							x	4
	Halosarcia lepidosperma					x													1
	Maireana marginata					x													1
	Threlkeldia diffusa										x								1
	Sclerolaena diacantha				x														1
Convolvulaceae	Wilsona humilis					x				x									2
Crassulaceae	*Cotyledon orbiculare																	x	1
Dilleniaceae	Hibbertia acerosa									x						x	x		3
	Hibbertia gracilipes														x	x	x		3
	Hibbertia aff. gracilipes (glabrous)									x									1

Vegetation Formations			Low Forest/Woodland			Open Woodland + Thicket/Heath								Mallee + Thicket/Heath					
Plant Associations		Priority Status	Ea	En/Ec/ Ea	Ep	Ma	Mc	Mx	Mp	Mh	Mm	Ms± Mb	Mg	My	Mr	Bl	Bm	Disturbed#	
	Hibbertia mucronata															x			1
	Hibbertia psilocarpa ms							x											1
	Hibbertia pungens																x		
	Hibbertia rupicola									x									1
Droseraceae	Drosera macranthera															x			
Epacridaceae	Acrotriche plurilocularis		x					x											2
	Acrotriche ramiflora					x				x							x		3
	Andersonia parvifolia							x				**X**				x			3
	Astroloma serratifolium					x				x						x			3
	Coeleanthera myrtoides																x		1
	Leucopogon carinatus														x	x			2
	Leucopogon conostephioides															x	x		2
	Leucopogon cuneifolius															x			1
	Leucopogon dielsianus														x	x	x		3
	Leucopogon infuscatus			x				x		x		x			x	x			6
	Lysinema ciliatum														x	x			2
	Styphelia intertexta									x									1
Euphorbiaceae	Beyeria brevifolia var. brevifolia															x			1
	Beyeria ?brevifolia var. robustior										x								1
	Beyeria lechenaultii										x								1
	Montaxis paxii					x													
	Poranthera microphylla					x													
	Stachystemon virgatum															x			1
Gentianaceae	*Centaurium erythraea COMMON CENTAURY																	x	1
Geraniaceae	*Geranium sp. GERANIUM																	x	1
Goodeniaceae	Coopernookia polygalacea		x	x				x		x					x	x	x		7

	Vegetation Formations		Low Forest/Woodland			Open Woodland + Thicket/Heath							Mallee + Thicket/Heath					
	Plant Associations	Priority Status	Ea	En/Ec/ Ea	Ep	Ma	Mc	Mx	Mp	Mh	Mm	Ms± Mb	Mg	My	Mr	Bl	Bm	Disturbed#	
	Coopernookia strophiolata					x				x							x		3
	Dampiera angulata									x					x	x			3
	Dampiera incana															x			1
	Dampiera sacculata																x		1
	Goodenia laevis ssp. humifusa									x							x		2
	Goodenia scapigera ssp. scapigera									x									1
Haloragaceae	Glischrocaryon aureum															x			
	Haloragodendron glandulosum		x																1
Lamiaceae	Microcorys glabra			x						x				x	x				4
Lauraceae	Cassytha melantha					x				x	x			x					4
	Cassytha pomiformis									x		x				x			3
Lobeliaceae	Lobelia rhombifolia															x			
Loganiaceae	Logania buxifolia															x			1
Mimosaceae	Acacia assimilis ssp. atroviridis					x													1
	Acacia brachyclada			x						x					x				3
	Acacia chrysocephala															x	x		2
	Acacia crispula															x			1
	Acacia cyclops					**X**										x			2
	Acacia disticha	P2				x						x							2
	Acacia durabilis	P3						x				x				x			3
	Acacia erinacea									x							x		2
	Acacia ferocior									x		x							2
	Acacia glaucoptera		x	x		x	x			x									5
	Acacia gonophylla					x										x	x		3
	Acacia heterochroa ssp. heterochroa															x			1

Vegetation Formations			Low Forest/Woodland			Open Woodland + Thicket/Heath				Mallee + Thicket/Heath									
	Plant Associations	Priority Status	Ea	En/Ec/ Ea	Ep	Ma	Mc	Mx	Mp	Mh	Mm	Ms± Mb	Mg	My	Mr	Bl	Bm	Disturbed#	
	Acacia ingrata									x	x					x	x		4
	Acacia laricina var. crassifolia	P2								x		**X**			x	x			4
	Acacia pinguiculosa ssp. pinguiculosa	P4								x						x		x	3
	Acacia rostellifera					x													1
	Acacia saligna					x													1
	Acacia spongolitica					x													1
	Acacia subcaerulea					x										x			2
	Acacia sulcata var. platyphylla									x						x			2
Moraceae	*Ficus carica FIG																	x	1
	*Ficus macrophylla MORETON BAY FIG																	x	1
Myrtaceae	Baeckea corynophylla					x		x		x		x			x	x	x		7
	Baeckea crispiflora									x						x			2
	Baeckea aff. latens (= KR Newbey 11085)					x													1
	Beaufortia micrantha var. micrantha															x	x		2
	Beaufortia orbifolia											x				x			2
	Beaufortia shaueri									x						x	x		3
	Callistemon phoeniceus					x													1
	Calothamnus pinifolius															x			1
	Calothamnus quadrifidus					x				x						x	x		4
	Calytrix leschenaultii																x		1
	Chamelaucium ciliatum															x			1
	Eucalyptus astringens		**X**	**X**															2
	Eucalyptus austrina					x													1
	Eucalyptus brachycalyx										x								1
	Eucalyptus calycogona					x							x						2
	Eucalyptus cernua		x	**X**		x	x	**X**		x		x							7

Vegetation Formations		Low Forest/Woodland			Open Woodland + Thicket/Heath								Mallee + Thicket/Heath					
Plant Associations	Priority Status	Ea	En/Ec/ Ea	Ep	Ma	Mc	Mx	Mp	Mh	Mm	Ms± Mb	Mg	My	Mr	Bl	Bm	Disturbed#	
Eucalyptus clivicola		x									x							2
Eucalyptus conglobata					x				x							x		3
Eucalyptus falcata															**X**			1
Eucalyptus flocktoniae			x			**X**	x		x	x	x				x			7
Eucalyptus incrassata														x	x	x		3
Eucalyptus indurata										x								1
Eucalyptus lehmannii															x			1
Eucalyptus leptocalyx					x				x		x			**X**		x		5
Eucalyptus longicornis ssp. corvina										x								1
Eucalyptus occidentalis					**X**													1
Eucalyptus phaenophylla ssp. interjacens									x					x				2
Eucalyptus phaenophylla ssp. phaenophylla			x		x		x		x		x		**X**	x	x	x		9
Eucalyptus phenax					x				x									2
Eucalyptus pileata		x			x	x	x		x			x	**X**					7
Eucalyptus platypus				**X**				**X**										2
Eucalyptus pleurocarpa									x						**X**	**X**		3
Eucalyptus scyphocalyx													**X**					1
Eucalyptus sporadica					x													1
Eucalyptus suggrandis								x	x		x							3
Eucalyptus tetraptera															x			1
Eucalyptus uncinata									x		x			x	x			4
Kunzea affinis									x									1
Kunzea cincinnata									x									1
Kunzea strigosa ms																x		
Leptospermum maxwellii									x						x	x		3
Leptospermum spinescens															x	x		2

Vegetation Formations			Low Forest/Woodland			Open Woodland + Thicket/Heath							Mallee + Thicket/Heath					
Plant Associations		Priority Status	Ea	En/Ec/ Ea	Ep	Ma	Mc	Mx	Mp	Mh	Mm	Ms± Mb	Mg	My	Mr	Bl	Bm	Disturbed#	
	Melaleuca acuminata					**X**													1
	Melaleuca bracteosa			x		x		x				**X**			x				5
	Melaleuca cf. bracteosa						x			x									2
	Melaleuca bromelioides					x			x	x	x								4
	Melaleuca calycina ssp. calycina					x								**X**			x		3
	Melaleuca carrii															x	x		2
	Melaleuca coronicarpa		x	x															2
	Melaleuca cucullata				x			**X**	x				x						4
	Melaleuca cuticularis					x													1
	Melaleuca glaberrima					x										x			2
	Melaleuca hamata					**X**				**X**					x	x			4
	Melaleuca haplantha		x		x			x	**X**										4
	Melaleuca lateriflora					x				x				x			x		4
	Melaleuca pauperiflora ssp. pauperiflora		x						x	x	**X**								4
	Melaleuca pomphostoma					x													1
	Melaleuca rigidifolia		**X**					x		x					**X**	x	x		6
	Melaleuca sp. gorse (AS George 7224)						x	x		x			x						4
	Melaleuca sp. Kundip (GF Craig 6020)	Signif.						**X**		x									2
	Melaleuca stramentosa	P1		x				x		x		**X**				x			5
	Melaleuca subfalcata			x		x				x					x		x		5
	Melaleuca subtrigona																x		1
	Melaleuca undulata						x												1
	Melaleuca viminea ssp. demissa					x													1
	Taxandria spathulata									x						**X**			2
	Verticordia densiflora ssp. cespitosa															x			1
Onagraceae	*Oenothera stricta EVENING PRIMROSE																	(x)	1

Vegetation Formations			Low Forest/Woodland			Open Woodland + Thicket/Heath				Mallee + Thicket/Heath									
Plant Associations		Priority Status	Ea	En/Ec/ Ea	Ep	Ma	Mc	Mx	Mp	Mh	Mm	Ms± Mb	Mg	My	Mr	Bl	Bm	Disturbed#	
Papilionaceae	Brachysema latifolium																	x	1
	Chorizema aciculare															x			
	Chorizema nervosum									x					x	x			3
	Chorizema trigonum															x	x		2
	Chorizema uncinatum															x			
	Daviesia anceps			x						x	x					x			4
	Daviesia articulata											x		x	x				3
	Daviesia benthamii					x				x			x				x		4
	Daviesia emarginata															x	x		2
	Daviesia lancifolia														x				1
	Daviesia mollis															x			1
	Daviesia nematophylla					x				x			x						3
	Daviesia teretifolia															x	x		2
	Eutaxia cuneata									x					x	x			3
	Eutaxia microphylla var. microphylla					x													1
	Gastrolobium congestum											x				x			2
	Gastrolobium parviflorum			x						x		x				x			4
	Gastrolobium tetragonophyllum					x													1
	Gompholobium confertum					x		x		x					x	x	x		6
	Gompholobium knightianum															x			
	Gompholobium marginatum															x			
	Hovea pungens															x			
	Jacksonia elongata															x	x		2
	Jacksonia viscosa															x			1
	Otion microphyllum																x		1
	Pultenaea conferta																x		1

Vegetation Formations			Low Forest/Woodland			Open Woodland + Thicket/Heath						Mallee + Thicket/Heath						
	Plant Associations	Priority Status	Ea	En/Ec/ Ea	Ep	Ma	Mc	Mx	Mp	Mh	Mm	Ms± Mb	Mg	My	Mr	Bl	Bm	Disturbed#	
	Pultenaea empetrifolia															x	x		2
	Pultenaea sp. Kundip (GF Craig 6008)	Signif.	x					x					x						3
	Templetonia retusa					x													1
Olacaceae	Olax benthamii															x			
Pittosporaceae	Billardiera bicolor									x									1
	Marianthus villosus	DRF				x						x				x			2
	Sollya heterophylla					x													1
Polygalaceae	Comesperma acerosum															x			1
	Comesperma volubile															x			
Primulaceae	*Anagallis arvensis PIMPERNEL																	x	1
Proteaceae	Banksia lemmaniana															**X**			1
	Banksia media														x		**X**		2
	Dryandra cirsioides															x			1
	Dryandra falcata															x			1
	Dryandra quercifolia															x			1
	Dryandra tenuifolia var. tenuifolia															x			1
	Grevillea concinna ssp. lemanniana															x			1
	Grevillea dolichopoda															x			1
	Grevillea disjuncta					x									x				2
	Grevillea oligantha					x				x					x				3
	Grevillea patentiloba									x					x	x	x		4
	Grevillea rigidia ssp. rigida															x			1
	Hakea corymbosa															x	x		2
	Hakea laurina					x				x						x	x		4
	Hakea lissocarpha									x					x	x	x		4
	Hakea marginata ssp. marginata															x	x		2

Vegetation Formations			Low Forest/Woodland			Open Woodland + Thicket/Heath				Mallee + Thicket/Heath									
Plant Associations		Priority Status	Ea	En/Ec/ Ea	Ep	Ma	Mc	Mx	Mp	Mh	Mm	Ms± Mb	Mg	My	Mr	Bl	Bm	Disturbed#	
	Hakea nitida									x									1
	Hakea obtusa															x			1
	Hakea pandanicarpa ssp. crassifolia															x	x		2
	Hakea trifurcata															x			1
	Hakea verrucosa									x	x					x			3
	Isopogon axillaris														x	x			2
	Isopogon trilobus																x		1
	Persoonia striata															x			1
	Persoonia teretifolia														x	x	x		3
	Petrophile fastigiata															x	x		2
	Petrophile seminuda															x			1
	Petrophile squamata															x	x		2
	Synaphea interioris															x			1
Rhamnaceae	Siegfriedia darwinioides	P4				x						x				x			3
	Spyridium cordatum									x						x	x		3
	Spyridium glaucum	P3										x							1
	Trymalium elachophyllum															x			
Rutaceae	Boronia crassifolia															x			1
	Boronia inconspicua									x									1
	Boronia inornata ssp. inornata									x	x						x		3
	Boronia octandra											x							
	Boronia oxyantha var. brevicalyx	P3	x	x								x							3
	Phebalium microphyllum		x																1
	Philotheca gardneri subsp. 'Ravensthorpe form'									x		x							
Santalaceae	Choretrum glomeratum															x	x		2

Vegetation Formations			Low Forest/Woodland			Open Woodland + Thicket/Heath				Mallee + Thicket/Heath									
Plant Associations		Priority Status	Ea	En/Ec/ Ea	Ep	Ma	Mc	Mx	Mp	Mh	Mm	Ms± Mb	Mg	My	Mr	Bl	Bm	Disturbed#	
	Exocarpus aphyllus			x		x				x									3
	Exocarpus sparteus															x			1
Sapindaceae	Dodonaea caespitosa																x		1
	Dodonaea concinna						x				x								2
	Dodonaea pinifolia					x	x			x	x								4
	Dodonaea ptarmicaefolia					x													1
	Dodonaea trifida	P3		x		x		x		x		x							5
Solanaceae	*Lycium ferocissimum AFRICAN BOXTHORN										x							x	2
Sterculiaceae	Lasiopetalum compactum			x						x		x							3
	Lasiopetalum rosmarinifolium					x													1
	Thomasia foliosa					x													1
	Thomasia microphylla			x						x		x			x				3
	Thomasia sarotes															x			
Stylidiaceae	Levenhookia pusilla					x													
	Stylidium albomontis											x				x			1
	Stylidium breviscapum															x			
Thymelaeaceae	Pimelea erecta					x													1
	Pimelea brachyphylla											x							
Violaceae	Hybanthus epacroides					x				x									2
	Hybanthus floribundus							x											1
TOTAL	total 303	10	15	20	9	81	11	23	6	91	22	32	7	9	36	133	71	30	
	native 280																		
	* Introduced species 23																		
	# Species in brackets (x) located on Hopetoun-Ravensthorpe Road reserve																		

Appendix 2

Summary of known locations of Acacia laricina *var.* crassifolia

Pop.	Site	Collection	Datum	Latitude/ Easting	Longitude/ Northing	Location Description	Site Description	Date surveyed	No. of Plants	Area searched	Tenement/ Reserve
1	Mt Short	AS George 5713				Mt Short, N of Ravensthorpe	Lateritic soil.	30/8/1963			PNR
2	Hayes Rd	M Bennett 614	GDA94	33 19' 04"	120 04' 21"	Hayes Rd, 4.6 km from junction with Nindilbilup Rd [N of Ravensthorpe]	Mallet with sparse understorey. Plain. Red brown clayey sand.	10/08/2000	common		?Nature Reserve
3A	Mt Desmond	CA Gardner 13693	GDA94	-33.6167	120.1500	Mount Desmond					PNR
3B	Mt Desmond	BR Maslin 3902	GDA94	-33.6131	120.1464	Mount Desmond, 9.8 km S of Ravensthorpe		10/09/1975			PNR
4A	Ravensthorpe Range	GF Craig 3387	GDA94	-33.6464	120.1625	c. 4 km SSE of Mount Desmond, 4.7 km SE of Mt Desmond; 2.4 km north along ridgetop track from entrance to Mt Iron mine; or 40 m north to 200 m south of Y-intersection of firebreaks on ridgetop	Mallee heath. 2 m upslope of old shaft.	2/11/1997	2		Mt Iron PL74/205
4B	Ravensthorpe Range		GDA94	239035	6274214		Open mallee and thicket/heath. Gravelly loamy sand over laterite. Disturbed gridlines E and W of track.	6/2/04 (GF Craig)	frequent in patches		PNR
5A	Kundip	GF Craig 6006	GDA94	-33.6728	120.1964	Ca. 2.7 km NE of old Kundip townsite; east of Kaolin mine	Open mallee and dense heath. Upper slope. Gravelly sandy clay loam.	12/08/2004			Tectonic
5B	Kundip	KR Newbey 9525A-1	GDA94	-33.6833	120.2000	Ravensthorpe Range, 2 km NE of Kundip	Open shrub mallee. Well drained loamy sand; ridge of low range.	9/02/1982	frequent in patches		Tectonic
5C	Kundip	GF Craig 5991	GDA94	-33.6871	120.2059	Ca. 2 km E of old Kundip townsite	Mixed mallee and shrubs. Clay loam, mid- to upper-slopes.	30/12/04			Tectonic
5D	Kundip	MH Simmons 1374	GDA94	-33.6333	120.1167	Kundip Mine road (S of Ravensthorpe)		1/09/1979			Tectonic

Pop.	Site	Collection	Datum	Latitude/ Easting	Longitude/ Northing	Location Description	Site Description	Date surveyed	No. of Plants	Area searched	Tenement/ Reserve
5E	Kundip	BR Maslin 4783	GDA94	-33.6833	120.1833	Ravensthorpe Range, near Kundip, ca 18 km S of Ravensthorpe township	Rocky W slopes of range.	31/8/1980			?Tectonic
5F	Kundip	KR Newbey 8054	GDA94	-33.6833	120.1833	Ravensthorpe Range, near Kundip,	Very open shrub mallee. Well drained, stony shallow sand over clay; moderately exposed stony ridge.	19/11/1980	rare		?Tectonic
5G	Kundip	KL Bradby 87	GDA94	-33.6897	120.1764	E of Kundip		8/11/1988			?Tectonic
6	Dunn Rock NR	GJ Keighery & N Gibson 4763				c. 33 km SSW of Lake King, 9.3 km NW of Mallee Rd junction; on N side of track that leaves road near Mallee and Aerodrome Rd junction.	Low woodland over shrub mallee over scrub and sedges. Upland flat. Gravelly yellow sand over gravel at 30 cm.	17/10/1999			Nature Reserve
6	Dunn Rock NR	GJ Keighery & N Gibson 7005				c. 33 km SSW of Lake King, 9.3 km NW of Mallee Rd junction; on N side of track that leaves road near Mallee and Aerodrome Rd junction.	Low woodland over shrub mallee over scrub and sedges. Upland flat. Gravelly yellow sand over gravel at 30 cm.	13/5/1999			Nature Reserve
7	Twertup	ED Kabay 958	GDA94	34 01' 09"	119 21' 46"	Road out of Twertup, Fitzgerald River National Park	Heathland. Fine sandy soil to depth. Flat.	27/10/1994	locally common		National Park

Summary of known locations of **Melaleuca stramentosa**

Pop.	Site	Collection	Datum	Latitude/ Easting	Longitude/ Northing	Location Description	Site Description	Date surveyed	No. of Plants	Area searched
1A	Sand/gravel pit	M Bennett 1		33 39'54"	120 10' 8"	15 km S of Ravensthorpe on Hopetoun Rd	Heath/thicket. Yellow sand over ?granite.	18/10/1997	Occasional	
1B	Sand/gravel pit	M Bennett 718		33 39' 35"	120 10' 46"	15 km S of Ravensthorpe on Hopetoun Rd, 0.8 km along track ENE from gravel pit	Red gravel over clay. Shrubland-mallee.	11/10/2002	Frequent	
1B	Sand/gravel pit	GF Craig 5812		33 39' 35"	120 10' 46"	15 km S of Ravensthorpe on Hopetoun Rd, 0.8 km along track ENE from gravel pit	Red gravel over clay. Shrubland-mallee.	11/10/2002	Frequent	
2	Hopetoun-Ravensthorpe Rd	KR Newbey 1611		33 41' 16"	120 6' 59"	18 miles N of Hopetoun	Clay.	25/10/1964		
3	Hopetoun-Ravensthorpe Rd	LA Craven, BJ Lepschi, IG Holli 9604		33 42' 00"	120 11' 00"	21 km S of South Coast Hwy	Dense mallee shrubland. Laterite.	5/11/1994		
4	Jerdacuttup Nth Rd	MG Corrick 8787		33 43' 00"	120 14' 00"	Jerdacuttup North Rd between Lee Rd and Hopetoun-Ravensthorpe Rd	Low heathland with slender mallees.	18/10/1983		
5A	Kundip E	GF Craig 6149	WGS84	240402	6268966	1 km east of Kundip townsite	Dense shrub heath. Pale loam with stony schist and quartz.	5/11/2004	many 1,000s	
5B	Kundip NE	GF Craig 6001	WGS84	240430	6270817	C. 2.4 km NE of Kundip townsite	Mid-dense mallee and shrub heath. Laterite gravel, orange sandy loam. Upper slope.	8/12/2003	many 1,000s	
5C	Kundip ENE	-	WGS84	240400	6270050	Road No. 8432 through Kundip Mining Leases.	Skeletal soils, W-facing slope.	5/5/2004 (GF Craig)	common	
6	Mt Iron mine	GF Craig 1985				North-east of Kundip		21/8/1992	dominant	

Pop.	Site	Collection	Datum	Latitude/ Easting	Longitude/ Northing	Location Description	Site Description	Date surveyed	No. of Plants	Area searched
7A	N of Mt Iron mine	-	WGS84	238894	6274193	2.4 km north along ridgetop track from entrance to Mt Iron mine; old gridlines to east and west of firebreak.	Open mallee and thicket/heath. Gravelly loamy sand over laterite.	6/2/2004 (GF Craig)	abundant	
7B	N of Mt Iron mine	-	WGS84	238710	6274288	2.7 km north along ridgetop track from entrance to Mt Iron mine; old gridline to west of firebreak.	Open mallee and thicket/heath. Gravelly loamy sand over laterite.	6/2/2004 (GF Craig)	abundant	

Appendix 3

GPS locations of Declared Rare and Priority Flora

Datum: WGS84 (GDA94 compatible)

	Cons. Status	Wpt	Zone	Easting	North	Notes
Northern Waste Dump:						
Marianthus villosus	DRF	11	51H	240559	6270997	2 plants, disturbed gridline; weak drainage
Marianthus villosus	DRF	13	51H	240539	6270975	2 plants, disturbed gridline
Acacia disticha	P2	4	51H	240012	6270672	5 plants in drainage
Acacia disticha	P2	7	51H	240068	6270736	10 plants, creekline
Acacia laricina var. crassifolia	P2	10	51H	240566	6271010	ocassional
Acacia laricina var. crassifolia	P2	12	51H	240522	6270934	ocassional
Acacia durabilis	P3	4	51H	240012	6270672	c. 20 plants in drainage
Acacia durabilis	P3	5	51H	239980	6270824	1 plant, old gridline
Acacia durabilis	P3	7	51H	240068	6270736	1 plant, creekline
Boronia oxyantha var. brevicalyx	P3	12	51H	240522	6270934	occasional
Siegfriedia darwinioides	P4	9	51H	240593	6270997	1 plant
Siegfriedia darwinioides	P4	12	51H	240522	6270934	common in drainage line
Hydrocotyle ?decipiens ms	P2	8	51H	240043	6270715	numerous, amongst moss in creekline
Southern Waste Dump:						
Melaleuca stramentosa	P1	20	51H	240717	6269804	patch c. 100 plants
Melaleuca stramentosa	P1	22	51H	240360	6269970	common
Acacia laricina var. crassifolia	P2	14	51H	240467	6269797	50+ plants
Acacia laricina var. crassifolia	P2	16	51H	240478	6269691	20+ plants
Acacia laricina var. crassifolia	P2	17	51H	240604	6269686	50+ plants
Acacia laricina var. crassifolia	P2	18	51H	240631	6269602	20+ plants
Acacia laricina var. crassifolia	P2	20	51H	240717	6269804	frequent
Acacia laricina var. crassifolia	P2	21	51H	240595	6269971	20+ plants, main drainage through waste dump
Acacia laricina var. crassifolia	P2	23	51H	240477	6270066	20+ plants, Road No.8432
Acacia laricina var. crassifolia	P2	27	51H	240948	6270225	few plants
Boronia oxyantha var. brevicalyx	P3	20	51H	240717	6269804	c. 10 plants
Dodonaea trifida	P3	14	51H	240467	6269797	1 plant
Dodonaea trifida	P3	20	51H	240717	6269804	50+ in weak drainage

	Cons. Status	Wpt	Zone	Easting	North	Notes
Siegfriedia darwinioides	P4	21	51H	240595	6269971	c. 10 plants, main drainage through waste dump
Siegfriedia darwinioides	P4	24	51H	240776	6270112	10+ plants, extending down weak drainage
Siegfriedia darwinioides	P4	25	51H	240823	6270068	5+ plants
Siegfriedia darwinioides	P4	26	51H	240936	6270100	5+ plants
Siegfriedia darwinioides	P4	27	51H	240948	6270225	few plants
Haul Road						
Melaleuca stramentosa	P1	31	51H	240655	6270281	large patch, 1000+
Melaleuca stramentosa	P1	3	51H	239937	6270177	c. 20 plants
Melaleuca stramentosa	P1	4	51H	239984	6270171	c. 10 plants
Acacia laricina var. crassifolia	P2	28	51H	240940	6270378	20+ plants
Acacia laricina var. crassifolia	P2	29	51H	240828	6270350	frequent
Acacia laricina var. crassifolia	P2	30	51H	240694	6270322	frequent
Acacia laricina var. crassifolia	P2	32	51H	240578	6270223	frequent
Acacia laricina var. crassifolia	P2	33	51H	240465	6270090	frequent
Acacia laricina var. crassifolia	P2	34	51H	240476	6270142	frequent
Acacia durabilis	P3	5	51H	240106	6270155	6 plants, creekline