
FLORA AND VEGETATION

ON THE WA BLUEMETAL QUARRY SURVEY AREA

AT SERPENTINE

Prepared for:
WA Bluemetal Quarry

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1. SUMMARY

Mattiske Consulting Pty Ltd was commissioned by WA Bluemetal Quarry to conduct a survey of flora and vegetation, and search for Declared Rare Flora, on Lots 246 and 344 and M 70/1240 near Serpentine. The botanical values on the WA Bluemetal Quarry survey area were assessed systematically by Mattiske Consulting Pty Ltd during a prime flowering period in October 2005. Three experienced botanists from Mattiske Consulting Pty Ltd were involved in the field studies. Therefore the survey effort was undertaken at an appropriate time to maximise the return for effort.

A total of 253 vascular plant taxa, including 244 species, from 154 plant genera and 56 families were recorded within three locations. Two of these locations are within the WA Bluemetal Quarry lease and the third is privately owned. No Declared Rare Flora species gazetted under the Wildlife Conservation Act (1950-1980) were located on the survey areas. No endangered or vulnerable species, pursuant to s179 of the Environmental Protection and Biodiversity Conservation Act (1999) were located during the survey. Two Priority taxa, as defined by the Department of Conservation and Land Management (2005a), were identified in the survey. These were *Millotia tenuifolia* var. *laevis* and *Pithocarpa ?corymbulosa*. Forty introduced species were identified during the survey, reflecting the proximity of agriculture, tracks and other environmental disturbance to the area.

The four vegetation complexes that occur in the WA Blue Metal survey area included Darling Scarp (DS), Dwellingup 2 (D2), Murray 1 (My1) and Yarragil (Yg1) as defined by Heddlie et al. (1980) and Mattiske and Havel (1998). The majority of the vegetation complexes are well represented (23.0%, 7.9%, 36.0% and 29.9% respectively) within the formal and informal reserve systems (Conservation Commission 2003). The exception to the latter is the Darling Scarp (7.9%), as it is largely in private landholdings.

A total of ten site-vegetation types were defined and mapped for the WA Bluemetal Quarry survey area. In addition, the disturbed and pasture areas were defined and mapped. These units were based on the site-vegetation types as developed by Havel for the northern Jarrah forest (Havel 1975a and 1975b). All of the site-vegetation types are well represented in the conservation estate.

None of these site-vegetation types are listed as threatened ecological communities listed by the Department of Conservation and Land Management (2005e) and English and Blyth (1997). None of these site-vegetation types are listed as threatened under the Environmental Protection and Biodiversity Conservation Act (1999).

The flora and vegetation values on the respective areas varies substantially largely in response to the differences between the underlying geology, landform and soils of the Darling Scarp (largely shallow granitic soils) and the Dwellingup (largely lateritic caprock and lateritic gravels) mapping units. There is a similar number of flora taxon on both M70/1240 and Loc 344), as both support a range of site conditions. The values of the native flora and vegetation on Loc 246 have been modified significantly by grazing activities. The condition of the vegetation on the survey area varied from "excellent" to "completely degraded", based on the scale as developed by Keighery (1994). A few local areas have been impacted by previous snagging tracks, dieback, clearing for agricultural activities and quarry activities.

2. INTRODUCTION

2.1 Background

Mattiske Consulting Pty Ltd was commissioned by WA Bluemetal Quarry to conduct a survey of flora and vegetation on Lots 246 and 344 and M 70/1240 near Serpentine (Figure 1).

The WA Bluemetal Quarry survey area is situated in the Shire of Serpentine-Jarrahdale. The survey area consists of three locations, two of which are covered by the WA Bluemetal Quarry lease and the third privately owned. The two locations which are covered by the lease are known as M70/1240 (the most northern and eastern parcel of the three, towards the top of the Darling Scarp) and Location 344 (on a lower section of the Darling Scarp). The third (privately owned) area is Location 246, and is the most western and southern of the three parcels.

The botanical values on the WA Bluemetal Quarry survey area were assessed systematically by Mattiske Consulting Pty Ltd, during a prime flowering period in October 2005. Three experienced botanists from Mattiske Consulting Pty Ltd were involved in the field studies.

2.2 Climate

Serpentine-Jarrahdale shire is approximately 40km south east of Perth in the southwest of Western Australia. The southwest has a warm dry Mediterranean climate with a defined seasonal pattern of cool, wet winters and hot, dry summers.

Climate statistics from the Bureau of Meteorology weather stations situated at Karnet (on the Darling Scarp) and Medina (on the Swan Coastal Plain) are given below. Although Medina is closer geographically to the WA Bluemetal Quarry survey area than is Karnet, Medina's position on the Swan Coastal Plain will cause differences in climate between Medina and the survey site due to the differences in altitude and topography, so comparison with data from Karnet was necessary. Generally, winter rain occurs during May, June and July in Medina, and June, July and August in Karnet. For Karnet, the highest total monthly rainfall was in June at 455.3mm. However, the highest total monthly rainfall recorded at Medina, 246.5mm, and the highest daily rainfall of 230mm were both recorded in the month of February.

Mean daily minimum and maximum temperatures at Medina in winter range from 8.0 °C to 19.3 °C (6.1 to 16.2 for Karnet), and in summer from 15.0 °C to 31.3 °C (but 13.5 °C to 30.7 °C for Karnet). Although these minima and maxima may seem to indicate a mild climate, temperature extremes lie well outside these ranges. The lowest temperature recorded at both Karnet and Medina was -2.0 °C in June. The highest temperatures recorded were 44.9 °C in Medina for January, and 44.5 °C in Karnet for February.

Table 1: Climate data for Karnet (Latitude 32.4400 S, Longitude 116.0744 E, elevation 286 m, for 1963 to 2004; Bureau of Meteorology 2005a)

Climate data	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Mean daily max temperature (C°)	30.7	30.5	27.7	23.2	19.1	16.2	15.2	15.7	17.5	20.7	24.4	28.2	22.4
Mean daily min temperature (C°)	15.3	15.7	14.1	11.8	9.1	7.4	6.3	6.1	7.3	8.8	11.4	13.5	10.6
Mean rainfall (mm)	16.8	22.3	25.3	67.9	146.4	223.5	226.3	189.1	130.8	81.0	47.2	19.5	1196.2
Highest monthly rainfall (mm)	167.0	107.1	92.3	165.1	310.7	455.3	440.9	294.1	280.7	189.4	152.4	82.6	-
Lowest monthly rainfall (mm)	0.0	0.0	0.9	0.0	36.7	48.0	104.6	42.9	15.8	2.0	1.0	0.0	-

Table 2: Climate data for Medina Research Centre (Latitude 32.2208 S, Longitude 115.8075 E, elevation 140 m, for 1983 to 2004; Bureau of Meteorology 2005b)

Climate data	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Mean daily max temperature (C°)	30.4	31.3	29.0	25.8	21.9	19.3	18.1	18.7	20.3	22.4	25.7	28.2	24.3
Mean daily min temperature (C°)	16.6	17.2	15.6	13.5	10.5	9.2	8.2	8.0	8.9	10.0	13.0	15.0	12.1
Mean rainfall (mm)	10.5	23.1	21.6	38.3	101.8	156.1	156.6	119.2	79.8	42.9	34.4	8.7	792.7
Highest monthly rainfall (mm)	86.2	246.5	67.4	114.0	226.9	250.8	248.9	170.7	130.2	108.0	93.2	29.4	-
Lowest monthly rainfall (mm)	0.0	0.0	1.3	3.2	34.7	74.2	81.6	70.0	41.8	7.9	6.0	0.0	-

2.3 Vegetation

The WA Bluemetal Quarry survey area lies within the Darling Botanical District of the South-western Botanical Province as recognized by Diels (1906) and later developed by Gardner (1942) and Beard (1979, 1980).

More recently, the vegetation of Western Australia has been assigned to bioregions under the Interim Biogeographical Regionalisation for Australia (IBRA) (Thackway and Cresswell 1995 and Environment Australia 2000, 2005). These subdivisions largely relied on the earlier physiographic work of Beard (1981). The WA Bluemetal Quarry survey area is within the Jarrah Forest bioregion, and has been summarised as having Jarrah-Marri forest on lateritic gravels, replaced by *Taxandria* shrublands on eluvial and alluvial soils and Wandoo-Marri on clayey soils to the east (Western Australian Herbarium 2005a).

Jarrah Forest is dominated by Jarrah *Eucalyptus marginata* subsp. *marginata*, with an understorey of small trees such as Sheoak *Allocasuarina fraseriana*, Bull Banksia *Banksia grandis* and Snottygobbles *Persoonia longifolia* and *Persoonia elliptica*. The groundcover is composed of woody shrubs such as Free Flowering *Lasiopetalum (Lasiopetalum floribundum)*, *Trymalium ledifolium* and Honey Bush (*Hakea lissocarpa*), with Balga (*Xanthorrhoea preissii*), Kingia (*Kingia australis*) and cycad (*Macrozamia riedlei*) (Beard 1990, Dell et al 1989).

Previous workers have stressed the significance of the climate, landforms and soils in determining the distribution of plant communities in this area (Diels 1906; Williams 1932, 1942; Speck 1952, 1958; Lange 1960; Churchill 1961, 1968; Smith 1974; Seddon 1972; Havel 1968, 1975a, 1975b; Heddle *et al.* 1980a; Beard 1981, Matisse and Havel 1998).

In vegetation mapping it is necessary to define and map the plant communities into groups with common characteristics in structure and floristics. This grouping and classification has been achieved by:

- . Havel on the Swan Coastal Plain (1968) and in the Northern Jarrah Forest (1975a, 1975b),
- . Beard (1979) in the Pinjarra area (1:250,000),
- . Heddle *et al.* (1980a) in the System 6 area; Perth, Pinjarra and Collie areas (1:250,000), and
- . Mattiske and Havel (1998) in the vegetation mapping for the Regional Forest Agreement.

The classification system of Heddle *et al.* (1980a), which utilized the concept of vegetation complexes, emphasized the relationships between the underlying landforms, soils and the plant communities. This latter system incorporated linkages with the previous work by Havel (1975a and b). The following vegetation complexes occur within and near the survey area:

Darling Scarp

Mosaic of Open Forest of *Eucalyptus marginata* subsp. *marginata* – *Corymbia calophylla*, with some admixtures with *Eucalyptus laevis* in the north (subhumid zone) and *Corymbia haematoxylon* in the south (humid zone) on deeper soils adjacent to outcrops, woodland of *Eucalyptus wandoo* (subhumid and semiarid zones), low woodland of *Allocasuarina huegeliana* on shallow soils over granite outcrops, closed heath of Myrtaceae – Proteaceae species and lithic complex on or near granite outcrops in all climate zones.

Dwellingup 2

Open Forest of *Eucalyptus marginata* subsp. *marginata* - *Corymbia calophylla* on lateritic uplands in subhumid and semiarid zones. Dominant vegetation-site types S, P; less consistently O, T and R.

Murray 1

Vegetation ranges from Open Forest of *Eucalyptus marginata* subsp. *marginata* - *Corymbia calophylla* - *Eucalyptus patens* on valley slopes to woodland of *Eucalyptus rudis* – *Melaleuca raphiophylla* on the valley floors in humid and subhumid zones. Dominant vegetation types C, Q, U, T; less consistently D, O, R, W.

Yarragil 1

Open Forest of *Eucalyptus marginata* subsp. *marginata* - *Corymbia calophylla* on slopes with mixtures of *Eucalyptus patens* and *Eucalyptus megacarpa* on the valley floors in humid and subhumid zones. Dominant vegetation types C, D, W; less consistently Q, T, U.

The site-vegetation types defined by Havel (1975a, 1975b) for the Northern Jarrah Forest covered the variation of plant communities on this section of the Darling Range. Although the plant communities in this area form a continuum, it is possible to classify the site-vegetation types by incorporating site descriptions (e.g. soils, topography, slope, aspect, soil moisture regimes), floristic information and structural information.

In the last twenty years, subsequent studies by Mattiske and Havel in the Northern Jarrah Forest have recognised a series of new vegetation types not covered previously by Havel (1975a, 1975b). These include variations on the previously defined site vegetation types (e.g. ST, SW) as well as site-vegetation types which were not covered by Havel (e.g. X, refer E.M. Mattiske and Associates 1988, 1992, 1993a).

3. METHODS

3.1 Fieldwork

An initial search for the Declared Rare and Priority flora species known to occur in the region was made using the Department of the Environment and Heritage (2005a and 2005b) and the Department of Conservation and Land Management databases (Western Australian Herbarium 2005a and 2005b). Photographs, location data and descriptions of these species were taken into the field to assist in identifying rare plants, and habitats where rare plants may be found.

The flora of the WA Bluemetal Quarry survey area was described and collected systematically at each survey site in three specific areas, from a grid overlaid on topographic maps with sites at 150m intervals, by three experienced botanists from Matiske Consulting Pty Ltd in October 2005. Selective opportunistic collecting was further undertaken at additional sites in plant communities of like structure and floristic composition. Details on topography, percentage litter cover, soil ratio, percentage of bare ground, outcropping rocks and their type, pebble type and size, and time since fire, were recorded at each site. The average height and percent foliage cover of all species, alive and dead, was recorded at each site. Digital photographs were taken of some species such as orchids, instead of collecting, to minimise the impact on potentially rare or endangered species.

All plant specimens collected during the field surveys were pressed, dried and fumigated in accordance with the requirements of the Western Australian Herbarium. The plant species were identified and then compared with pressed specimens housed at the Western Australian Herbarium. Where appropriate, plant taxonomists with specialist skills were consulted. Nomenclature of the species recorded follows the Western Australian Herbarium standards (2005a, 2005b).

3.2 Local and Regional Significance

The Environmental Protection Authority (2004) in Guidance Statement 51 stated that species, subspecies, varieties, hybrids and ecotypes may be significant other than as Declared Rare Flora or Priority Flora, for a variety of reasons, including:

- “ a keystone role in a particular habitat for threatened species, or supporting large populations representing a significant proportion of the local regional population of a species;
- . relic status;
- . anomalous features that indicate a potential new discovery;
- . being representative of the range of a species (particularly, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range);
- . the presence of restricted subspecies, varieties, or naturally occurring hybrids;
- . local endemism/a restricted distribution;
- . being poorly reserved.”

Plant communities or vegetation may be significant for a range of reasons, other than a statutory listing as a Threatened Ecological Community or because the extent is below a threshold level. The Environmental Protection Authority (2004) in Guidance Statement 51 stated that significant vegetation may include communities that have:

- “ scarcity;
- . unusual species;
- . novel combinations of species;
- . a role as a refuge;
- . a role as a key habitat for threatened species or large populations representing a significant proportion of the local to regional total population of a species;
- . being representative of the range of a unit (particularly, a good local and/or regional example of a unit in “prime” habitat, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range);
- . a restricted distribution.”

The application of the degree of significance may apply at a range of scales. Plant communities are referred to as locally significant where the presence of Priority Flora species has been recorded, where they provide a range extension of particular taxa from previously recorded locations, or where they are very restricted to one or two locations or where they occur as small isolated communities. In addition, communities that exhibit unusually high structural and species diversity are also of local significance (Mattiske EM, pers. comm.). Plant communities are referred to as regionally significant where they are limited to specific landform types, are uncommon or restricted plant community types within the regional context, or support populations of Declared Rare Flora (Mattiske EM, pers. comm.).

3.3 Rare and Priority Flora

Species of flora and fauna are given rare or priority conservation status when populations are restricted geographically or threatened by local processes. The Department of Conservation and Land Management recognises these threats of extinction and consequently applies regulations towards population and species protection.

Rare Flora species are gazetted under subsection 2 of section 23F of the Wildlife Conservation Act (1950). It is an offence to "take" or damage gazetted rare flora without ministerial approval. Section 23F of the Wildlife Conservation Act (1950-1980) defines "to take" as "... to gather, pick, cut, pull up, destroy, dig up, remove or injure the flora or to cause or permit the same to be done by any means." Priority Flora are under consideration for declaration as 'rare flora', but are in urgent need of further survey (Priority One to Three) or require monitoring every 5-10 years (Priority Four). The definitions used by the Western Australian Department of Conservation and Land Management to categorise Rare and Priority Flora are presented in Table 3.

Table 3: Definition of Rare and Priority Flora Species (Department of Conservation and Land Management 2005a)

Conservation Code	Category
R	Declared Rare Flora – Extant Taxa "Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection and have been gazetted as such."
P1	Priority One – Poorly Known Taxa "Taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey."
P2	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 urgently need further survey."
P3	Priority Three – Poorly Known Taxa "Taxa which are known from several populations, and the taxa are not believed to be under immediate threat (i.e. not currently endangered), either due to the number of known populations (generally >5), or known populations being large, and either widespread or protected. Such taxa are under consideration for declaration as 'rare flora' but need further survey."
P4	Priority Four – Rare Taxa "Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5-10 years."

Threats of extinction of species are also recognized at a Federal Government level and are categorized according to the Environmental Protection and Biodiversity Conservation Act, 1999. Categories of threatened species are summarized in Table 4.

Table 4: Categories of Threatened Flora Species Environmental Protection and Biodiversity Conservation Act 1999 (Department of the Environment and Heritage 2005a)

Category Code	Category
Ex	Extinct Taxa for which there is no reasonable doubt that the last member of the species has died.
ExW	Extinct in the Wild Taxa which are known only to survive in cultivation, in captivity or as naturalised populations well outside past ranges; or have not been recorded in known and/or expected habitats, at appropriate seasons, anywhere in past ranges, despite exhaustive surveys over time frames appropriate to their life cycles and forms.
CE	Critically Endangered Taxa which face an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
E	Endangered Taxa which are not critically endangered and face a very high risk of extinction in the wild in the immediate or near future, as determined in accordance with the prescribed criteria.
V	Vulnerable Taxa which are not critically endangered or endangered and face a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
CD	Conservation Dependent Taxa which are the foci of specific conservation programs, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within a period of 5 years.

3.4 Condition Rating

The condition of each plant community was rated according to the scale as developed by Keighery (1994) and as used for assessing Bush Forever sites (Government of Western Australia 2000). The scale is summarised in Table 5.

Table 5: Condition rating scale from Bush Forever (Government of Western Australia 2000), based on Keighery 1994

Rating	Description	Explanation
1	Pristine	Pristine or nearly so, no obvious signs of disturbance.
2	Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
3	Very Good	Vegetation structure altered, obvious signs of disturbance. Disturbance to vegetation structure covers repeated fire, aggressive weeds, dieback, logging, grazing.
4	Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. Disturbance to vegetation structure covers frequent fires, aggressive weeds at high density, partial clearing, dieback and grazing.
5	Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. Disturbance to vegetation structure includes frequent fires, presence of very aggressive weeds, partial clearing, dieback and grazing.
6	Completely degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas often described as "parkland cleared" with the flora comprising weed or crop species with isolated native trees or shrubs.

4. OBJECTIVES

In 2005, WA Bluemetal Quarry commissioned Matisse Consulting Pty Ltd to undertake a flora and vegetation-mapping program of the WA Bluemetal Quarry survey area at Serpentine.

The specific objectives of this study were to:

- Define vegetation communities to enable mapping of the vegetation on the WA Bluemetal Quarry survey area,
- Assess the condition of all vegetation within the survey area,
- Produce maps of vegetation communities and vegetation condition within the survey area,
- Assess the conservation status of all vegetation communities and plant taxa, and
- Prepare a report summarising the findings.

5. RESULTS

5.1 Flora

A total of 253 vascular plant taxa from 154 plant genera and 56 families were recorded on the WA Bluemetal Quarry survey area in Location 246, Location 344 and M70/1240.

No Declared Rare Flora species gazetted under the Wildlife Conservation Act (1950-1980) were located on the WA Bluemetal Quarry survey area. No endangered or vulnerable species, pursuant to s179 of the Environmental Protection and Biodiversity Conservation Act (1999) were located during the survey. However, two Priority taxa, as defined by the Department of Conservation and Land Management (2005a), were identified in the survey. These were *Millotia tenuifolia* var. *laevis* and *Pithocarpa ?corymbulosa* (Table 6). Neither of these species are restricted to the survey area; however both are relatively geographically restricted and are only known from 4 and 20 records respectively on the basis of State Herbarium records (Department of Conservation and Land Management 2005b). The latter lack of collections also reflects the lack of survey effort in the wider region.

Table 6: Locations of Priority Flora species found during the WA Bluemetal Quarry survey

Species	GPS Location (GDA - Zone 50J)		Location
	Easting (mE)	Northing (mN)	
<i>Pithocarpa ?corymbulosa</i> P2	408980	6426520	Loc 344
<i>Millotia tenuifolia</i> var. <i>laevis</i> P2	409686	6428901	M70/1240
<i>Millotia tenuifolia</i> var. <i>laevis</i> P2	409700	6428764	M70/1240
<i>Millotia tenuifolia</i> var. <i>laevis</i> P2	409691	6428675	M70/1240
<i>Millotia tenuifolia</i> var. <i>laevis</i> P2	409168	6428464	M70/1240
<i>Millotia tenuifolia</i> var. <i>laevis</i> P2	409144	6427991	M70/1240
<i>Millotia tenuifolia</i> var. <i>laevis</i> P2	409280	6428120	M70/1240
<i>Millotia tenuifolia</i> var. <i>laevis</i> P2	409280	6428840	M70/1240

In M70/1240, 161 taxa from 47 Families, 105 genera and 159 species were collected. One Priority Two species was collected in this area; namely *Millotia tenuifolia* var. *laevis*. Eleven species of introduced plant (i.e. weeds) were found in M70/1240. This area was generally Jarrah *Eucalyptus marginata* subsp. *marginata* or Jarrah/Marri *Eucalyptus marginata* subsp. *marginata* / *Corymbia calophylla* forest with subdominant trees *Allocasuarina fraseriana*, *Banksia grandis* and occasionally *Persoonia*

longifolia and *Nuytsia floribunda* on lateritic soils. Dominant understorey plants included the grasstrees *Xanthorrhoea preissii* and *Xanthorrhoea gracilis*, shrubs *Dryandra sessilis*, *Trymalium ledifolium* and *Hypocalymma angustifolium*. Other understorey plants included species from the genera *Drosera*, *Stylidium*, *Hibbertia* and *Conostylis*. Evidence of disturbance included old logging tracks, sawn logs and weeds. There were signs of dieback and storm damage in some places, particularly in the many "black gravel" areas. The pocket to the far south-east of M70/1240 (south-west of the creek) was generally in a better condition with healthier vegetation (less disturbance) than much of the remainder of the survey area.

In Location 344, 170 taxa were collected from 46 families, 113 genera and 166 species. One Priority Two species was found in the area, namely *Pithocarpa ?corymbulosa*. Twenty-nine introduced plant species were found. Location 344 was predominantly Marri (*Corymbia calophylla* forest with a disturbed understorey on loamy soils, and some large granite outcrops. Around the granite outcrops, there were *Acacia pulchella*, *Banksia sphaerocarpa*, *Melaleuca parviceps*, *Pimelea imbricata* var. *piliger*, *Stylidium dichotomum*, *Darwinia citriodora* and *Verticordia huegelii* var. *huegelii* but also weeds such as **Briza maxima* and **Trifolium campestre*. The forest nearest the creek (northern end of Location 344, at the bottom of the Darling Scarp) had a "parkland" appearance, with a severely degraded understorey consisting of *Xanthorrhoea preissii*, *Phyllanthus calycinus* and *Macrozamia riedlei* and weeds such as **Brachypodium distachyon* and **Briza maxima*. This is probably the result of historic grazing by cattle and may be being perpetuated due to the high density of Western Grey Kangaroos *Macropus fuliginosus* now inhabiting the area.

Location 246 was a highly degraded environment consisting of a few native trees (e.g. *Eucalyptus rudis*, *Corymbia calophylla*) over introduced grasses such as **Avena barbata*, **Briza maxima* and **Lolium rigidum*. There were 15 taxa (and 15 species) identified, from 7 families and 13 genera. No Priority species were found in Location 246. Thirteen weeds were identified in Location 246.

Thirty-nine introduced species were identified during the survey. This number largely reflects the proximity of agriculture and other disturbances on the area.

5.2 Vegetation

A total of ten site-vegetation types were defined and mapped for the WA Bluemetal Quarry survey area. In addition, the disturbed and pasture areas were defined and mapped. The native vegetation areas were based on the site-vegetation types that were defined by Havel (1975a and 1975b). These site-vegetation types are described in the following text and presented on the enclosed vegetation map (Figure 1).

CW - Woodland to Open Forest of *Eucalyptus rudis* – *Corymbia calophylla* with dense *Taxandria linearifolia* and *Astartea scoparia* in understorey on creek-lines and water-courses (this type is a variant of site-vegetation types C and W as defined by Havel (1975a) and in part reflects the narrow linear nature of the C type and the need to combine this type with the type W for mapping purposes (CW). This type occurs within the Murray and Yarragil complexes as defined by Heddle *et al.* (1980a) and Matiske and Havel (1998).

This site-vegetation type occurs in the gullies and creek-beds of the western valley floors, which are dominated by loamy soils in the Darling Ranges. This site-vegetation type occurs in other conservation areas (Heddle *et al.* 1980b; Department of Conservation and Environment 1980; Department of Conservation and Land Management 1987) and tends to be dominated by sedges and specific shrub species which dominate the wetter lower slopes and creek-beds (e.g. *Astartea scoparia* and *Taxandria linearifolia*), as well as species which reflect the moister and fertile slopes of the valley systems (e.g. *Hypocalymma angustifolium*, *Eucalyptus patens* and *Acacia extensa* of site-vegetation type W).

D - Open Forest of *Eucalyptus marginata* subsp. *marginata* – *Corymbia calophylla* on lower slopes with mixed low understorey species, including *Baeckea camphorosmae* and *Acacia extensa* (site-vegetation type D as defined by Havel (1975a)). This type occurs mainly within the Yarragil and Swamp complexes as defined by Heddle *et al.* (1980a) and Matiske and Havel (1998).

This site-vegetation type occur on the lower, less fertile slopes with sandy-clays to clay loams on the western valley systems in the Darling Ranges and also occur in other conservation areas (Hedde *et al.* 1980b; Department of Conservation and Environment 1980; Department of Conservation and Land Management 1987). This site-vegetation type tends to be dominated by specific shrub species, which dominate the moister and less fertile lower slopes of the valley systems (e.g. *Hypocalymma angustifolium* and *Baeckea camphorosmae* of site-vegetation type D).

- PW - Open Forest of *Allocasuarina fraseriana* - *Eucalyptus marginata* subsp. *marginata* - *Corymbia calophylla* with scattered understorey, including *Grevillea wilsonii*, *Adenanthos barbiger*, *Baeckea camphorosmae* and *Hypocalymma angustifolium* (this type is a variant of site-vegetation type P as defined by Havel (1975a) due to the presence of moisture indicators such as *Hypocalymma angustifolium* and *Baeckea camphorosmae*). This type occurs within the Dwellingup, Dwellingup-Hester and Yarragil complexes as defined by Hedde *et al.* (1980a) and Matiske and Havel (1998).

This site-vegetation type occurs on the lower slopes and less commonly the mid slopes of the undulating hills on the Darling Ranges. The type is not well represented in the conservation estate as it appears to be a local variant of the P site-vegetation type (Hedde *et al.* 1980b; Department of Conservation and Environment 1980; Department of Conservation and Land Management 1987). This site-vegetation type tends to be dominated by specific shrub species which dominate the sandy-gravelly slopes and moist soil conditions of the Darling Ranges (e.g. *Lechenaultia biloba*, *Allocasuarina fraseriana* (formerly *Casuarina fraseriana*), *Adenanthos barbiger* and *Banksia grandis* of site-vegetation type P and *Hypocalymma angustifolium* and *Baeckea camphorosmae* of the site-vegetation type W which dominates moister soils in the nearby forest areas).



Photograph 1: Open Forest of *Allocasuarina fraseriana* - *Eucalyptus marginata* subsp. *marginata* - *Corymbia calophylla* - *Banksia grandis* over *Dryandra sessilis* (PW site-vegetation type).

- PT - Open Forest of *Allocasuarina fraseriana* - *Eucalyptus marginata* subsp. *marginata* - *Corymbia calophylla* - *Banksia grandis* with scattered understorey, including *Adenanthos barbiger*, *Leucopogon verticillatus* and *Clematis aristata* var. *occidentalis* (this site type is a variant of the site-vegetation types P and T as defined by Havel (1975a)). This type occurs within the Dwellingup-Hester complex as defined by Heddle *et al.* (1980a) and Mattiske and Havel (1998).

This site-vegetation type occurs on the mid to upper slopes of the undulating hills on the Darling Ranges. This combined type of types P and T is relatively restricted in distribution within the Northern Jarrah Forest and is poorly represented in the conservation estate (Heddle *et al.* 1980b; Department of Conservation and Environment 1980; Department of Conservation and Land Management 1987).

This site-vegetation type tends to be dominated by specific shrub species which dominate the sandy-gravelly slopes of the Darling Ranges (e.g. *Allocasuarina fraseriana*, *Adenanthos barbiger*, *Clematis aristata* var. *occidentalis*, *Leucopogon verticillatus* and *Banksia grandis* of site-vegetation types P and T) but which lack some of the key indicators of the P type (e.g. *Grevillea wilsonii*) and includes species which occur on the gravelly soils (*Hovea chorizemifolia* and *Leucopogon verticillatus*).



Photograph 2: Open Forest of *Allocasuarina fraseriana* - *Eucalyptus marginata* subsp. *marginata* - *Corymbia calophylla* - *Banksia grandis* over *Dryandra sessilis* (PS site-vegetation type).

- PS - Open Forest of *Allocasuarina fraseriana* - *Eucalyptus marginata* subsp. *marginata* - *Corymbia calophylla* - *Banksia grandis* with scattered understorey, including *Adenanthos barbiger* (this site type is a variant of the site-vegetation types P and S as defined by Havel (1975a)). This type occurs within the Dwellingup and Dwellingup-Hester complexes as defined by Heddle *et al.* (1980a) and Mattiske and Havel (1998).

This site-vegetation type occurs on the mid to upper slopes of the undulating hills on the Darling Ranges. This combined type of types P and S is relatively widespread in distribution within the Northern Jarrah Forest and is well represented in the conservation estate (Hedde *et al.* 1980b; Department of Conservation and Environment 1980; Department of Conservation and Land Management 1987). This site-vegetation type tends to be dominated by specific shrub species which dominate the sandy-gravelly slopes of the Darling Ranges (e.g. *Allocasuarina fraseriana*, *Adenanthos barbiger*, *Leucopogon propinquus* and *Banksia grandis* of site-vegetation types P and S) but which lack some of the key indicators of the P type (e.g. *Grevillea wilsonii*) and includes species which occur on the gravelly soils (*Hovea chorizemifolia* and *Leucopogon capitellatus*).

- S - Open Forest of *Eucalyptus marginata* subsp. *marginata* - *Banksia grandis* - *Allocasuarina fraseriana* with scattered understorey, including *Adenanthos barbiger*, *Leucopogon capitellatus* and *Styphelia tenuiflora* (site-vegetation type S as defined by Havel (1975a)). This type occurs within the Dwellingup and Dwellingup-Hester complexes as defined by Hedde *et al.* (1980a) and Mattiske and Havel (1998).

This site-vegetation type occurs on the upper slopes, and to a lesser degree mid slopes, of the undulating hills on the Darling Ranges. The type is widespread in distribution within the Northern Jarrah Forest and is well represented in the conservation estate (Hedde *et al.* 1980b; Department of Conservation and Environment 1980; Department of Conservation and Land Management 1987). This site-vegetation type tends to be dominated by specific shrub species, which dominate the gravelly slopes of the Darling Ranges (e.g. *Adenanthos barbiger*, *Leucopogon propinquus*, *Styphelia tenuiflora*, *Leucopogon capitellatus*, *Banksia grandis* and *Hovea chorizemifolia*).

- SW - Open Forest of *Eucalyptus marginata* subsp. *marginata* - *Corymbia calophylla* - *Banksia grandis* with scattered understorey, including *Adenanthos barbiger*, *Hypocalymma angustifolium* and *Styphelia tenuiflora* (this type is a variant of site-vegetation type S as defined by Havel (1975a) due to the presence of moisture indicators such as *Hypocalymma angustifolium* and *Baeckea camphorosmae*). This type occurs within the Dwellingup, Dwellingup-Hester and Yarragil complexes as defined by Hedde *et al.* (1980a) and Mattiske and Havel (1998).

This type is not well represented in the conservation estate as it appears to be a local variant of the S site-vegetation type (Hedde *et al.* 1980b; Department of Conservation and Environment 1980; Department of Conservation and Land Management 1987). This site-vegetation type tends to be dominated by specific shrub species which dominate the gravelly slopes and moist soil conditions of the Darling Ranges (e.g. *Leucopogon capitellatus*, *Leucopogon propinquus*, *Hovea chorizemifolia*, *Adenanthos barbiger* and *Banksia grandis* of site-vegetation type S and *Hypocalymma angustifolium* and *Baeckea camphorosmae* of the site-vegetation type W which dominates moister soils in the nearby forest areas).

- TS - Open Forest of *Eucalyptus marginata* subsp. *marginata* - *Corymbia calophylla* with scattered understorey, including *Leucopogon verticillatus* and *Clematis aristata* var. *occidentalis* (site-vegetation type T as defined by Havel (1975a)). This type occurs within the Helena, Murray, Dwellingup and Dwellingup-Hester complexes as defined by Hedde *et al.* (1980a) and Mattiske and Havel (1998).

This site-vegetation type occurs on the upper slopes, and to a lesser degree mid slopes, of the undulating hills on the Darling Ranges. This type is widespread in distribution within the Northern Jarrah Forest and is well represented in the conservation estate (Hedde *et al.* 1980b; Department of Conservation and Environment 1980; Department of Conservation and Land Management 1987). This site-vegetation type tends to be dominated by specific shrub species, which dominate the more fertile loams of the Darling Ranges (e.g. *Leucopogon verticillatus*, *Clematis aristata* var. *occidentalis* and *Hovea chorizemifolia*).

- R - Open Woodland of *Eucalyptus marginata* subsp. *marginata* - *Corymbia calophylla* on fringes of granite outcrops or shallow soils (site-vegetation type R as defined by Havel 1975a) within the Cooke, Helena, Dwellingup and Dwellingup-Hester complexes as defined by Heddle *et al.* (1980a) and Mattiske and Havel (1998).

This site-vegetation type occurs on the shallow soils surrounding outcrops on the upland and valley systems on the Darling Ranges. This type is restricted in distribution within the Northern Jarrah Forest, but is well represented in the conservation estate, e.g. the Monadnocks near Mt Cooke and Mt Windsor (Heddle *et al.* 1980b; Department of Conservation and Environment 1980; Department of Conservation and Land Management 1987). This site-vegetation type tends to be dominated by specific shrub species, which reflect the soils and moisture associated with outcrops on the Darling Ranges (e.g. *Trymalium ledifolium*, *Phyllanthus calycinus* and *Hypocalymma angustifolium*).



Photograph 3: Mosaic of Closed Heath of Myrtaceae – Proteaceae species (G site-vegetation type) and Open Forest of *Eucalyptus marginata* subsp. *marginata* - *Corymbia calophylla* on shallow soils (R site-vegetation type).

- G - Closed Heath of Myrtaceae – Proteaceae species on shallow soils of granite outcrops (site-vegetation type G as defined by Havel 1975b) within the Cooke, Helena and Darling Scarp vegetation complexes as defined by Heddle *et al.* (1980a) and Mattiske and Havel (1998).

This site-vegetation type occurs on the shallow soils associated with outcrops on the upland and valley systems on the Darling Ranges. This type is restricted in distribution within the Northern Jarrah Forest, but is well represented in the conservation estate, e.g. the Monadnocks near Mt Cooke and Mt Windsor (Heddle *et al.* 1980b; Department of Conservation and Environment 1980; Department of Conservation and Land Management 1987).

This site-vegetation type tends to be dominated by specific shrub species, which reflect the soils and moisture associated with outcrops on the Darling Ranges (e.g. *Darwinia citriodora*, *Trymalium ledifolium*, *Phyllanthus calycinus*, *Acacia pulchella*, *Banksia sphaerocarpa*, *Melaleuca parviceps*, *Pimelea imbricata* var. *piligera*, *Stylidium dichotomum* and *Verticordia huegelii* var. *huegelii* and *Hypocalymma angustifolium*).



Photograph 4: Disturbed, grazed and partly modified Open Forest of *Eucalyptus marginata* subsp. *marginata* - *Corymbia calophylla*.

5.3 Review of the Conservation Status of the Site-vegetation Types

A number of site-vegetation types were found to be locally and regionally significant. These site-vegetation types are:

- . The site-vegetation types G and R are locally significant as they are associated with localised outcropping. Both site-vegetation types are well represented in the conservation estate (Heddlé *et al.* 1980a).
- . The valley types (CW) are also significant in providing habitat diversity for fauna species.
- . The combinations PW and SW site-vegetation types have significant implications for the management of the *Phytophthora cinnamomi* infections in the area. It should be recognized that dieback infections are present on the upper slopes of Location M70/1240 and therefore there is still a need to introduce hygiene measures.

5.4 Review of Physiological Stress in the Survey Area

The condition of the vegetation on the survey area varied from “excellent” to “completely degraded”, based on the scale as developed by Keighery (1994). A few local areas have been impacted by previous snigging tracks, dieback (mainly on M70/1240), clearing for agricultural activities (mainly Loc 246) and quarry activities (Loc 344).

6. DISCUSSION

Mattiske Consulting Pty Ltd was commissioned by WA Bluemetal Quarry to conduct an assessment of the flora and vegetation values on three locations near Serpentine. Mattiske Consulting Pty Ltd undertook the field studies during a prime flowering period in October 2005. Three experienced botanists from Mattiske Consulting Pty Ltd were involved in the field studies. Therefore the survey effort was undertaken at an appropriate time to maximise the return for effort.

Vegetation Complexes

The four vegetation complexes that occur in the WA Blue Metal survey area included Darling Scarp (DS), Dwellingup 2 (D2), Murray 1 (My1) and Yarragil (Yg1). The majority of the vegetation complexes are well represented (23.0%, 7.9%, 36.0% and 29.9% respectively) within the formal and informal reserve systems (Conservation Commission 2003). The exception to the latter is the Darling Scarp (7.9%), as it is largely in private landholdings. Any land swap that might include less disturbed sections of the Darling Scarp complex (with its associated vegetation on the shallow and granitic soils) would benefit the conservation of this complex in the regional context.

Site-Vegetation Types

A total of ten site-vegetation types were defined and mapped for the WA Bluemetal Quarry survey area. In addition, the disturbed and pasture areas were defined and mapped. These units were a combination of Havel's (1975a and 1975b) site-vegetation types, and all of the site-vegetation types are well represented in the conservation estate. A total of ten site-vegetation types and two disturbed types (pasture and disturbed) were defined within the three survey areas, namely:

Table 7: Summary of Site - Vegetation Types recorded on the Survey Areas

Site-Vegetation Types	Location 246	Location 344	M70/1240
CW	X	X	X
D		X	X
G		X	
R		X	
S		X	X
SW			X
PW			X
PS			X
PT			X
TS		X	X
Pasture	X		
Disturbed		X	

The site-vegetation types varied between the respective areas and this in part reflects the differences between the underlying landforms and soils associated with the Darling Scarp and the Dwellingup mapping units (Table 7). Although there was some overlap between the site-vegetation types, the types differed in either key overstorey species or indicator species. All of the site-vegetation types occur in similar environments in adjacent areas of State Forest and National Parks.

Threatened Ecological Communities (State and Federal Listings)

None of these site-vegetation types are listed as threatened ecological communities listed by the Department of Conservation and Land Management (2005e) and English and Blyth (1997). None of these site-vegetation types are listed as threatened under the Environmental Protection and Biodiversity Conservation Act (1999).

Vegetation Condition

The condition of the vegetation on the survey area varied from “excellent” to “completely degraded”, based on the scale as developed by Keighery (1994). A few local areas have been impacted by previous snigging tracks, dieback, clearing for agricultural activities and quarry activities.

7. ACKNOWLEDGMENTS

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8. LIST OF PARTICIPANTS

The following personnel of Matiske Consulting Pty Ltd were involved with this project:

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APPENDIX A: VASCULAR PLANT SPECIES ON WA BLUEMETAL QUARRY SURVEY AREAS

Note: ^ - planted species, * - introduced species, R - Rare species, P1 to P4 - Priority species

FAMILY	SPECIES	M 70/1240	Loc 344	Loc 246
ADIANTACEAE	<i>Adiantum aethiopicum</i>		X	
	<i>Cheilanthes austrotenuifolia</i>		X	
	<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>		X	
ZAMIACEAE	<i>Macrozamia riedlei</i>	X	X	
POACEAE	* <i>Aira caryophyllea</i>		X	
	* <i>Aira cupaniana</i>	X	X	
	<i>Austrodanthonia caespitosa</i>	X	X	
	<i>Austrodanthonia pilosa</i>		X	
	* <i>Avena barbata</i>		X	X
	* <i>Brachypodium distachyon</i>		X	
	* <i>Briza maxima</i>	X	X	X
	* <i>Briza minor</i>	X	X	X
	* <i>Bromus diandrus</i>		X	X
	* <i>Bromus ?hordeaceus</i>			X
	* <i>Ehrharta longiflora</i>		X	
	* <i>Hordeum leporinum</i>			X
	* <i>Lolium rigidum</i>			X
	<i>Microlaena stipoides</i>	X		
	<i>Neurachne alopecuroidea</i>	X	X	
	<i>Tetrarrhena laevis</i>	X	X	
	* <i>Vulpia myuros</i>	X		
CYPERACEAE	<i>Cyathochaeta avenacea</i>	X	X	
	<i>Gahnia aristata</i>		X	
	<i>Gahnia decomposita</i>	X		
	* <i>Isolepis prolifera</i>			X
	<i>Lepidosperma drummondii</i>		X	
	<i>Lepidosperma effusum</i>		X	
	<i>Lepidosperma leptostachyum</i>	X	X	
	<i>Lepidosperma pubisquamatum</i>	X	X	
	<i>Lepidosperma squamatum</i>	X		
	<i>Lepidosperma tetraquetrum</i>	X	X	
	<i>Mesomelaena tetragona</i>	X		
<i>Tetraria capillaris</i>	X	X		
<i>Tetraria octandra</i>	X	X		
RESTIONACEAE	<i>Desmocladius asper</i>		X	
	<i>Desmocladius fasciculatus</i>	X	X	
	<i>Hypolaena exsulca</i>	X		
	<i>Loxocarya cinerea</i>		X	
CENTROLEPIDACEAE	<i>Centrolepis aristata</i>	X		
PHILYDRACEAE	<i>Philydrella pygmaea</i> subsp. <i>pygmaea</i>	X		
JUNCACEAE	* <i>Juncus articulatus</i>			X
	<i>Luzula meridionalis</i>		X	

APPENDIX A: VASCULAR PLANT SPECIES ON WA BLUEMETAL QUARRY SURVEY AREAS

Note: ^ - planted species, * - introduced species, R - Rare species, P1 to P4 - Priority species

FAMILY	SPECIES	M 70/1240	Loc 344	Loc 246
DASYPOGONACEAE	<i>Lomandra caespitosa</i>	x	x	
	<i>Lomandra hermaphrodita</i>	x		
	<i>Lomandra micrantha</i> subsp. <i>micrantha</i>	x	x	
	<i>Lomandra sonderi</i>	x	x	
XANTHORRHOEACEAE	<i>Xanthorrhoea gracilis</i>	x	x	
	<i>Xanthorrhoea preissii</i>	x	x	
PHORMIACEAE	<i>Dianella revoluta</i>	x		
	<i>Stypandra glauca</i>		x	
ANTHERICACEAE	<i>Agrostocrinum scabrum</i>		x	
	<i>Caesia micrantha</i>	x	x	
	<i>Caesia micrantha/occidentalis</i>		x	
	<i>Chamaescilla corymbosa</i>	x	x	
	<i>Dichopogon capillipes</i>	x	x	
	<i>Laxmannia squarrosa</i>	x		
	<i>Sowerbaea laxiflora</i>		x	
	<i>Thysanotus dichotomus</i>	x	x	
	<i>Thysanotus fastigiatus</i>	x		
	<i>Thysanotus manglesianus</i>	x	x	
	<i>Thysanotus multiflorus</i>	x	x	
<i>Thysanotus thyrsoides</i>	x	x		
COLCHICACEAE	<i>Burchardia multiflora</i>	x		
	<i>Burchardia umbellata</i>	x	x	
HAEMODORACEAE	<i>Conostylis aculeata</i>	x	x	
	<i>Conostylis aculeata</i> subsp. <i>preissii</i>	x	x	
	<i>Conostylis setigera</i>	x		
	<i>Conostylis setosa</i>	x	x	
	<i>Conostylis</i> sp.	x		
	<i>Haemodorum laxum</i>	x	x	
	<i>Haemodorum ?laxum</i>		x	
<i>Haemodorum</i> sp.		x		
DIOSCOREACEAE	<i>Dioscorea hastifolia</i>		x	
IRIDACEAE	* <i>Moraea flaccida</i>		x	
	<i>Orthrosanthus laxus</i> var. <i>laxus</i>		x	
	<i>Patersonia occidentalis</i>		x	
	<i>Patersonia rudis</i>	x		
	* <i>Romulea rosea</i>		x	
ORCHIDACEAE	<i>Caladenia ?magniclavata</i>	x		
	<i>Caladenia flava</i>	x	x	
	* <i>Disa bracteata</i>		x	
	<i>Elythranthera brunonis</i>	x		
	<i>Eriochilus</i> sp.	x		

APPENDIX A: VASCULAR PLANT SPECIES ON WA BLUEMETAL QUARRY SURVEY AREAS

Note: ^ - planted species, * - introduced species, R - Rare species, P1 to P4 - Priority species

FAMILY	SPECIES	M 70/1240	Loc 344	Loc 246
ORCHIDACEAE	<i>Pterostylis</i> sp.	x		
(Continued)	<i>Pyrorchis nigricans</i>		x	
	<i>Thelymitra crinita</i>	x	x	
CASUARINACEAE	<i>Allocasuarina fraseriana</i>	x		
	<i>Allocasuarina humilis</i>		x	
PROTEACEAE	<i>Adenanthos barbiger</i>	x	x	
	<i>Banksia grandis</i>	x	x	
	<i>Banksia sphaerocarpa</i>		x	
	<i>Dryandra armata</i> var. <i>armata</i>		x	
	<i>Dryandra lindleyana</i>	x	x	
	<i>Dryandra sessilis</i>	x	x	
	<i>Grevillea bipinnatifida</i>		x	
	<i>Grevillea wilsonii</i>	x		
	<i>Hakea amplexicaulis</i>	x		
	<i>Hakea lissocarpa</i>	x	x	
	<i>Hakea stenocarpa</i>	x	x	
	<i>Hakea trifurcata</i>		x	
	<i>Hakea undulata</i>		x	
	<i>Persoonia elliptica</i>		x	
	<i>Persoonia longifolia</i>	x		
	<i>Petrophile biloba</i>		x	
	<i>Stirlingia latifolia</i>	x		
LORANTHACEAE	<i>Nuytsia floribunda</i>	x		
AMARANTHACEAE	<i>Ptilotus manglesii</i>	x	x	
RANUNCULACEAE	<i>Clematis aristata</i> var. <i>occidentalis</i>	x	x	
	<i>Ranunculus colonorum</i>		x	
LAURACEAE	<i>Cassytha ?glabella</i>		x	
DROSERACEAE	<i>Drosera bulbosa</i>	x		
	<i>Drosera erythrorhiza</i>	x	x	
	<i>Drosera erythrorhiza</i> subsp. <i>collina</i>	x		
	<i>Drosera gigantea</i>	x		
	<i>Drosera glanduligera</i>	x		
	<i>Drosera hyperostigma</i>	x		
	<i>Drosera menziesii</i>		x	
	<i>Drosera menziesii</i> subsp. <i>menziesii</i>		x	
	<i>Drosera ?neesii</i>		x	
	<i>Drosera pallida</i>		x	
	<i>Drosera platystigma</i>	x		
	<i>Drosera rosulata</i>	x		
	<i>Drosera</i> sp. (climbing)		x	
CRASSULACEAE	<i>Crassula colorata</i> var. <i>colorata</i>	x		

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FAMILY	SPECIES	M 70/1240	Loc 344	Loc 246
MIMOSACEAE	<i>Acacia alata</i> var. <i>alata</i>	x	x	
	<i>Acacia extensa</i>	x		
	<i>Acacia pulchella</i>	x	x	
	<i>Acacia urophylla</i>		x	
CAESALPINIACEAE	<i>Labichea punctata</i>	x		
PAPILIONACEAE	<i>Bossiaea ornata</i>		x	
	<i>Chorizema dicksonii</i>		x	
	<i>Daviesia horrida</i>		x	
	<i>Gompholobium knightianum</i>	x		
	<i>Gompholobium marginatum</i>	x	x	
	<i>Hovea chorizemifolia</i>		x	
	<i>Kennedia coccinea</i>	x		
	<i>Kennedia prostrata</i>		x	
	* <i>Lotus subbiflorus</i>		x	x
	<i>Mirbelia dilatata</i>		x	
	* <i>Trifolium campestre</i>		x	
* <i>Trifolium campestre</i> var. <i>campestre</i>		x		
* <i>Trifolium subterraneum</i>		x		
OXALIDACEAE	* <i>Oxalis corniculata</i>	x	x	
	* <i>Oxalis pes-caprae</i>		x	
LINACEAE	* <i>Linum trigynum</i>		x	
RUTACEAE	<i>Boronia fastigiata</i>	x		
	<i>Philotheca spicata</i>	x		
TREMANDRACEAE	<i>Tetratheca nuda</i>		x	
EUPHORBIACEAE	* <i>Euphorbia peplus</i>		x	
	<i>Monotaxis grandiflora</i> var. <i>grandiflora</i>	x	x	
	<i>Poranthera microphylla</i>	x		
	<i>Phyllanthus calycinus</i>	x	x	
STACKHOUSIACEAE	<i>Stackhousia monogyna</i>		x	
	<i>Tripterococcus brunonis</i>	x		
SAPINDACEAE	<i>Dodonaea ceratocarpa</i>		x	
RHAMNACEAE	<i>Trymalium floribundum</i>		x	
	<i>Trymalium floribundum</i> subsp. <i>floribundum</i>	x	x	
	<i>Trymalium ledifolium</i>	x		
STERCULIACEAE	<i>Lasiopetalum floribundum</i>	x		
	<i>Lasiopetalum glabratum</i>	x		

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FAMILY	SPECIES	M 70/1240	Loc 344	Loc 246
DILLENIACEAE	<i>Hibbertia acerosa</i>	x		
	<i>Hibbertia amplexicaulis</i>	x	x	
	<i>Hibbertia commutata</i>	x		
	<i>Hibbertia glomerata</i>	x		
	<i>Hibbertia glomerata</i> subsp. <i>darlingensis</i>	x	x	
	<i>Hibbertia huegelii</i>		x	
	<i>Hibbertia hypericoides</i>		x	
	<i>Hibbertia ?pachyrrhiza</i>	x	x	
	<i>Hibbertia rupicola</i>	x		
THYMELAEACEAE	<i>Pimelea ciliata</i>		x	
	<i>Pimelea imbricata</i> var. <i>piligera</i>		x	
	<i>Pimelea spectabilis</i>		x	
	<i>Pimelea suaveolens</i>	x		
MYRTACEAE	<i>Astartea scoparia</i>	x	x	
	<i>Baeckea camphorosmae</i>	x	x	
	<i>Corymbia calophylla</i>	x	x	x
	<i>Darwinia citriodora</i>		x	
	<i>Eucalyptus marginata</i> subsp. <i>marginata</i>	x	x	
	<i>Eucalyptus patens</i>	x		
	<i>Eucalyptus rudis</i>	x		x
	<i>Eucalyptus wandoo</i>	x		
	<i>Hypocalymma angustifolium</i>	x	x	
	<i>Kunzea micrantha</i> subsp. <i>micrantha</i>	x	x	
	<i>Melaleuca parviceps</i>		x	
	<i>Melaleuca radula</i>		x	
	<i>Pericalymma ellipticum</i>	x		
	<i>Taxandria linearifolia</i>	x	x	x
	<i>Verticordia densiflora</i> var. <i>?densiflora</i>	x		
	<i>Verticordia huegelii</i> var. <i>huegelii</i>	x	x	
<i>Verticordia pennigera</i>		x		
APIACEAE	<i>Daucus glochidiatus</i>	x	x	
	<i>Eryngium pinnatifidum</i>		x	
	<i>Hydrocotyle callicarpa</i>	x	x	
	<i>Pentapeltis peltigera</i>	x	x	
	<i>Platysace compressa</i>	x		
	<i>Trachymene pilosa</i>	x	x	
	<i>Xanthosia candida</i>	x		
	<i>Xanthosia huegelii</i>	x		
EPACRIDACEAE	<i>Leucopogon capitellatus</i>	x	x	
	<i>Leucopogon ?gracillimus</i>		x	
	<i>Leucopogon nutans</i>	x	x	
	<i>Leucopogon propinquus</i>	x		
	<i>Leucopogon verticillatus</i>	x		
	<i>Styphelia tenuiflora</i>	x		

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PRIMULACEAE	* <i>Anagallis arvensis</i>	x	x	
LOGANIACEAE	<i>Phyllangium paradoxum</i>	x		
ASCLEPIADACEAE	* <i>Gomphocarpus fruticosus</i>		x	x
BORAGINACEAE	* <i>Echium plantagineum</i>		x	
LAMIACEAE	<i>Hemigenia incana</i>		x	
	<i>Hemigenia rigida</i>	x		
	* <i>Mentha</i> sp.		x	
SOLANACEAE	* <i>Solanum nigrum</i>	x		
SCROPHULARIACEAE	* <i>Bartsia trixago</i>		x	
	* <i>Parentucellia</i> sp.	x		
OROBANCHACEAE	* <i>Orobanche minor</i>		x	
RUBIACEAE	* <i>Galium murale</i>		x	
	<i>Opercularia echinocephala</i>	x	x	
	<i>Opercularia hispidula</i>		x	
CAMPANULACEAE	<i>Wahlenbergia gracilentia</i>	x		
LOBELIACEAE	<i>Isotoma hypocrateriformis</i> var. <i>hypocraterif</i>	x		
GOODENIACEAE	<i>Dampiera linearis</i>	x	x	
	<i>Goodenia micrantha</i>		x	
	<i>Lechenaultia biloba</i>	x	x	
	<i>Scaevola calliptera</i>	x	x	
	<i>Scaevola glandulifera</i>		x	
STYLIDIACEAE	<i>Levenhookia pusilla</i>	x	x	
	<i>Stylidium brunonianum</i>	x	x	
	<i>Stylidium calcaratum</i>	x	x	
	<i>Stylidium dichotomum</i>	x	x	
	<i>Stylidium hispidum</i>	x	x	
	<i>Stylidium junceum</i>	x		
	<i>Stylidium piliferum</i>	x		
	<i>Stylidium repens</i>	x		
	<i>Stylidium schoenoides</i>	x		
ASTERACEAE	* <i>Arctotheca calendula</i>	x	x	x
	<i>Craspedia variabilis</i>	x	x	
	<i>Hyalosperma cotula</i>	x	x	
	* <i>Hypochaeris glabra</i>	x	x	
	<i>Lagenophora huegelii</i>	x	x	
	<i>Millotia tenuifolia</i>	x		
	<i>Millotia tenuifolia</i> var. <i>laevis</i> (P2)	x		

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FAMILY	SPECIES	M 70/1240	Loc 344	Loc 246
ASTERACEAE	<i>Pithocarpa ?corymbulosa</i> (P2)		x	
(Continued)	<i>Podolepis lessonii</i>		x	
	<i>Podotheca angustifolia</i>	x		
	<i>Pterochaeta paniculata</i>	x		
	<i>Rhodanthe citrina</i>	x		
	<i>Senecio hispidulus</i>		x	
	<i>Senecio hispidulus</i> var. <i>hispidulus</i>	x		
	<i>Senecio pinnatifolius</i> var. <i>pinnatifolius</i>	x		
	<i>Siloxerus multiflorus</i>		x	
	* <i>Sonchus oleraceus</i>		x	
	* <i>Tolpis barbata</i>		x	
	<i>Trichocline spathulata</i>	x		
	* <i>Ursinia anthemoides</i>	x	x	