
**FLORA AND VEGETATION ASSESSMENT OF
CLOVERDALE
LEASE AREA**

Prepared for:

Iluka Resources Ltd

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1. SUMMARY

Mattiske Consulting Pty Ltd was commissioned by Iluka Resources to conduct a vegetation survey for a proposed mineral sands mine south of Capel, Western Australia. The objectives of the study were to update and expand on the earlier studies by Hart, Simpson and Associates (2001), Mattiske Consulting Pty Ltd (2003) and GHD Pty Ltd (2005). The specific work undertaken by Mattiske Consulting Pty Ltd in the spring months of 2005 included a search for rare and priority flora, defining and mapping the plant communities present, assessing the condition of the plant communities and reviewing the local and regional conservation value of the flora and vegetation.

The Department of Conservation and Land Management (2005a) records indicate that 11 Rare, 2 Priority 1, 4 Priority 2, 15 Priority 3 and 11 Priority 4 taxa may potentially occur in the Cloverdale survey area. During the recent studies, one Rare flora species and three Priority species were recorded on the Cloverdale survey area. The previous report by GHD Pty Ltd (2005) recorded *Calectasia cyanea* (white). This species is a rare plant and is more restricted than *Calectasia narragara*. The previous collection by GHD Pty Ltd (2005) is more likely to be *Calectasia narragara* (white variant of this taxon). This white variant has been recorded previously (Department of Conservation and Land Management 2005a).

A total of 248 taxa (including subspecies and varieties) from 164 genera and 54 families were recorded within the Cloverdale survey area (Appendix A). Representation was greatest among the Papilionaceae (24 taxa), Myrtaceae (18 taxa), Orchidaceae (17 taxa), Poaceae (16 taxa), Proteaceae (15 taxa) and Cyperaceae (14 taxa). This total compares with a total of 341 taxa (including subspecies and varieties) from 196 genera and 64 families on the Cloverdale and Yoganup survey areas since 2002 (Mattiske Consulting Pty Ltd 2003, GHD Pty Ltd 2005 and recent survey).

The populations of the Rare flora species – *Caladenia huegelii* should be protected from any disturbance. As these plants occur in the remnants on Loc 2015 this should be possible in the proposed development, as it is intended to avoid the remnant on this property which supports this species.

The populations of the Priority flora species should be protected from disturbance wherever possible as these species are all under some degree of threat. The *Franklandia triaristata* and *Pultenaea skinneri* occur within the remnants of native vegetation on part of Loc 3096 in the north of the lease area. Therefore these latter populations should be protected from the proposed developments. The *Acacia semitrullata* occurred on a range of sites and not all populations will be disturbed by the proposed developments.

Eight vegetation communities were recorded in the Cloverdale survey area, including three communities dominated by *Corymbia calophylla*, which occur on heavy loam soils and two *Eucalyptus marginata* communities, one *Banksia attenuata* woodland and one *Agonis flexuosa* woodland which occur on sandy soils. Additionally, a *Melaleuca pressiana* woodland was also recorded on seasonally wet area with heavy soils. One *Corymbia calophylla* community (C2) recorded in the survey is equivalent to community 3a ‘*Corymbia calophylla* – *Kingia australis* woodlands on heavy soils’ which is listed as critically endangered under the EPBC Act (1999).

The Cloverdale survey area is primarily on private land that consists mainly of cultivated paddocks and plantations. The native vegetation consists of small remnants of native vegetation often on road reserve, drainage lines or partially grazed paddocks. The C2 community is largely degraded with only remnant trees of *Corymbia calophylla* and *Kingia australis* persisting. Therefore there is little value in maintaining these values within this particular community on the agricultural areas. The localised strip of the C2 community on the Warns Road supports a larger range of understorey species and should be protected as far as possible from disturbance. However in view of the size of this roadside verge the longer-term prospects for protecting this area from weed invasion are limited.

The condition of the remaining vegetation (according to the Bush Forever condition rating) has been modified by grazing, weed invasion and dieback. The pockets of vegetation that are locally and regionally significant include the remnants that support the rare orchid on Loc 2015, the block of remnant vegetation on Loc 3096 on the northern section of the lease area and the riverine communities (C1) along the Ludlow and Capel Rivers that provide corridors for fauna movement. On current planning, it appears that most of these areas will not be directly impacted by the proposed developments.

2. INTRODUCTION

Iluca Resources Ltd proposes to establish a mineral sand mine approximately eight kilometres south of Capel, called the Cloverdale Mineral Sands Project. The vegetation survey area is approximately 6.5km long by 3km wide, which includes the area overlying the resource. The survey area is primarily on private land, which has been cleared for agriculture with small remnants of native vegetation often on road reserves and drainage lines.

Two vegetation surveys have previously been conducted in the Cloverdale area. A preliminary Ecological Assessment conducted by Hart, Simpson and Associates in 2001. In this study only a small area was surveyed but one DRF and one Priority 3 species was recorded. A more detailed study was conducted March 2005 by GHD Pty Ltd that covered the area in the present survey.

Mattiske Consulting (2003) also conducted a survey of the Yoganup West project area, which lies on the eastern fringes of the Cloverdale Project (and overlaps in one remnant area).

2.1 Declared Rare, Priority and Threatened Species

Species of flora and fauna are defined as Declared Rare or Priority conservation status where their 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) and therefore it is an offence to “take” or damage 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 need of further survey (Priority One to Three) or require monitoring every 5-10 years (Priority Four). Table 1 presents the definitions of Declared Rare and the four Priority ratings under the Wildlife Conservation Act (1950) as extracted the Department of Conservation and Land Management (2005a, 2005b).

Table 1: Definition of Rare and Priority Flora Species (Department of Conservation and Land Management, 2005a)

Conservation Code	Category
	Declared Rare Flora – Extant Taxa
R	“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.”
	Priority One – Poorly Known Taxa
P1	“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.”
	Priority Two – Poorly Known Taxa
P2	“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 (not currently endangered). Such taxa are under consideration for declaration as ‘rare flora’, but urgently need further survey.”
	Priority Three – Poorly Known Taxa
P3	“Taxa which are known from several populations, and the taxa are not believed to be under immediate threat (ie. 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.”
	Priority Four – Rare Taxa
P4	“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 recognised at a Federal Government level and are categorised according to the Environmental Protection and Biodiversity Conservation Act (EPBC Act), 1999 (Department of Environment and Heritage 2005a). Categories of threatened species are summarised in Table 2.

Table 2: Categories of Threatened Flora Species (Environmental Protection and Biodiversity Conservation Act, 1999)

Category Code	Category
Ex	<p>Extinct</p> <p>Taxa for which there is no reasonable doubt that the last member of the species has died.</p>
ExW	<p>Extinct in the Wild</p> <p>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.</p>
CE	<p>Critically Endangered</p> <p>Taxa which face an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.</p>
E	<p>Endangered</p> <p>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.</p>
V	<p>Vulnerable</p> <p>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.</p>
CD	<p>Conservation Dependent</p> <p>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.</p>

2.2 Wetlands

Much of the Cloverdale project area is recorded as palusplain or seasonally waterlogged lands. One of the Resource Enhancement Wetlands (#671) is located northwest of the Cloverdale lease area on the boundary which straddles the Plantation Road. This wetland is some 2km west of the orebody.

One gazetted Conservation Category Wetland (#826) occurs within the Cloverdale lease area. The wetland boundary follows the Vacant Crown Land boundary along the Ludlow River, immediately west of Warns/Armstrong Road. The wetland is downstream of the projected orebody.

Two key local rivers cross the Cloverdale lease area, the Ludlow and the Capel Rivers. The Capel River occurs on the northern fringes of the Cloverdale lease area and flows from east to west. The river was flowing at the time of the survey (September/October 2005). This river has been recorded as flowing in March (GHD Pty Ltd 2005). The Ludlow River crosses the Cloverdale lease area in the middle of the lease area. Although Ludlow River was not flowing in March 2005 (GHD Pty Ltd 2005), it was flowing in September/October 2005. The Ludlow River flows from east to west. The riparian vegetation along both rivers has been degraded by agricultural activities.

2.3 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 may be 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 may be 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.).

2.4 Vegetation

The proposed mining 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 Department of Environment and Heritage 2005a). These subdivisions largely relied on the earlier physiographic work of Beard (1981).

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 1958; Lange 1960; Churchill 1961, 1968; Smith 1974; Seddon 1972; Havel 1968, 1975a, 1975b; Heddle *et al.* 1980a; Beard 1981, Mattiske 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),
- . Smith (1974) on the Collie area (1:250,000),
- . 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 complexes on the Swan Coastal Plain were defined and mapped by Heddle *et al.* (1980a). The vegetation complexes on the adjacent Darling Scarp and Plateau were revised and mapped by Mattiske and Havel (1998) for the purposes of the Regional Forest Agreement.

The Cloverdale lease area occurs on three vegetation complexes as defined by Heddle *et al.* (1980a), namely:

Abba - A mixture of open forest of *Corymbia calophylla* – *Eucalyptus marginata* – *Banksia* spp. and woodland of *Corymbia calophylla*. Abba is similar to Forrestfield and Guildford vegetation complexes, but differs in the lack of *Eucalyptus wandoo*.

Swan - A woodland of *Eucalyptus rudis* – *Melaleuca raphiophylla*, with localised occurrences of low open forest of *Casuarina obesa* and *Melaleuca cuticularis* along creeks and on flood-plains.

Southern River – Open woodland of *Corymbia calophylla* – *Eucalyptus marginata* – *Banksia* spp. on flats and plains, with fringing woodlands of *Eucalyptus rudis* – *Melaleuca raphiophylla* along creek beds.

All of these vegetation complexes have been largely cleared and modified by agricultural activities and as a result only localised remnants remain.

2.5 Threatened Ecological Communities

Communities are described as ‘Threatened Ecological Communities’ (TEC’s) if they have been defined by the Western Australian Threatened Ecological Communities Scientific Advisory Committee and found to be Presumed Totally Destroyed (PD), Critically Endangered (CR), Endangered (EN) or Vulnerable (VU). For definitions of TEC categories and criteria refer to English and Blyth (1997) and Department of Conservation and Land Management (2005c). Selected plant communities have also been listed as “Threatened Ecological Communities” under the Environmental Protection and Biodiversity Conservation Act (EPBC Act 1999). The TEC’s at the national level are defined on the Environment Australia website (www.ea.gov.au).

Five Threatened Ecological Communities occur in the general Capel area, Table 3. Communities 10b and 3a are listed as endangered under the Commonwealth EPBC Act (1999) (Department of Environment and Heritage 2005b).

Table 3: Threatened Ecological Communities found in the general Capel area

Gibson <i>et al.</i> (1994) plant community type	General Description	Status (EPBC Act 1999 Category)
10b	Shrublands of southern Swan Coastal Plain Ironstones (Busselton area)	Critically Endangered
2	Southern wet shrublands, Swan Coastal Plain	Endangered
3a	<i>Corymbia calophylla</i> – <i>Kingia australis</i> woodlands on heavy soils, Swan Coastal Plain	Critically Endangered
1b	<i>Corymbia calophylla</i> woodlands on heavy soils of the southern Swan Coastal Plain	Vulnerable
7	Herb rich saline shrublands in clay pans	Vulnerable

3. OBJECTIVES

The specific objectives of the flora and vegetation survey were to:

- identify all vascular plant species present within the three sites;
- review the conservation status of the vascular plant species by reference to current literature and current listings by the Department of Conservation and Land Management (2005a and 2005b) and the Department of the Environment and Heritage web site under the EPBC Act (1999);
- compare the plant communities at each site with those defined by Gibson *et al.* (1994) to aid in assessing their local and regional significance; and
- produce a report summarising the findings.

4. METHODS

The flora of the Cloverdale survey area was described and collected systematically at 21 recording sites, during September and October, 2005. At each site the following floristic and environmental notes were made: topography, percentage litter cover, soil ratio, percentage of bare ground, outcropping rocks and their type, pebble type and size, and time since fire. For each species recorded, the average height and percent foliage cover of species both alive and dead was noted. The condition of each plant community was rated according to the scale used for assessing Bush Forever sites (Government of Western Australia 2000). The scale is summarised in Table 4.

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

Table 4: 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.

5. RESULTS

5.1 Flora

A total of 248 taxa (including subspecies and varieties) from 164 genera and 54 families were recorded within the Cloverdale survey area (Appendix A). Representation was greatest among the Papilionaceae (24 taxa), Myrtaceae (18 taxa), Orchidaceae (17 taxa), Poaceae (16 taxa), Proteaceae (15 taxa) and Cyperaceae (14 taxa). This total compares with a total of 341 taxa (including subspecies and varieties) from 196 genera and 64 families on the Cloverdale and Yoganup survey areas since 2002 (Mattiske Consulting Pty Ltd 2003, GHD 2005 and recent survey).

54 introduced (weed) taxa were recorded. Four of these introduced species are listed by the Department of Agriculture (2005) pursuant to Section 37 of the Agriculture and Related Resources Protection Act 1976. The two species and their classes are summarized below:

- *?Carthamnus lanatus* (P3) – Control of infestation in such a way that prevents the spread of seed or plant parts within and from the property on or in livestock, fodder, grain, vehicles and/or machinery. Treat to destroy and prevent seed set all plants. The specimen collected resembled this species (hence the question mark) and therefore conservative management measures should be applied.
- *Zantedeschia aethiopica* (P1, P4) - P1 – prohibits movement of plants or their seeds within the State, This prohibits the movement of contaminated machinery and produce including livestock and fodder. P4 – prevent the spread of infestation from the property on or in livestock, fodder, grain, vehicles and/or machinery. Treat to destroy and prevent seed set on all plants.
- *Solanum linnaeanum* (P1, P4) – was recorded previously near the Ludlow River (Mattiske Consulting Pty Ltd 2003 and GHD Pty Ltd 2005). P1 – prohibits movement of plants or their seeds within the State, This prohibits the movement of contaminated machinery and produce including livestock and fodder. P4 – prevent the spread of infestation from the property on or in livestock, fodder, grain, vehicles and/or machinery. Treat to destroy and prevent seed set on all plants.

During the survey work concern was also expressed by landowners that there was a local concern regarding Doublegee (*Emex australis* – P1). *Emex australis* was recorded in the survey work undertaken by GHD Pty Ltd (2005) near the Capel River, Appendix A. P1 - prohibits movement of plants or their seeds within the State, This prohibits the movement of contaminated machinery and produce including livestock and fodder.

5.2 Rare and Priority Flora

The Department of Conservation and Land Management (2005a) records indicate that 11 Rare, 2 Priority 1, 4 Priority 2, 15 Priority 3 and 11 Priority 4 taxa may potentially occur in the Cloverdale survey area (Appendix B). During the recent studies one Rare flora species and three Priority species were recorded on the Cloverdale survey area (Table 5). The previous report by GHD Pty Ltd (2005) recorded *Calectasia cyanea* (white). This species is a rare plant and is more restricted than *Calectasia narragara*. The previous collection by GHD Pty Ltd (2005) is more likely to be *Calectasia narragara* (white variant of this taxon). This white variant has been recorded previously (Department of Conservation and Land Management 2005a).

Caladenia huegelii was located during the survey, which is a Declared Rare Flora pursuant to subsection (2) of section 23F of the Wildlife Conservation Act (1950) and as listed by the Department of Conservation and Land Management (2005a). *Caladenia huegelii* is also listed as Endangered pursuant to section 179 of the Environmental Protection Biodiversity Conservation Act (1999), Appendix B. *Caladenia huegelii* is an orchid found on the Swan Coastal Plain between Perth and Cape Naturaliste. According to the Herbarium of Western Australia there are 28 records of the species from 19 localities that are usually from Banksia woodlands on grey or brown sands. In the Cloverdale survey area it was found in a *Banksia attenuata* – *Banksia ilicifolia* woodland (B1) in the mine impact zone on Loc 2015. A total of five individual plants were located after two extensive searches of Loc 2015 that were conducted on the 23th September and 13th October.

Three Priority taxa as defined by the Department of Conservation and Land Management (2005a), *Franklandia triaristata* (P4), *Pultenaea skinneri* (P3) and *Acacia semitrullata* (P3), were located during the survey.

Franklandia triaristata is small erect shrub is found in Jarrah forest on mainly white or grey sands in the south west corner of WA. In the Cloverdale survey area it was recorded on Loc 3096 in a *Eucalyptus marginata* – *Banksia attenuata* woodland (E1). The species was not found in any proposed mining areas during the current survey.

Pultenaea skinneri is slender shrub of up to 3 metres that occurs in winter wet depressions in Jarrah forest in south west corner of WA. In the Cloverdale survey area it was recorded from two locations within the remnant vegetation area on Loc 3096 in a *Eucalyptus marginata* – *Banksia attenuata* woodland (E1). The species was not found in any proposed mining areas during the current survey..

Acacia semitrullata is a small, pungent shrub found mostly on the Swan Coastal Plain in the south west corner of WA, with one outlying population known from near Walpole. This species grows mainly on white or grey sand on sandplains and swampy areas. In the Cloverdale survey area it was recorded from four locations. Three populations occur outside the mine impact area in community E1 and B1 within the remnant vegetation area on Loc 3096 and in community E1 on Downs Rd. One population occurs in the mine impact area in community B1 on Loc 2015.

Table 5: Locations of Rare and Priority flora recorded by Matiske Consulting in the Cloverdale survey area, September and October, 2005

Species	Location (GDA)
<i>Caladenia huegelii</i> (DRF)	368264 mE
	6278779 mN
	368264 mE
	6278779 mN
	368278 mE
	6278777 mN
	368381 mE
	6278545 mN
	368382 mE
6278554 mN	
<i>Acacia semitrullata</i> (P3),	367736 mE
	6278430 mN
	371330 mE
	6280792 mE
	366670 mE
	6280150 mN
	368342 mE
6278455 mN	
<i>Pultenaea skinneri</i> (P3)	371371 mE
	6280753 mN
	371285 mE
	6280871 mE
<i>Franklandia triaristata</i> (P4)	371330 mE
	6280792 mE

5.3 Vegetation

A total of eight vegetation communities were recorded in the Cloverdale survey area, including three communities dominated by *Corymbia calophylla*, which occur on heavy loam soils, two *Eucalyptus marginata* communities, one *Banksia attenuata* woodland and one *Agonis flexuosa* woodland which occur on sandy soils. Additionally, a *Melaleuca preissiana* woodland was also recorded on seasonally wet areas with heavy soils (Figure 1). The remaining areas consist mainly of cultivated paddocks and plantations with occasional remnant trees or small patches of vegetation with *Corymbia calophylla*, *Eucalyptus marginata* subsp. *marginata* or *Melaleuca preissiana*. The condition of the remnant vegetation areas is presented in Figure 2.

- A1 – Woodland of *Agonis flexuosa* over pasture on sandy soils. This community has been subjected to grazing pressures and very little of the understorey persists. The community is largely degraded (condition rating 5).
- B1 – Open Woodland of *Banksia attenuata* - *Banksia ilicifolia* over *Kunzea ericifolia*, *Podocarpus drouynianus* and *Dasyopogon bromeliifolius* with emergent *Eucalyptus marginata* subsp. *marginata* on sandy soils. This community has been subjected to grazing pressures and very little of the understorey persists. The community varies from very good to largely degraded (condition ratings 3 and 5). The rare orchid (*Caladenia huegelii*) was recorded in this community.
- C1 – Open Forest to Woodland of *Corymbia calophylla* - *Eucalyptus rudis* over *Melaleuca preissiana*, *Melaleuca rhapsiophylla* and *Agonis flexuosa* over *Astartea scoparia*, *Taxandria linearifolia* and *Cyathochaeta avenacea* on major watercourses. This community has been subjected to grazing pressures and very little of the understorey persists. The community varies from good to largely degraded (condition ratings 4 to 5), see Appendix B.

- C2 – Open Forest to Woodland of *Corymbia calophylla* over *Banksia grandis*, *Kingia australis* and *Xanthorrhoea preissii* on loam soils. This community is equivalent to the equivalent to community 3a ‘*Corymbia calophylla* – *Kingia australis* woodlands on heavy soils’ (as defined by Gibson et al. 1994). This community is listed at the State level (CALM 2005c) as critically endangered and at the Federal level under the EPBC Act (1999) as a Threatened Ecological Community. The areas within the survey area are largely degraded and range from condition 4 to 6 (with only the *Corymbia calophylla* (Marri) and *Kingia australis* present in many instances within the paddocks), see Appendix B.
- C3 – Woodland of *Corymbia calophylla* over pasture on loam soils. The areas within the survey area are largely degraded (condition scale 5 - 6), see Appendix B.
- E1 - Open Woodland of *Eucalyptus marginata* subsp. *marginata* - *Banksia attenuata* - *Banksia grandis* - *Xylomelum occidentale* over *Stirlingia latifolia* and *Dasypogon bromeliifolius* on sandy soils. This community has been protected from grazing pressures and consequently the understorey persists. The condition of the community varies from excellent to good (condition ratings 2 to 4). The decline in the condition is largely related to the infestation of dieback (*Phytophthora cinnamomi*) in the community, see Appendix B.
- E2 – Open Forest of *Eucalyptus marginata* subsp. *marginata* - *Corymbia calophylla* over low shrubs and herbs on sandy-loam soils. This community has been protected from regular grazing pressures and consequently some of the understorey persists. The condition of the community is good (4).
- M1 – Woodland of *Melaleuca preissiana* over *Hypocalymma angustifolium* and mixed sedges. This community has been protected from grazing pressures and consequently the understorey persists. The condition of the community is very good (condition rating 3). The decline in the condition is largely related to the infestation of dieback (*Phytophthora cinnamomi*) in the community.
- CL – Mostly cleared cultivated paddocks with occasional *Corymbia calophylla*, *Eucalyptus marginata* subsp. *marginata* and *Melaleuca preissiana*.
- PL – Plantations.

6. DISCUSSION

The survey effort was undertaken in the spring months of 2005 (September and October) by four experienced botanists. This work supplemented earlier studies by Hart, Simpson and Associates (2001), Mattiske Consulting Pty Ltd (2003) and GHD Pty Ltd (2004). The occurrence of a range of orchid species and annual species reflects the wide coverage of the flora species (Appendix A).

During the recent studies, one Rare flora species and three Priority species were recorded on the Cloverdale survey area. The previous report by GHD (2005) recorded *Calectasia cyanea* (white). This species is a rare plant and is more restricted than *Calectasia narragara*. The previous collection by GHD (2005) is more likely to be *Calectasia narragara* (white variant of this taxon). This white variant has been recorded previously (Department of Conservation and Land Management 2005a).

A total of 248 taxa (including subspecies and varieties) from 164 genera and 54 families were recorded within the Cloverdale survey area (Appendix A). Representation was greatest among the Papilionaceae (24 taxa), Myrtaceae (18 taxa), Orchidaceae (17 taxa), Poaceae (16 taxa), Proteaceae (15 taxa) and Cyperaceae (14 taxa). This total compares with a total of 341 taxa (including subspecies and varieties) from 196 genera and 64 families on the Cloverdale and Yoganup survey areas since 2002 (Mattiske Consulting Pty Ltd 2003, GHD 2005 and recent survey).

The populations of the Rare flora species – *Caladenia huegelii* should be protected from any disturbance. Any proposed disturbances of this taxon, which is listed under both the Wildlife Conservation Act (1950) and the EPBC Act (1999), will require approvals by the State and Federal Environment Ministers. As these plants occur in the remnants on Loc 2015 this should be possible in the proposed development, as it is intended to avoid the remnant on this property which supports this species.

The populations of the Priority flora species should be protected from disturbance wherever possible as these species are all under some degree of threat. The *Franklandia triaristata* and *Pultenaea skinneri* occur within the remnants of native vegetation on the remnant vegetation area on Loc 3096 in the north of the lease area. Therefore these latter populations should be protected from the proposed developments. The *Acacia semitrullata* occurred on a range of sites and not all populations will be disturbed by the proposed developments.

Eight vegetation communities were recorded in the Cloverdale survey area, including three communities dominated by *Corymbia calophylla*, which occur on heavy loam soils and two *Eucalyptus marginata* communities, one *Banksia attenuata* woodland and one *Agonis flexuosa* woodland which occur on sandy soils. Additionally, a *Melaleuca pressiana* woodland was also recorded on seasonally wet area with heavy soils. One *Corymbia calophylla* community (C2) recorded in the survey is equivalent to community 3a ‘*Corymbia calophylla* – *Kingia australis* woodlands on heavy soils’ which is listed as critically endangered under the EPBC Act (1999).

The Cloverdale survey area is primarily on private land that consists mainly of cultivated paddocks and plantations. The native vegetation consists of small remnants of native vegetation often on road reserve, drainage lines or partially grazed paddocks. The C2 community is largely degraded with only remnant trees of *Corymbia calophylla* and *Kingia australis* persisting. Therefore there is little value in maintaining these values within this particular community on the agricultural areas (Appendix B). The localised strip of the C2 community on the Warns Road supports a larger range of understorey species and should be protected as far as possible from disturbance. However in view of the size of this roadside verge the longer-term prospects for protecting this area from weed invasion are limited.

The condition of the remaining vegetation (according to the Bush Forever condition rating) has been modified by grazing, weed invasion and dieback. The pockets of vegetation that are locally and regionally significant include the remnants that support the rare orchid on Loc 2015, the block of remnant vegetation on Loc 3096 on the northern section of the lease area and the riverine communities (C1) along the Ludlow and Capel Rivers that provide corridors for fauna movement. On current planning, it appears that most of these areas will not be directly impacted by the proposed developments. Indirect impacts should be minimal, however it is recommended that the less disturbed areas on Loc 2015 and 3096 should be monitored.

The riverine vegetation is of less concern for the flora and vegetation values as these areas on the Capel and Ludlow rivers have been significantly modified by past grazing activities. Nevertheless there is a need to maintain the communities in these areas as they provide significant values for fauna corridors and landscape values.

7. LIST OF PARTICIPANTS

The following personnel of Mattiske Consulting Pty Ltd have been involved with this project:

Principal Ecologist:	Dr E. M. Mattiske
Botanists:	Mr D. Rathbone Ms B. Taylor Ms F. Smith

8. REFERENCES

- Beard, J.S. (1979)
The vegetation of the Pinjarra Area, Western Australia. Map and Explanatory Memoir, 1:250,000 Series, Vegmap Publications, Perth.
- Beard, J.S. (1980)
A New Phytogeographic Map of Western Australia. Western Australian Herbarium Notes Number 3: 37-58.
- Beard, J.S. (1981)
Vegetation Survey of Western Australia. Swan. Map and Explanatory Notes, Sheet 7, 1:1,000,000 Series, University of Western Australia Press, Perth.
- Beard, J.S. (1990)
Plant Life of Western Australia. Kangaroo Press Pty Ltd, Kenthurst, N.S.W.
- Churchward, H.M. and McArthur, W.M. (1980)
Landforms and Soils of the Darling System. In: *Atlas of Natural Resources, Darling System, Western Australia.* Department of Conservation and Environment, Western Australia.
- Commonwealth of Australia. (2001)
National Targets and Objectives for Biodiversity Conservation 2001-2005. AGPS, Canberra.
- Churchill, D.M. (1961)
The Tertiary and Quaternary vegetation and climate in relation to the living flora in South Western Australia. Ph.D. thesis, University of Western Australia.
- Churchill, D.M. (1968)
The distribution of and prehistory of Eucalyptus diversicolor F.Muell., E. marginata Donn ex Sm., and E. calophylla R.Br. in relation to rainfall. Aust. J. Bot. **16**: 125-151.
- Churchward, H.M and W.M. McArthur (1980)
Landforms and Soils of the Darling System, Western Australia. In: Department of Conservation and Environment (1980) *Atlas of Natural Resources Darling System, Western Australia.* Published by the Department of Conservation and Environment, Perth, 1980.
- Dell, B., Havel, J.J., Malajcsuk, N. (editors) (1989)
The Jarrah Forest: a complex Mediterranean ecosystem. Kluwer Academic Publishers, Netherlands.
- Department of Agriculture (2005)
Declared Plants List.
http://agspsrv34.agric.wa.gov.au/programs/app/dec_pl/declaredplants.htm
- Department of Conservation and Environment (1980)
Atlas of Natural Resources Darling System, Western Australia. Published by the Department of Conservation and Environment, Perth, 1980.
- Department of Conservation and Land Management (2005a)
Florabase. Department of Conservation and Land Management.
<http://www.calm.wa.gov.au/science/florabase.html>
- Department of Conservation and Land Management (2005b)
Max Version 2.1.1.129. Department of Conservation and Land Management.

-
- Department of Conservation and Land Management (2005c)
List of Threatened Ecological Communities on the (TEC) Database endorsed by the Minister for the Environment.
http://www.naturebase.net/plants_animals/watscu/pdf/tec/endorsed_tec_list_jan04.pdf
- Department of the Environment and Heritage (2005a)
EPBC Act List of Threatened Flora
<http://www.deh.gov.au/cgi-bin/sprat/public/publicthreatenedlist.pl?wanted=flora>
- Department of the Environment and Heritage (2005b)
EPBC Act List of Threatened Ecological Communities.
<http://www.deh.gov.au/cgi-bin/sprat/public/publiclookupcommunities.pl>
- Diels, L. (1906)
Die Pflanzenwelt von Western-Australien sudlich des Wendekreises. Vegn. Erde 7, Leipzig.
- English, V. and Blyth, J. (1997)
Identifying and Conserving Threatened Ecological Communities (TECs) in the South West Botanical Province. Published jointly by Environment Australia, Canberra and the Department of Conservation and Land Management, Perth.
- Environmental Protection Authority (2004)
Guidance for the Assessment of Environmental Factors (in accordance with the Environmental Protection Act 1986) – Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia. No. 51. June 2004.
- Gardner, C.A. (1942)
The vegetation of Western Australia with special reference to climate and soils. J. Proc. R. Soc. West. Aust. **28**:11-87.
- GHD Pty Ltd (2004)
Iluka Resources Ltd. Environmental Assessment, Flora and Fauna Survey.
- Gibson, N., Keighery, B.J., Keighery, G.J., Burbidge, A.H. and Lyons, M.N. (1994)
A Floristic survey of the southern Swan Coastal Plain. Unpublished Report for the Australian Heritage Commission prepared by Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.).
- Government of Western Australia (2000)
Bush Forever Volume 2. Directory of Bush Forever Sites. Department of Environmental Protection, Perth.
- Hart, Simpson and Associates Pty Ltd (2001)
Tutunup West Deposit: Ecological Review. An unpublished report prepared for Iluka Resources Limited, October 2001.
- Havel, J.J. (1968)
The potential of the northern Swan Coastal Plain for Pinus pinaster Ait plantations. Bull. For. Dep. W. Aust. **76**.
- Havel, J.J (1975a)
Site-vegetation mapping in the northern jarrah forest (Darling Range). I. Definition of site-vegetation types. Bull. For. Dep. W. Aust. **86**.
- Havel, J.J (1975b)
Site-vegetation mapping in the northern jarrah forest (Darling Range). II. Location and mapping of site-vegetation types. Bull. For. Dep. W. Aust. **87**.

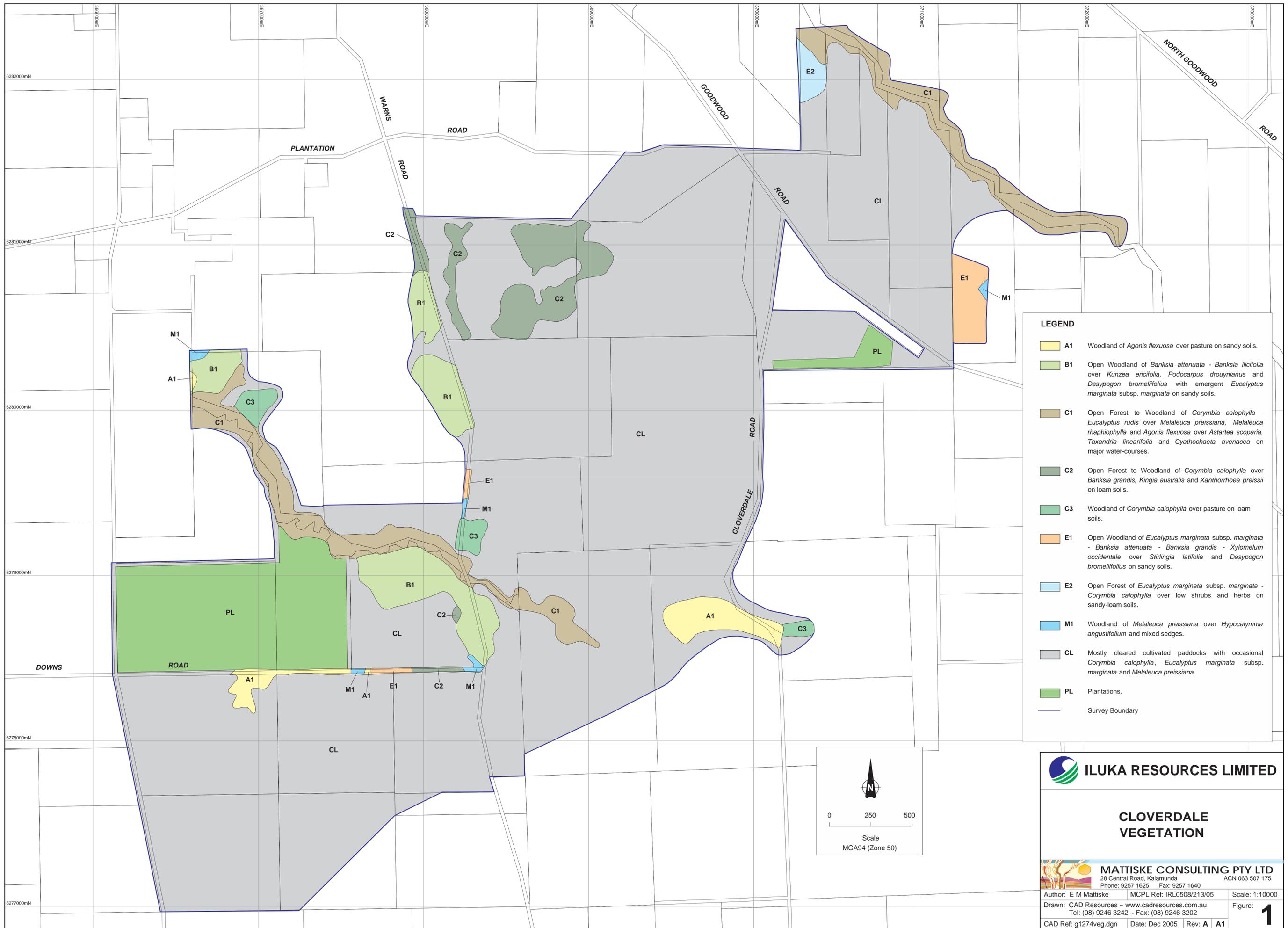
-
- Heddl, E.M., J.J. Havel, and O.W. Loneragan (1980a)
Vegetation Complexes of the Darling System, Western Australia. In: Department of Conservation and Environment (1980) *Atlas of Natural Resources Darling System, Western Australia.* Department of Conservation and Environment, Perth, 1980.
- Heddl, E.M., J.J. Havel, and O.W. Loneragan (1980b)
Focus on Northern Jarrah Forest Conservation and Recreation Areas. Forest Focus Number **22.**
- Hoffman, N. and Brown, A. (1992)
Orchids of South-west Australia. Second edition. University of Western Australia Press.
- Hopper, S.D., van Leeuwen, S., Brown, A.P. and S.J. Patrick (1990).
Western Australia's Endangered Flora. Department of Conservation and Land Management, Wanneroo, Western Australia.
- Keighery, B.J. (1994)
Bushland Plant Survey. A Guide to Plant Community Survey for the Community. Wildflower Society of WA (Inc.), Western Australia.
- Lange, R.T. (1960)
Rainfall and soil control of tree species distribution around Narrogin, Western Australia. J. Roy. Soc. W. Aust. **43**:104-110.
- Mattiske, E.M. and Havel, J.J. (1998)
Vegetation Complexes – Pinjarra 1:250,000 Sheet. Vegetation Mapping in the South West of Western Australia” for Environment Australia and the Department of Conservation and Land Management, Perth.
- Mattiske Consulting Pty Ltd (2003)
Flora and Vegetation on Yoganup West Survey Area. Unpublished report prepared for Iluka Resources Limited, January 2003.
- Shepherd, D.P., Beeston, G.R., and Hopkins, A.J.M. (2002)
Native Vegetation in Western Australia – extent, type and status. Resource Management Technical Report 249, Department of Agriculture, Western Australia.
- Speck, N.H. (1958)
The vegetation of the Darling-Irwin botanical districts and an investigation of the distribution of the family Proteaceae in south-western Western Australia. Ph.D. thesis, University of Western Australia.
- Seddon, G. (1972)
Sense of Place. A Response to an Environment, the Swan Coastal Plain, Western Australia. University of Western Australia Press, Nedlands.
- Smith, F.G. (1974)
Vegetation Survey of Western Australia. Vegetation Map of the Collie Sheet. 1:250 000. Department of Agriculture, Western Australia.
- Thackway, R. and Cresswell, I.D. (1995)
An Interim Biogeographic Regionalisation for Australia: a framework for setting priorities in the national reserves system cooperative program. Australian Nature Conservation Agency Canberra.
- Wildlife Conservation Act (1950-1980)
Wildlife Conservation Act and Regulations. Western Australian Government Publication.

Williams, R.F. (1932)

An ecological analysis of the plant communities of the jarrah region on a small area near Darlington. J. Roy. Soc. W. Aust. **18**: 105-124.

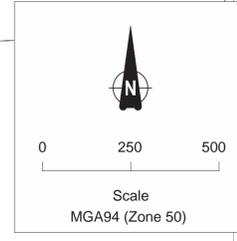
Williams, R.F. (1942)

An ecological study near Beraking forest station. J. Roy. Soc. W. Aust. **31**: 19-31.



LEGEND

- A1** Woodland of *Agonis flexuosa* over pasture on sandy soils.
- B1** Open Woodland of *Banksia attenuata* - *Banksia ilicifolia* over *Kunzea ericifolia*, *Podocarpus drouynianus* and *Dasypogon bromeliiifolius* with emergent *Eucalyptus marginata* subsp. *marginata* on sandy soils.
- C1** Open Forest to Woodland of *Corymbia calophylla* - *Eucalyptus rudis* over *Melaleuca preissiana*, *Melaleuca raphiophylla* and *Agonis flexuosa* over *Astarea scoparia*, *Taxandria linearifolia* and *Cyathochaeta avenacea* on major water-courses.
- C2** Open Forest to Woodland of *Corymbia calophylla* over *Banksia grandis*, *Kingia australis* and *Xanthorrhoea preissii* on loam soils.
- C3** Woodland of *Corymbia calophylla* over pasture on loam soils.
- E1** Open Woodland of *Eucalyptus marginata* subsp. *marginata* - *Banksia attenuata* - *Banksia grandis* - *Xylomelum occidentale* over *Stirlingia latifolia* and *Dasypogon bromeliiifolius* on sandy soils.
- E2** Open Forest of *Eucalyptus marginata* subsp. *marginata* - *Corymbia calophylla* over low shrubs and herbs on sandy-loam soils.
- M1** Woodland of *Melaleuca preissiana* over *Hypocalymma angustifolium* and mixed sedges.
- CL** Mostly cleared cultivated paddocks with occasional *Corymbia calophylla*, *Eucalyptus marginata* subsp. *marginata* and *Melaleuca preissiana*.
- PL** Plantations.
- Survey Boundary

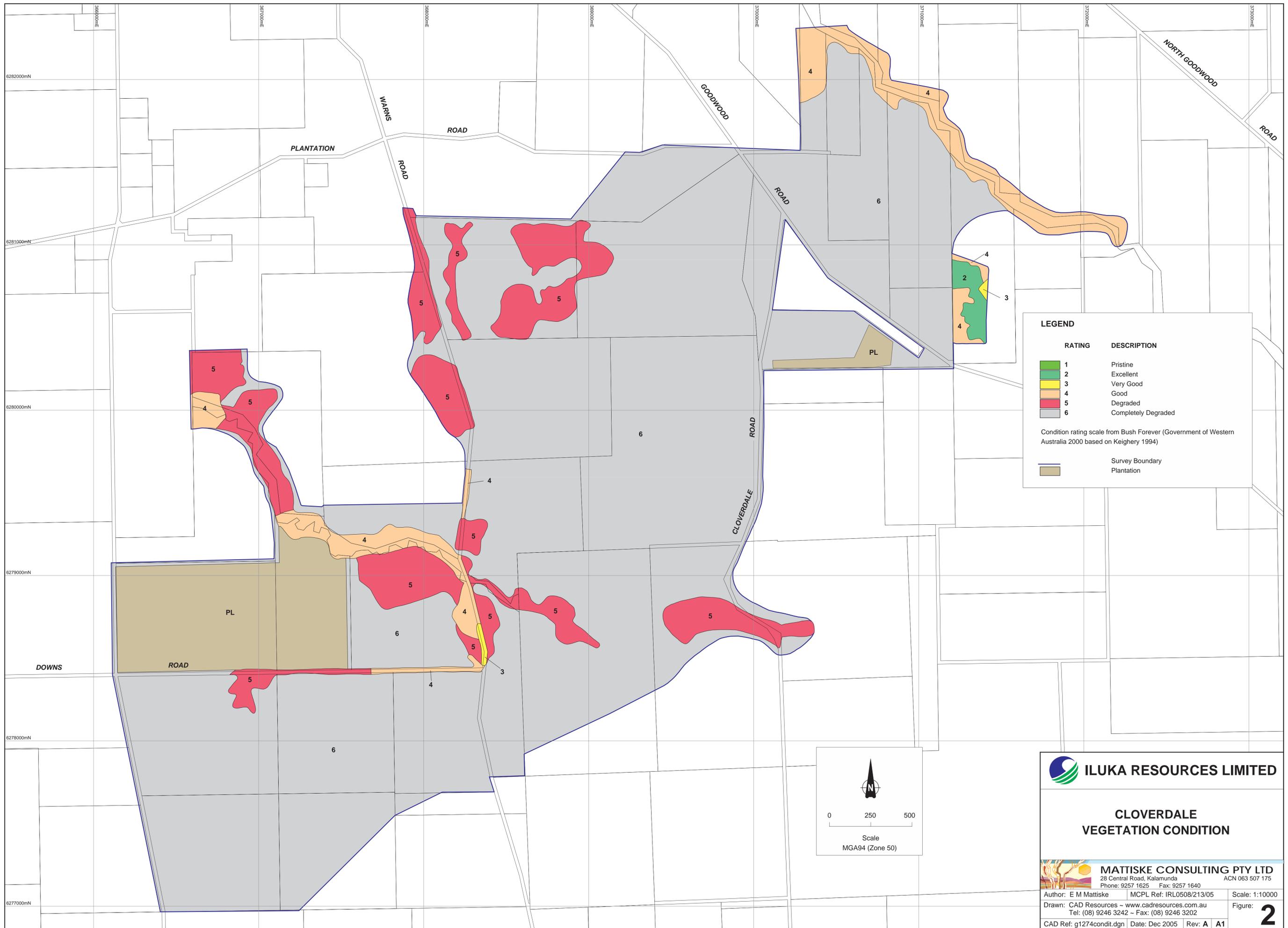


ILUKA RESOURCES LIMITED

CLOVERDALE VEGETATION

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 CAD Ref: g1274veg.dgn Date: Dec 2005 Rev: **A A1**

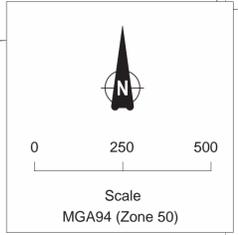


LEGEND

RATING	DESCRIPTION
1	Pristine
2	Excellent
3	Very Good
4	Good
5	Degraded
6	Completely Degraded

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

— Survey Boundary
 ■ Plantation



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CLOVERDALE VEGETATION CONDITION

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 CAD Ref: g1274condit.dgn Date: Dec 2005 Rev: A A1

APPENDIX A: VASCULAR PLANT SPECIES ON THE CLOVERDALE LEASE AREA, 2005

Note: * - Introduced Species

SCC - State Conservation Code - R - Rare; P1 - Priority 1; P2 - Priority 2; P3 - Priority 3;

P4 - Priority 4 (Department of Conservation and Land Management 2005a)

FCC - Federal Conservation Code - CE - Critically Endangered; E - Endangered; V - Vulnerable
(Department of Environment and Heritage 2005a)

FAMILY	SPECIES	Mattiske Mattiske GHD			SCC	FCC
		2003	2005	2005		
ADIANTACEAE	<i>Adiantum aethiopicum</i>					X
DENNSTAEDTIACEAE	<i>Pteridium esculentum</i>	X	X			X
LINDSAEACEAE	<i>Lindsaea linearis</i>	X	X			X
ZAMIACEAE	<i>Macrozamia riedlei</i>		X			X
PODOCARPACEAE	<i>Podocarpus drouynianus</i>	X	X			X
PINACEAE	* <i>Pinus radiata</i>		X			X
JUNCAGINACEAE	<i>Triglochin linearis</i>		X			
POACEAE	* <i>Aira praecox</i>		X			
	<i>Amphipogon turbinatus</i>		X			
	* <i>Anthoxanthum odoratum</i>		X			
	<i>Austrodanthonia caespitosa</i>	X				
	<i>Austrostipa</i> sp.					X
	* <i>Avena barbata</i>	X	X			
	* <i>Avena</i> sp.					X
	* <i>Briza maxima</i>		X			X
	* <i>Briza minor</i>		X			X
	* <i>Bromus diandrus</i>	X	X			
	* <i>Bromus</i> sp.					X
	* <i>Cynodon dactylon</i>		X			
	* <i>Digitaria</i> sp.					X
	* <i>Ehrharta calycina</i>		X			
	* <i>Ehrharta longiflora</i>		X			
	* <i>Eragrostis curvula</i>	X	X			X
	* <i>Festuca</i> sp.					X
	* <i>Holcus lanatus</i>	X	X			
	* <i>Hordeum geniculatum</i>		X			
	* <i>Hordeum leporinum</i>	X				
	* <i>Lagurus ovatus</i>		X			
	* <i>Lolium perenne</i>	X				
	* <i>Lolium</i> sp.		X			
	<i>Neurachne alopecuroidea</i>		X			X
	* <i>Pennisetum clandestinum</i>					X
	* <i>Phalaris minor</i>	X				X
	* <i>Poa annua</i>		X			
	* <i>Polypogon monspeliensis</i>	X				
	* <i>Stenopetalum secundatum</i>	X				
	Poaceae sp.					X

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Note: * - Introduced Species

SCC - State Conservation Code - R - Rare; P1 - Priority 1; P2 - Priority 2; P3 - Priority 3;

P4 - Priority 4 (Department of Conservation and Land Management 2005a)

FCC - Federal Conservation Code - CE - Critically Endangered; E - Endangered; V - Vulnerable
(Department of Environment and Heritage 2005a)

FAMILY	SPECIES	Mattiske Mattiske GHD			SCC	FCC
		2003	2005	2005		
CYPERACEAE	<i>Baumea articulata</i>		X			
	<i>Baumea vaginalis</i>		X			
	<i>Cyathochaeta avenacea</i>		X			
	<i>Cyathochaeta equitans</i>				X	
	<i>Cyperus ?congestus</i>				X	
	<i>Gahnia trifida</i>		X			
	<i>Isolepis cernua</i> var. <i>setiformis</i>		X			
	* <i>Isolepis marginata</i>		X			
	<i>Isolepis stellata</i>				X	
	<i>Lepidosperma effusum</i>				X	
	<i>Lepidosperma gladiatum</i>			X		
	<i>Lepidosperma gracile</i>			X	X	
	<i>Lepidosperma longitudinale</i>	X			X	
	<i>Lepidosperma pubisquameum</i>			X		
	<i>Lepidosperma squamatum</i>	X	X		X	
	<i>Lepidosperma tetraquetrum</i>				X	
	<i>Mesomelaena tetragona</i>	X	X		X	
	<i>Schoenus curvifolius</i>			X	X	
	<i>Tetraria capillaris</i>			X		
	<i>Tetraria octandra</i>			X	X	
ARACEAE	* <i>Zantedeschia aethiopica</i>		X			
RESTIONACEAE	<i>Anarthria prolifera</i>		X			
	<i>Desmocladus fasciculatus</i>	X	X			
	<i>Hypolaena exsulca</i>	X	X		X	
	<i>Loxocarya cinerea</i>		X			
	<i>Lyginia barbata</i>	X	X		X	
	<i>Lyginia imberbis</i>				X	
	<i>Meeboldina denmarkica</i>				X	
	<i>Meeboldina roycei</i> (ms)		X			
JUNCACEAE	* <i>Juncus bufonius</i>		X			
	<i>Juncus pallidus</i>		X		X	
	<i>Juncus subsecundus</i>		X		X	
CENTROLEPIDACEAE	<i>Centrolepis drummondiana</i>		X		X	
DASYPOGONACEAE	<i>Calectasia narragara</i>		X		X	
	<i>Dasypogon bromeliifolius</i>	X	X		X	
	<i>Kingia australis</i>	X	X		X	
	<i>Lomandra hermaphrodita</i>		X			
	<i>Lomandra nigricans</i>		X			
	<i>Lomandra preissii</i>		X		X	
	<i>Lomandra sericea</i>		X		X	
	<i>Lomandra</i> sp.		X			

APPENDIX A: VASCULAR PLANT SPECIES ON THE CLOVERDALE LEASE AREA, 2005

Note: * - Introduced Species

SCC - State Conservation Code - R - Rare; P1 - Priority 1; P2 - Priority 2; P3 - Priority 3;

P4 - Priority 4 (Department of Conservation and Land Management 2005a)

FCC - Federal Conservation Code - CE - Critically Endangered; E - Endangered; V - Vulnerable
(Department of Environment and Heritage 2005a)

FAMILY	SPECIES	Mattiske Mattiske GHD			SCC	FCC
		2003	2005	2005		
XANTHORRHOACEAE	<i>Xanthorrhoea gracilis</i>		X	X		
	<i>Xanthorrhoea preissii</i>	X	X	X		
	<i>Xanthorrhoea brunonis</i>			X		
	<i>Xanthorrhoea brunonis</i> subsp. <i>semibarbata</i>		X			
ANTHERICACEAE	<i>Agrostocrinum scabrum</i> subsp. <i>scabrum</i>		X			
	<i>Chamaescilla corymbosa</i>		X			
	<i>Chamaescilla corymbosa</i> var. <i>corymbosa</i>			X		
	<i>Dichopogon capillipes</i>		X			
	<i>Johnsonia acaulis</i>		X			
	<i>Johnsonia lupulina</i>		X	X		
	<i>Laxmannia sessiliflora</i> subsp. <i>australis</i>		X			
	<i>Laxmannia sessiliflora</i> subsp. <i>sessiliflora</i>			X		
	<i>Laxmannia minor</i>			X		
	<i>Sowerbaea laxiflora</i>		X			
	<i>Thysanotus manglesianus</i>		X	X		
	<i>Thysanotus multiflorus</i>		X			
	<i>Thysanotus patersonii</i>		X	X		
	<i>Thysanotus sparteus</i>			X		
	<i>Thysanotus tenellus</i>			X		
	<i>Thysanotus</i> sp.			X		
<i>Tricoryne elatior</i>		X				
<i>Tricoryne humilis</i>		X				
PHORMIACEAE	<i>Stypandra glauca</i>			X		
COLCHICACEAE	<i>Burchardia multiflora</i>		X			
	<i>Burchardia umbellata</i>		X	X		
HAEMODORACEAE	<i>Anigozanthos manglesii</i>		X			
	<i>Anigozanthos</i> sp.			X		
	<i>Conostylis aculeata</i>			X		
	<i>Conostylis aculeata</i> subsp. <i>aculeata</i>		X			
	<i>Conostylis aculeata</i> subsp. <i>preissii</i>		X			
	<i>Conostylis laxiflora</i>		X			
	<i>Conostylis serrulata</i>		X	X		
	<i>Conostylis setigera</i> subsp. <i>setigera</i>		X			
	? <i>Conostylis setosa</i>		X			
	<i>Haemodorum laxum</i>		X			
	<i>Haemodorum</i> sp.			X		
	<i>Haemodorum</i> sp.2			X		
<i>Phlebocarya ciliata</i>		X				
<i>Phlebocarya filifolia</i>		X				
AMARYLLIDACEAE	* <i>Amaryllis belladonna</i>			X		

APPENDIX A: VASCULAR PLANT SPECIES ON THE CLOVERDALE LEASE AREA, 2005

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P4 - Priority 4 (Department of Conservation and Land Management 2005a)

FCC - Federal Conservation Code - CE - Critically Endangered; E - Endangered; V - Vulnerable
(Department of Environment and Heritage 2005a)

FAMILY	SPECIES	Mattiske Mattiske GHD			SCC	FCC
		2003	2005	2005		
IRIDACEAE	* <i>Freesia alba</i> x <i>leichtlinii</i>		X			
	<i>Patersonia occidentalis</i>		X	X		
	* <i>Romulea rosea</i>	X		X		
	* <i>Romulea rosea</i> var. <i>?communis</i>		X			
	* <i>Sparaxis bulbifera</i>		X			
ORCHIDACEAE	<i>Caladenia attingens</i> subsp. <i>attingens</i>		X			
	<i>Caladenia longicauda</i> subsp. <i>eminens</i>		X			
	<i>Caladenia flava</i>			X		
	<i>Caladenia flava</i> subsp. <i>flava</i>		X			
	<i>Caladenia huegelii</i>		X	X	R	E
	<i>Caladenia nana</i>			X		
	<i>Caladenia nana</i> subsp. <i>unita</i>		X			
	<i>Cyanicula sericea</i>		X			
	* <i>Disa bracteata</i>	X	X			
	<i>Diuris amplissima</i>		X			
	<i>Drakaea glyptodon</i>		X			
	<i>Elythranthera brunonis</i>		X	X		
	<i>Eriochilus ?dilatatus</i>			X		
	<i>Leporella fimbriata</i>			X		
	<i>Microtis media</i> subsp. <i>media</i>		X			
	<i>Paracaleana nigrita</i>		X			
	<i>Prasophyllum</i> sp.			X		
	<i>Pterostylis recurva</i>		X			
	<i>Pterostylis vittata</i>		X			
	<i>Pterostylis</i> aff. <i>vittata</i>			X		
	<i>Pyrorchis nigricans</i>		X	X		
	<i>Thelymitra ?crinita</i>		X			
	<i>Thelymitra</i> sp. Narrow			X		
<i>Thelymitra</i> sp. Wide			X			
<i>Thelymitra</i> sp.			X			
CASUARINACEAE	<i>Allocasuarina fraseriana</i>	X				
	<i>Allocasuarina humilis</i>		X	X		
PROTEACEAE	<i>Adenanthos meisneri</i>		X	X		
	<i>Adenanthos obovatus</i>		X	X		
	<i>Banksia attenuata</i>	X	X	X		
	<i>Banksia grandis</i>	X	X	X		
	<i>Banksia ilicifolia</i>	X	X	X		
	<i>Banksia littoralis</i>	X		X		
	<i>Conospermum capitatum</i>		X			
	<i>Dryandra lindleyana</i>		X	X		
	<i>Dryandra lindleyana</i> var. <i>lindleyana</i>		X			
	<i>Franklandia triaristata</i>		X			P4
	<i>Grevillea trifida</i>			X		
	<i>Grevillea quercifolia</i>			X		

APPENDIX A: VASCULAR PLANT SPECIES ON THE CLOVERDALE LEASE AREA, 2005

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(Department of Environment and Heritage 2005a)

FAMILY	SPECIES	Mattiske Mattiske GHD			SCC	FCC
		2003	2005	2005		
PROTEACEAE	<i>Hakea amplexicaulis</i>		X			
(Continued)	<i>Hakea ceratophylla</i>				X	
	<i>Hakea lissocarpa</i>		X		X	
	<i>Hakea prostrata</i>				X	
	<i>Hakea ruscifolia</i>		X		X	
	<i>Hakea varia</i>				X	
	<i>Persoonia longifolia</i>	X	X		X	
	<i>Petrophile linearis</i>		X		X	
	<i>Stirlingia latifolia</i>		X		X	
	<i>Xylomelum occidentale</i>	X	X		X	
LORANTHACEAE	<i>Nuytsia floribunda</i>	X	X		X	
POLYGONACEAE	* <i>Acetosella vulgaris</i>	X	X			
	* <i>Emex australis</i>				X	
	* <i>Rumex crispus</i>		X		X	
	* <i>Rumex</i> sp.				X	
CHENOPODIACEAE	* <i>Chenopodium album</i>				X	
AMARANTHACEAE	<i>Alternanthera nodiflora</i>		X			
CARYOPHYLLACEAE	* <i>Cerastium glomeratum</i>		X			
	* <i>Cerastium</i> sp.				X	
	* <i>Silene gallica</i> var. <i>quinquevulnera</i>		X			
	* <i>Spergularia rubra</i>		X			
	* <i>Petrohragia dubia</i>		X			
	* <i>Stellaria media</i>		X			
RANUNCULACEAE	<i>Ranunculus colonorum</i>	X				
	* <i>Ranunculus muricatus</i>		X			
FUMARIACEAE	* <i>Fumaria capreolata</i>		X			
BRASSICACEAE	* <i>Brassica tournefortii</i>		X			
DROSERACEAE	<i>Drosera erythrorhiza</i>		X			
	<i>Drosera gigantea</i>		X			
	<i>Drosera glandigulera</i>				X	
	<i>Drosera menziesii</i>		X		X	
	<i>Drosera menziesii</i> subsp. <i>penicillaris</i>		X			
	<i>Drosera nitidula</i> subsp. <i>nitidula</i>		X			
	<i>Drosera pallida</i>		X		X	
CRASSULACEAE	<i>Crassula colorata</i> var. <i>acuminata</i>		X			
	* <i>Crassula</i> sp.				X	

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(Department of Environment and Heritage 2005a)

FAMILY	SPECIES	Mattiske Mattiske GHD			SCC	FCC
		2003	2005	2005		
PITTOSPORACEAE	<i>Billardiera variifolia</i>		X			
MIMOSACEAE	<i>Acacia applanata</i>			X		
	<i>Acacia extensa</i>		X	X		
	<i>Acacia huegelii</i>		X			
	<i>Acacia pulchella</i>	X	X	X		
	<i>Acacia semitrullata</i>		X	X	P3	
	<i>Acacia stenoptera</i>		X	X		
	<i>Acacia uliginosa</i>			X		
	<i>Acacia willdenowiana</i>		X			
	<i>Paraserianthes lophantha</i>			X		
PAPILIONACEAE	<i>Bossiaea eriocarpa</i>		X	X		
	<i>Chorizema ?cordatum</i>			X		
	<i>Chorizema ilicifolium</i>		X			
	<i>Daviesia decurrens</i>		X			
	<i>Daviesia divaricata</i> subsp. <i>divaricata</i> (ms)		X			
	<i>Daviesia incrassata</i>		X	X		
	<i>Daviesia physodes</i>		X	X		
	<i>Daviesia preissii</i>		X			
	<i>Euchilopsis linearis</i>		X			
	<i>Eutaxia virgata</i>		X			
	<i>Gompholobium capitatum</i>	X	X			
	<i>Gompholobium tomentosum</i>		X	X		
	<i>Hardenbergia comptoniana</i>		X	X		
	<i>Jacksonia furcellata</i>	X	X	X		
	<i>Jacksonia horrida</i>		X			
	<i>Jacksonia sparsa</i>			X		
	<i>Jacksonia spinosa</i>			X		
	<i>Jacksonia sternbergiana</i>			X		
	<i>Kennedia coccinea</i>		X	X		
	<i>Kennedia prostrata</i>		X	X		
	* <i>Lotus angustissimus</i>		X			
	* <i>Lotus subbiflorus</i>		X			
	* <i>Lotus uliginosus</i>		X			
	* <i>Medicago</i> sp.		X			
	<i>Mirbelia dilatata</i>		X	X		
	* <i>Ornithopus compressus</i>		X			
	<i>Pultenaea skinneri</i>		X		P4	
	<i>Sphaerolobium drummondii</i>		X			
	* <i>Trifolium angustifolium</i>	X				
	* <i>Trifolium campestre</i>	X				
GERANIACEAE	<i>Geranium retrorsum</i>		X			
	* <i>Pelargonium capitatum</i>			X		

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P4 - Priority 4 (Department of Conservation and Land Management 2005a)

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(Department of Environment and Heritage 2005a)

FAMILY	SPECIES	Mattiske Mattiske GHD			SCC	FCC
		2003	2005	2005		
OXALIDACEAE	* <i>Oxalis ?corniculata</i>		X			
	* <i>Oxalis pes-caprae</i>		X			
	* <i>Oxalis ?purpurea</i>		X			
RUTACEAE	<i>Boronia dichotoma</i>		X			
	<i>Philotheca spicata</i>		X		X	
POLYGALACEAE	<i>Comesperma virgatum</i>		X			
EUPHORBIACEAE	* <i>Euphorbia</i> sp.				X	
	<i>Phyllanthus calycinus</i>		X		X	
	<i>Stachystemon virgatus</i>		X			
STACKHOUSIACEAE	<i>Stackhousia monogyna</i>		X		X	
RHAMNACEAE	<i>Cryptandra arbutiflora</i> var. <i>tubulosa</i>		X			
	<i>Trymalium floribundum</i>		X		X	
	<i>Trymalium ledifolium</i>		X			
MALVACEAE	* <i>Malva dendromorpha</i>				X	
STERCULIACEAE	<i>Lasiopetalum</i> sp.				X	
DILLENIACEAE	<i>Hibbertia amplexicaulis</i>		X			
	<i>Hibbertia commutata</i>		X			
	<i>Hibbertia ferruginea</i>				X	
	<i>Hibbertia huegelii</i>				X	
	<i>Hibbertia hypericoides</i>	X	X		X	
	<i>Hibbertia racemosa</i>		X		X	
	<i>Hibbertia stellaris</i>		X			
	<i>Hibbertia subvaginata</i>		X			
	<i>Hibbertia vaginata</i>		X		X	
VIOLACEAE	<i>Hybanthus calycinus</i>				X	
THYMELIACEAE	<i>Pimelea</i> sp.				X	
MYRTACEAE	<i>Agonis flexuosa</i> var. <i>flexuosa</i>	X	X		X	
	<i>Astartea scoparia</i>	X	X		X	
	<i>Baeckea camphorosmae</i>		X		X	
	<i>Calytrix flavescens</i>		X			
	<i>Calytrix fraseri</i>		X			
	<i>Calytrix</i> sp.				X	
	<i>Corymbia calophylla</i>	X	X		X	
	<i>Eucalyptus marginata</i>				X	
	<i>Eucalyptus marginata</i> subsp. <i>marginata</i>	X	X			
<i>Eucalyptus rudis</i>		X		X		

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FAMILY	SPECIES	Mattiske Mattiske GHD			SCC	FCC
		2003	2005	2005		
MYRTACEAE	<i>Hypocalymma angustifolium</i>	x	x	x		
(Continued)	<i>Hypocalymma robustum</i>	x	x	x		
	<i>Kunzea ericifolia</i> subsp. <i>ericifolia</i>		x			
	<i>Kunzea glabrescens</i>			x		
	<i>Kunzea micrantha</i>			x		
	<i>Kunzea recurva</i>		x			
	<i>Melaleuca cuticularis</i>	x				
	<i>Melaleuca lateritia</i>			x		
	<i>Melaleuca preissiana</i>	x	x	x		
	<i>Melaleuca raphiophylla</i>	x	x			
	<i>Melaleuca thymoides</i>		x	x		
	<i>Melaleuca viminea</i> subsp. <i>viminea</i>		x			
	<i>Pericalymma ellipticum</i>			x		
	<i>Pericalymma ellipticum</i> var. <i>ellipticum</i>		x			
	<i>Taxandria linearifolia</i>	x	x	x		
HALORAGACEAE	<i>Myriophyllum ?salsugineum</i>		x			
APIACEAE	<i>Centella asiatica</i>			x		
	<i>Daucus glochidiatus</i>		x			
	<i>Trachymene pilosa</i>		x	x		
EPACRIDACEAE	<i>Astroloma pallidum</i>		x			
	<i>Conostephium pendulum</i>		x	x		
	<i>Leucopogon australis</i>	x				
	<i>Leucopogon carinatus</i>			x		
	<i>Leucopogon conostephioides</i>		x			
	<i>Leucopogon glabellus</i>		x			
	<i>Leucopogon polymorphus</i>			x		
	<i>Leucopogon propinquus</i>			x		
	<i>Leucopogon sprengelioides</i>		x			
	<i>Lysinema ciliatum</i>			x		
	<i>?Sphenotoma capitatum</i>			x		
PRIMULACEAE	* <i>Anagallis arvensis</i>		x			
LOGANIACEAE	<i>Phyllangium divergens</i>		x			
	<i>Phyllangium paradoxum</i>			x		
LAMIACEAE	* <i>Mentha pulegium</i>		x			
	* <i>Mentha spicata</i>			x		
SOLANACEAE	* <i>Solanum linnaeanum</i>	x		x		
	* <i>Solanum nigrum</i>		x	x		
OROBANCHACEAE	* <i>Orobanche minor</i>		x	x		

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(Department of Environment and Heritage 2005a)

FAMILY	SPECIES	Mattiske Mattiske GHD			SCC	FCC
		2003	2005	2005		
PLANTAGINACEAE	* <i>Plantago minor</i>					X
RUBIACEAE	<i>Opercularia apiciflora</i>		X			
	<i>Opercularia hispidula</i>		X			
CAMPANULACEAE	* <i>Wahlenbergia capensis</i>		X			
LOBELIACEAE	<i>Lobelia alata</i>					X
	* <i>Monopsis debilis</i>		X			
GOODENIACEAE	<i>Dampiera linearis</i>		X			
	<i>Scaevola calliptera</i>		X			
	Goodeniaceae sp.					X
STYLIDIACEAE	<i>Levenhookia pusilla</i>		X			
	<i>Stylidium brunonianum</i>		X			X
	<i>Stylidium calcaratatum</i>		X			
	<i>Stylidium carnosum</i>		X			
	<i>Stylidium junceum</i>		X			
	<i>Stylidium neurophyllum</i> (ms)		X			
	<i>Stylidium piliferum</i>		X			
	<i>Stylidium repens</i>		X			
	<i>Stylidium schoenoides</i>		X			
ASTERACEAE	* <i>Arctotheca calendula</i>		X			X
	* <i>?Carthamus lanatus</i>		X			
	* <i>Conyza sumatrensis</i>		X			X
	* <i>Cotula turbinata</i>		X			X
	* <i>Hypochaeris glabra</i>	X	X			X
	<i>Lagenophora huegelii</i>		X			
	<i>Millotia tenuifolia</i>		X			
	<i>Quinetia urvillei</i>		X			
	<i>Rhodanthe citrina</i>		X			X
	* <i>Sonchus asper</i> subsp. <i>asper</i>		X			
	* <i>Sonchus oleraceus</i>		X			
	* <i>Symphytotricum subulatum</i>					X
	* <i>Ursinia anthemoides</i>	X	X			X

APPENDIX B: POTENTIAL RARE AND PRIORITY FLORA IN THE CLOVERDALE AREA

The following list was compiled from GHD 2005, Department of Conservation and Land Management (2005a) and Department of Environment and Heritage (2005a).

Taxon (species, subspecies and varieties)	State Conservation Code (CALM 2005a)	Federal Conservation Code (DEH 2005a)
<i>Acacia flagelliformis</i>	P4	-
<i>Amperea micrantha</i>	P2	-
<i>Andersonia ferricola</i>	P1	-
<i>Anthotium junciforme</i>	P4	-
<i>Aponogeton junciforme</i>	P4	-
<i>Banksia meisneri</i> subsp. <i>ascendens</i>	P4	-
<i>Blennospora doliiformis</i>	P3	-
<i>Boronia anceps</i>	P3	-
<i>Boronia humifusa</i>	P1	-
<i>Boronia tetragona</i>	P3	-
<i>Brachyscias verecundus</i>	R	-
<i>Caladenia busselliana</i>	R	E
<i>Caladenia huegelii</i>	R	E
<i>Chamaescilla gibsonii</i>	P3	-
<i>Chamelaucium roycei</i> (ms)	R	V
<i>Chordifex gracilior</i>	P3	-
<i>Dryandra nivea</i> subsp. <i>uliginosa</i>	R	E
<i>Dryandra squarrosa</i> subsp. <i>argillacea</i>	R	V
<i>Eremaea blackwelliana</i>	P4	-
<i>Franklandia triaristata</i>	P4	-
<i>Grevillea elongata</i>	R	V
<i>Grevillea maccutcheonii</i>	R	E
<i>Grevillea manglesioides</i> subsp. <i>ferricola</i>	P2	-
<i>Hakea oldfieldii</i>	P3	-
<i>Haloragis tenuifolia</i>	P3	-
<i>Isopogon formosus</i> subsp. <i>dasylepis</i>	P3	-
<i>Jacksonia sparsa</i> (ms)	P4	-
<i>Lasiopetalum membranaceum</i>	P3	-
<i>Loxocarya magna</i>	P3	-
<i>Mitreola minima</i>	P2	-
<i>Petrophile latericola</i> (ms)	R	E
<i>Rhodanthe pyrethrum</i>	P3	-
<i>Schoenus natans</i>	P4	-
<i>Stylidium leeuwinense</i>	P3	-
<i>Synaphea hians</i>	P3	-
<i>Tetratheca parvifolia</i>	P3	-
<i>Trichocline</i> sp. <i>Treeton</i>	P2	-
<i>Tripterococcus brachylobus</i> (ms)	P4	-
<i>Verticordia attenuata</i>	P3	-
<i>Verticordia densiflora</i> var. <i>pedunculata</i>	R	E
<i>Verticordia lindleyi</i> subsp. <i>lindleyi</i>	P4	-
<i>Verticordia plumosa</i> var. <i>vassensis</i>	R	E
<i>Villarsia submersa</i>	P4	-