DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

RFQ 418 6/02

ENVIRONMENTAL IMPACT ASSESSMENT OF FUEL REDUCTION BUFFERS ON THE NATURE CONSERVATION VALUES IN NATURE RESERVES AND CROWN LAND FOR FIRE MANAGEMENT

October 2002

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Woodman Environmental Consulting ('WEC') were contracted by the Department of Conservation and Land Management ('CALM') to undertake vegetation, conservation value and fire impact studies on several planned fuel reduction buffer strips within the Lake Magenta Nature Reserve (A Class Reserve 25113), Dunn Rock Nature Reserve (36445) and UCL (3030) adjoining Lake King Nature Reserve. It has been proposed by CALM that a 40m wide fuel reduction strip will be utilised as part of a fuel reduction management strategy, involving the chaining and subsequent burning of these areas to help contain the spread of wildfire. An initial environmental impact assessment of this operation is required prior to these fuel reduction operations commencing. This includes providing information on the floristics and plant community structure present within the fuel reduction area, the conservation values of these plant communities, and post-fire effects such as introduction of weeds and wind erosion on these plant communities.

This initial assessment conducted during the course of this survey has included: a literature review; detailed mapping of plant communities ('vegetation units') throughout the survey area; detailing of plant species lists for these plant communities and the presentation of known and predicted effects of such operations on these areas. The establishment of 10 permanent monitoring plots within the survey area to gain direct information on the effect of the fuel reduction activities on the vegetation was also conducted. The survey area consists of four fuel reduction buffer sections located in the Lake Magenta Nature Reserve, Dunn Rock Nature Reserve, and UCL (3030).

A total of 348 native vascular plant species were recorded over the entire survey area during July – August 2002. One hundred genera and 38 families are represented in this total. The family Myrtaceae had the greatest number of species recorded, with 109 species. Other well-represented families were Proteaceae (62 species), Papilionaceae (31 species) and Epacridaceae (21 species). One DRF, potentially two Priority 1, two Priority 2, five Priority 3 and one Priority 4 species were recorded during this survey.

A total of 26 intact vegetation units were mapped within the entire survey area in July – August 2002. These consist of six Woodland/Forests, 16 Shrub Mallees and four Heath/Thickets. Shrub mallee vegetation units were also the most commonly mapped units, with area mapped as Woodland or Heath low in comparison. The majority of the Shrub Mallee vegetation units were dominated by several *Eucalyptus* mallee spp., with few units being dominated by one or two *Eucalyptus* spp. The majority of Woodland areas were mapped within the Dunn Rock and UCL (3030) sections, which contained the Woodland/Forests dominated by *Eucalyptus occidentalis*, *Eucalyptus salmonophloia*, *Eucalyptus densa* and the mallet species, *Eucalyptus argyphea*. *Eucalyptus platypus*-dominated vegetation units were only mapped within the Lake Magenta North section, with no Woodland vegetation units mapped within the Lake Magenta South section. Heath vegetation units were also only mapped as occurring within the Dunn Rock and UCL (3030) sections.

One Degraded and/or Modified vegetation unit was mapped over the survey area, being areas utilised for gravel and/or sand extraction (DEG2). None of these areas were mapped within the Lake Magenta or Dunn Rock Sections, with several occurring within the UCL (3030).

The entire fuel reduction buffer survey area was mapped as having a weed cover class of 0 – 20% throughout. No major infestations of weed were noted during the survey, despite areas being in close proximity to pasture areas, and past burning of these reserves. The DEG2 areas were also reasonably free of weeds. The dried heads of *Brassicaceae sp., were recorded in several areas near pasture, having blown in from infested areas. They have not at present invaded any of the survey area.

The sensitivity of the vegetation units mapped to the proposed fuel reduction program varied depending on the structure and species composition of each unit. The following recommendations are made based on the results of the flora and vegetation survey.

- During chaining operations, the disturbance of topsoil must be minimised as far as practicable by minimising vehicle and machine traffic through the vegetation. This includes the minimisation of disturbance of mallee eucalypt lignotubers. Although this cannot be totally avoided, minimisation of disturbance to the topsoil will result in less chance of weed invasion.
- The time between initial chaining and regrowth of vegetation must be minimised. This includes a short time between chaining and burning (no more than six weeks), and in a season that is suitable for regrowth, preferably in autumn. This is prior to the winter rains that will help seedling growth, and will result in reduced water stress for seedling survival.
- Vegetation units W1, W5 and W6 not to be chained or burnt. This may require management at time of burning to prevent the control burn leaving the designated areas. Vegetation unit W3 covers large areas of the Lake Magenta North section and is a result of previous burns. Although this vegetation unit is slow growing, it is well represented in other areas of the reserve, and would be very difficult to exclude from the fuel reduction operations.
- Chaining operators must be notified of the locations of the established McDonald plots, to avoid destruction of the north-west peg. It is recommended that prior to chaining a small wooden dumpy peg be positioned in this corner. This is less likely to be lost during the chaining.
- An appropriate frequency of burning must be determined. This should take into account both regrowth of the sections, life-history of the dominant species and potential negative effects of high-frequency burning. Data from previous studies on serotinous obligate seeders shows that these species are the ones most at risk from high-frequency fires, but also require some burning to stimulate new growth to avoid complete senescence. It is recommended that a minimum 15 year interval be kept between burning episodes.
- Established McDonald plots should be re-surveyed in the spring following the initial chaining and burning. This should include recording the foliage cover, health and height of all species within the $100m^2$ quadrat, the presence and foliage cover of

upper stratum species within the $400m^2$ quadrat, and a Muir description of the vegetation at that time.

- It is recommended that the McDonald plots are monitored during spring every year for the first five years, then every two years thereafter. All species that appear in these plots should then be recorded, along with their cover, to produce a record of the succession of the vegetation within each of these units. This will provide information on the length of time various species require before re-establishment, and the appearance of new species after fire.
- Particular attention must be paid to the population of the DRF species *Acacia leptalea*, which is present in the Lake Magenta North section. It is predicted that this species will be killed outright by the fire, but will regenerate from soil-stored seed, and may increase in number after the fire event. The response to fire (or any other disturbance) is not known at present and therefore difficult to predict.
- The risk of problems such as weed invasion and erosion are the least within the Lake Magenta North section, with all other sections sharing significant boundaries with cleared paddocks. Weed invasion may become a problem in the other three areas if the ground is left open for a considerable period of time, especially in spring. The fuel reduction area within the UCL (3030) section will only need to be chained and burned if the existing Old Newdegate Rd which separates the UCL (3030) from the Dunn Rock Nature Reserve is not wide enough to act as an effective fire barrier.
- Statistical comparison of post chaining and burning data with the pre-operation data should be conducted. Comparisons should initially focus on species presence to identify re-colonisation patterns, with *t* tests conducted annually on total cover and species richness for each quadrat. Full comparison of pre and post operation foliage cover data should be undertaken using *t* test methods for significant species at the 5 year monitoring and each monitoring after that to determine recovery of post operation communities. In addition to the *t* test methods, generation of similarity indices for each quadrat comparing pre and post operation data, utilising the full dataset, will provide a measure of progress toward pre operation condition.

1 INTRODUCTION

Woodman Environmental Consulting ('WEC') were contracted by the Department of Conservation and Land Management ('CALM') to undertake vegetation, conservation value and fire impact studies on several planned fuel reduction buffer strips within the Lake Magenta Nature Reserve (A Class Reserve 25113), Dunn Rock Nature Reserve (36445) and UCL (3030) adjoining Lake King Nature Reserve. Wildfires are natural phenomena in the Wheatbelt Region, and can have devastating impacts on native flora and fauna, as well as private property. CALM are seeking to implement management strategies including the use of fuel reduction buffers in nature reserves to minimise the impact of wildfires on both conservation values within the nature reserves and surrounding areas, and on private property values in areas neighbouring these nature reserves.

It has been proposed by CALM that a 40m wide fuel reduction strip will be utilised as part of a fuel reduction management strategy, involving the chaining and subsequent burning of these areas to help contain the spread of wildfire. An initial environmental impact assessment of this operation is required prior to these fuel reduction operations commencing. This includes providing information on the floristics and plant community structure present within the fuel reduction area, the conservation values of these plant communities, and post-fire effects such as introduction of weeds and wind erosion on these plant communities.

This initial assessment conducted during the course of this survey has included: a literature review; detailed mapping of plant communities ('vegetation units') throughout the survey area; detailing of plant species lists for these plant communities and the presentation of known and predicted effects of such operations on these areas. Ten permanent monitoring plots were also established within the survey area to gain direct information on the effect of the fuel reduction activities on the vegetation.

The survey area consists of four fuel reduction buffer sections located in the Lake Magenta Nature Reserve, Dunn Rock Nature Reserve, and UCL (3030). The Lake Magenta South section is comprised of a 12 km long section along the southern boundary of the Lake Magenta Nature Reserve, starting from the south-western corner heading east, and lies north of the boundary track. The Lake Magenta North section is comprised of a 30km section through the centre of the Lake Magenta Reserve heading east from track junction C1, and lies south of the existing track. The Dunn Rock section is comprised of a 19km section along the southernmost boundary of the Dunn Rock Nature Reserve, and lies north of the boundary track. The UCL section is comprised of a 12km section along the southern boundary of the UCL (3030) heading east from Tarco Road, and lies north of the Old Newdegate Road.

Previous studies detailing vegetation associations, floristics, soil erosion potential and potential impacts on the vegetation have been undertaken by Coates (1987) in the Lake Magenta Nature Reserve and by Martinick and Associates (1984) in the Dunn Rock

Nature Reserve. CALM requires these areas to be re-surveyed due to the time lapse since these studies were undertaken, and the subsequent changes in structure and floristics which may have occurred since the mid 1980's.

A description of the Lake Magenta Reserve, including background information on flora and fauna of the reserve, past fire history, and a Plan for Management of the Reserve was published in 1982 (Crook and Burbidge 1982). A map of previous fires compiled from aerial photography up until 1982 was produced, with four major fires occurring in the reserve between 1956 and 1968. A very intense fire in 1972 defoliated mallee vegetation, destroyed all litter and killed 70% of *Eucalyptus salmonophloia* (Salmon Gum) at Sullivan's Soak, in the north of the reserve. Several other fires, in late 1972, and 1976-1977 were also detailed. Approximately 60% of the reserve was burnt between 1960-1982. These fires were either a result of lightning strike, or the accidental escape of clearing burns. Coates (1987) described another fire in the reserve in 1984, starting on the northern boundary and burning southeast towards the lake. Frequent fires were uncommon in the reserve in the past, and these burns were mostly associated with farmland development (Crook and Burbidge 1982).

A system of 6m wide internal fire-breaks, in the form of cleared tracks dividing the reserve into 12 compartments, and perimeter firebreaks were proposed to be adequate to control wildfire within the reserve. It was noted that fires were more likely to originate within the reserve from lightning-strike than from clearing-burns outside of the reserve, because most of the adjoining land has been developed and has a low fuel-load, particularly over summer (Crook and Burbidge 1982). However, the Katanning Eastern Reserves Fire Management Plan (draft) states that most fires come from external ignition sources, and that stubble burns and header fires are still a larger threat. Internal firebreaks are graded every five years (which is budget dependent) to remove eucalypt growth. Within the Lake Magenta Management Plan (Crook and Burbidge 1982), there was a provision for one or two wider buffers of frequently burned vegetation, in the form of a second cleared break 100-200m away from an existing track with the intervening vegetation being burned. No similar buffer zone was noted for the perimeter fire-breaks.

1.1 Background

Numerous studies regarding fire ecology of Australian vegetation have been undertaken, and general responses of various ecological systems throughout Australia to the effect of burning are understood (Whelan and Main 1979; Dell 1984; Ford 1985; McCaw 1989; Cowling and Lamont 1987; Hobbs and Atkins 1990). Very little information of the regenerative responses of the vegetation within the specific survey area to fire is available. Whelan *et. al.* (2001) noted that fire responses will be site-specific, and except on a coarse level it is almost impossible to predict the effects of a particular fire, or sequence of fires, on any species based on studies of fire-response patterns at other sites and at other times. However, the information on the effects of burning of typical woodland, mallee, mallee-heath and heath vegetation types in similar areas may aid in determining likely responses of the vegetation to the proposed fuel reduction operations.

Planning an appropriate fire regime to provide both adequate protection from large fires for both reserve vegetation and private property, and to conserve native vegetation values within these reserves needs to take into account both an appropriate burning interval (fire frequency), and method of burning. Plant species utilise several different strategies to survive wildfire, and these are based on attributes such as maturation rates, seed bank characteristics, life spans and mode of recovery from disturbance. It is likely that no single fire regime will be optimal for all plant species within an area, due to these different strategies, and the various amounts of time taken to reach reproductive maturity. Groups include obligate seeders (serotinous and soil-stored seed banks), resprouters (woody and herbaceous) and ephemerals (Bradstock and Cohn 2001). Some studies have also found that within a particular species, different strategies will be used in different areas, with individuals being killed by fire in one area, only to resprout in another (Whelan *et. al.* 2001).

Obligate seeder species reproduce after fire events only from seed, as the parent plants are usually killed by fire. Seed banks are stored either in the soil, or within woody cones (serotinous or bradysporous species). Bradstock and Cohn (2001) state that the genera *Callitris* and *Hakea* are the only obligate seeders with serotinous seed banks. However, Hopkins (1985) also mentions such species as *Allocasuarina huegelii*, *Banksia media*, *Callitris preissii* var. *verrucosa*, *Callitris roei*, *Dryandra nobilis*, *Eucalyptus astringens*, *Hakea laurina*, *Lambertia inermis* and *Melaleuca eleuterostachya*. The genus *Banksia* also includes some serotinous obligate seeders. Cowling and Lamont (1987) reported adult mortality of the bradysporous species *Banksia leptophylla* and *Banksia prionotes* of 100% following both spring and autumn burns, with the majority of *Banksia attenuata* and *Banksia menziesii* individuals resprouting. Various studies into the fire response of *Banksia* spp. with regard to seed germination levels and breaking of dormancy mechanisms have been reported (Cowling and Lamont 1987; McCaw and Smith 1992; Hobbs and Atkins 1990). It has been reported that in the western mallee-heath, several diverse serotinous obligate-seeder proteaceous and myrtaceous genera account for more than one-quarter of all species (Keith *et. al.* 2001a).

Obligate serotinous seeders will be affected by a fire frequency that is more frequent than the length of the juvenile phase (time from germination to sexual maturity). Fire frequency that is higher than the juvenile phase will kill recruitments before they have had time to set seed themselves. This is exacerbated by the situation that a single fire will usually exhaust canopy-stored seed banks. It was noted by Keith *et. al.* (2001a) that species-rich heath flora of southwestern Australia are particularly susceptible to loss of diversity when exposed to these regimes because of their large number of serotinous obligate seeders. Burrows (2002) noted that a sustained regime of frequent burning (3-4 year intervals) resulted in a reduction in the abundance of two key obligate seed species, in a study near Manjimup, in the Jarrah Forest. Hopkins (1985) also noted that recurrent fire at an interval equal to, or slightly longer than, the primary juvenile period can lead to gradual extinction of obligate serotinous species. It was also noted that this group of species is the most vulnerable to mis-management, however species in this group can be used to develop management guidelines for the communities in which they occur. McMahon (1984b) also concluded that fires at intervals four years or less drastically reduced total seedling recruitment post-fire, and eliminated *Banksia ornata*, a serotinous

obligate seed regenerator. After a ten-year interval, seedling recruitment was not altered significantly. However, if a fire is not experienced before the parent plants senesce, seed stored within the canopy may become non viable and therefore useless after a fire is experienced (Keith *et. al.* 2001a).

Obligate seeders forming a soil stored seed bank include species from the genera *Acacia*, *Beyeria* and *Senna* (Bradstock and Cohn 2001). Parent plants of the majority of these species are killed outright by fire, and recruitment occurs through a soil stored seed bank. Most obligate seeders reach maturity by three years after fire, however this will be dependent upon site quality and post-fire rainfall. Persistent soil seed banks may not be exhausted by a single fire. However, soil stored seed banks may be depleted by successive fires depending upon the rapidity of the depletion of the seed bank. Keith *et. al.* (2001a) however notes that some non-leguminous soil seed banks from sandplain kwongan may be exhausted more readily by a single fire.

Resprouter species are not necessarily killed outright by fire, depending upon the intensity of the burn, the particular species and the characteristics of the individual plant. These species resprout from a variety of fire-resistant organs, including lignotubers, active epicormic buds, rhizomes and suckers, and include such species as *Melaleuca uncinata*, *Eucalyptus* spp., *Dodonaea viscosa* and *Myoporum* spp. (Bradshaw and Cohn 2001). If these organs are slow to develop, fires at short intervals will kill new recruits so that elevated losses of established plants cannot be offset (Keith *et. al.* 2001a). For example, populations of *Banksia obolongifolia* declined under a five-year fire interval, whilst stayed stable under a 14-year fire interval.

Many mallee *Eucalyptus* species are tolerant of fire, and will resprout either from epicormic buds, or from the lignotuber. Mallee populations have been shown to regenerate from one fire every five to ten years (Bradstock and Cohn 2001). It was also shown in this study mallees experiencing more frequent fires had a significantly higher mortality after autumn burns than after spring burns.

Keith *et. al.* (2001a) commented that the seedlings of non-resprouters grow faster and mature earlier than those of resprouter species . Energy is accumulated in resprouter species in the lignotuber or root tissues, rather than in the leaves, which is utilised when resprouting after the next fire event. Woody resprouters can however be prone to extinction under high-frequency fire regimes, although rates of decline of these species are lower than that of obligate seeders (Keith *et. al.* 2001b).

Ephemeral species (or those with transient seed banks) are those species that germinate, flower and set seed between fire episodes. They are commonly of families such as Anthericaceae, Haemodoraceae, Orchidaceae and Xanthorrhoeaceae. Many of these species are pyrogenic, having a fire-stimulated seed bank. Post-fire recruitment of these species therefore must wait for the post-fire flowering event and subsequent seed release. The appearance of these species post-fire usually resulted in increased species richness in recently burnt areas (McMahon 1984a; Hopkins 1985).

Whelan *et. al.* (2001) described five different fire response patterns, which may be exhibited over time. These include a null response, reduction and recovery, monotonic decline, facilitation and decline, and recruitment and thinning. The null response scenario occurs when populations are unchanged after a fire event. This can include established plants of long-lived species that resprout after a fire event. The reduction and recovery scenario is exhibited by a reduction of the population after fire, followed by a long post-fire recovery phase during which the population remains at a low density. Rainforest species in wet sclerophyll forests show this pattern. The monotonic decline to local extinction after a fire, with no immediate recovery, occurs mainly for vertebrate species rather than plant species. The facilitation and decline scenario occurs as the population increases after a fire, followed by a decline until the next fire event. Post-fire annuals and ephemerals exhibit this pattern. Other species such as obligate seeders with a limited life span but fire-stimulated germination such as *Acacia* also show this scenario over a medium time-scale. Obligate seeders exhibit a recruitment and thinning scenario, where the population size diminishes after fire, then rapidly increases followed by a gradual decline (Whelan *et. al.* 2001).

van der Moezel and Bell (1984) during a study of Western Australian mallee located 620km ESE of Perth found that the post-fire species richness in the sites studied was greater than the pre-fire species richness. Most 'new' species were short-lived, fast-growing species, which germinated from soil-stored seed. This differs from results gained by Hobbs and Aitkins (1990), where species richness continued to increase up to five years after burning in *Banksia* Woodland. Tree mallee communities were the most diverse studied, with shrub communities being the least diverse (van der Moezel and Bell 1984). The majority of the species studied were killed outright by fire, with species surviving in this habitat regenerating from seed. This suggests that the particular environment had evolved to experience a low-frequency burning regime. Between 50-100 years may be needed for such communities to complete recovery to a dominant low mallee woodland formation with dense understorey and sparse ground cover (van der Moezel and Bell 1984). Very long intervals between fires, in excess of 100 years, probably result in a taller and more open tree canopy, a tall sparse shrub layer and a herbaceous ground cover.

Fire can increase the germinability of seed of some species, as reported in Wellington and Noble (1984). Seed establishment increased from <100 seedlings per hectare in unburnt mallee stands, to 10 000 seedlings per hectare after burning (during a study after a wildfire in 1977/1978 in eastern Australia). There was a high subsequent mortality of these seedlings, due to low soil moisture availability, however it was also reported that none of the seedlings that germinated in unburnt sites survived either. This fire also increased the adult mortality eight-fold. Fire can create a 'nursery' type effect, where enhanced germination rates, a temporary period of increased availability of resources through nutrient release and a reduction of depletion in soil moisture by adult plants all enhance seedling germinability and establishment.

The timing of burning may also affect post-fire germinability and recruitment. Hobbs and Aitkins (1990) found that within *Banksia* Woodland near Gingin that autumn burns promoted seedling regeneration for various species, however vegetative regrowth of

species such as *Eremaea pauciflora* and *Dampiera linearis* was more rapid after spring burning. It was recommended that burns in these *Banksia* Woodlands be conducted in spring rather than autumn. Bradstock and O'Connell (1988) found in their study of *Banksia ericifolia* and *Petrophile pulchella* (Sydney region) that intense burns in late summer/autumn promoted high establishment of these species, and a fire interval at this time of 8-10 years could be tolerated with no decline in numbers. However, fires between 10-15 years regardless of season or intensity could occur with little risk of population decline. Cowling and Lamont's (1987) study also confirmed that the number of *Banksia* seedlings recruited per parent after an autumn burn was almost twice as high as after a spring burn.

Hopkins (1985) produced a provisional, management-orientated scheme, based on the life history details of fire sensitive, obligate seed regenerating tree and shrub species with a bradysporous habit. These estimates are to be indicative, rather than definitive. It was estimated that for areas experiencing 300-400mm annual rainfall (Lake Magenta – Dunn Rock area) that a recurrent fire of interval less than 8 years will result in a loss of plant species, ie. the minimum interval for shrub species needs to be at least 8 years. The estimated time for these shrub dominated plant communities to reach maturity is 19-20 years. The minimum time between fires for tree species was estimated at 30 years, with the estimated time for some forest and woodland communities to develop to maturity was in excess of 100 years.

Effects of chaining/rolling and burning on both native vegetation as a whole and on specific species were undertaken by McCaw (1989) and McCaw and Smith (1992). Increases in species richness in the short to mid-term following just chaining or burning, or a combination of the two, was reported by McCaw (1989). The response of soil-borne seed may be greater in chained areas due to the greater heat pulse close to the soil. The rate of regeneration will determine how long the strip will remain as an effective buffer. Regeneration will be higher in areas that have a greater number of resprouters, or where thickets are formed from soil-born seed. The life of the buffer may be extended for a further 12-15 years where slower growing seed species are present (McCaw 1989). The effect of grazing pressure on newly burnt areas also determines the rate of regrowth of strips, in particular in perimeter areas where rabbits and kangaroos are more numerous. McCaw (1989) states that the invasion of weeds is probably little different to strips that are simply burnt.

McCaw and Smith (1992) studied the effects of scrub-rolling and burning on two serotinous species, *Banksia baxteri* and *Hakea crassifolia* on seed release, within the Stirling Range National Park. *Banksia baxteri* responded to the burning, with a high level of follicle rupture and seed release for felled individuals. However felled but unburnt individuals did not release significant amounts of seed despite desiccation. Follicles of *Hakea crassifolia*, however, opened after scrub-rolling, as well as after burning. It was recommended that the time between scrub-rolling and burning be kept short, by no more than a few weeks, as seed released during scrub-rolling may be damaged by subsequent heat if follicles open after felling. Follicle opening by *Hakea crassifolia* is related to factors such as diurnal variation in temperature, relative humidity, and continued attachment to only partially-severed root systems. It was recommended

that scrub-rolling operations be undertaken in autumn, to avoid prolonged drying of these follicles during summer.

Burning operations may involve a greater risk of invasion by introduced (weed) species, in particular weedy grasses. Hobbs and Atkins (1988) researched the invasiveness of two species, **Ursinia anthemoides* and **Avena fatua*, which are common weed species within the Wheatbelt. In general, these species only established well where the soil had been disturbed, however also increased greatly when fertiliser had been added. This differed from native annual species, whose growth also increased with the addition of fertiliser but did not need soil disturbance to become established. Hobbs and Aitkins (1990) found that invasion by non-native species in *Banksia* Woodland increased after autumn burning in comparison to spring burning. Hobbs and Aitkins (1990) also found that non-native species were only found in recently burned stands. Bradstock and Cohn (2001) also noted the high risk of weed invasion in areas which are subject to mechanical disturbances through trail and fuel-break construction.

The effects fire regimes on fauna has also been documented by several researchers (Keith *et. al.* 2001a). Negative effects on fauna can be as a result of both mortality due to the burn itself, decline post-fire due to the destruction of habitat, and also over the long term due to changes in overall vegetation structure. The decline of bird species, in particular rare species, can be a symptom of inappropriate fire regimes. In most cases, these threatened bird species required long-unburnt vegetation, and intervals between fires longer than those which have occurred since European settlement. This is particularly important to note as malleefowl, present within the Lake Magenta Nature Reserve, require long-unburnt stands of vegetation.

The effect of fire regimes on various fauna groups have been discussed by Bradstock and Cohn (2001). Reptile diversity and abundance in long-unburnt mallee can be lower than in more recently burnt areas. In recently burnt mallee (<1 year), opportunistic bird species are most common. Between 1-10 years post-burn, species that normally use the mallee as well as other communities, such as heath and woodlands, are present. At 10-30 years post-fire, bird species endemic to mallee areas are favoured. Species such as the malleefowl (*Leipoa ocellata*) prefer areas that have been left unburnt for >30 years, having taller mallee with an open understorey. This species is reliant on litter for nest building. Unburnt patches of vegetation are utilised by malleefowl for colonisation or emigration after extensive fires. A succession of mammal species colonisation and use also follows the age and thus structure of native vegetation. Different mammal species have differing requirements, such as post-fire species richness with an abundance of seeds, to vegetation with greater vertical diversity (*Leptospermum* and *Melaleuca* spp.).

A discrepancy may exist between the fire interval time that is suitable to maintain species richness and vegetation structure within an area, and the amount of time in which that particular area will again be able to carry fire. This is of concern when the main aim of fuel reduction is to reduce the chance of fire spreading to an adjacent area. Bradstock and Cohn (2001) state that in mallee areas free of *Triodia*, vigorous herbage growth as a result of a large-scale fire followed by above-average rainfall has resulted in the same area being burnt twice in three years.

Martinick and Associates surveyed the Dunn Rock Reserve in 1984 to locate appropriate locations for firebreaks to be constructed within this reserve. The following constraints when locating appropriate firebreaks were listed:

- habitats which are poorly represented in the reserve;
- vulnerable habitats such as granite areas;
- habitats of endangered fauna;
- populations of plants belonging to species which are rare and endangered or of special scientific interest;
- areas susceptible to erosion; and
- areas of difficult access such as winter boggy patches and gullies.

It was noted that fire regime cycles set below maturation are considered undesirable. Taller woodland types can be burnt without killing the overstorey, however most *Eucalyptus* spp. within the reserve are killed outright by fire and will require several decades to regenerate (Martinick and Associates 1984). It was also noted that existing peripheral fire-breaks showed little evidence of erosion, including drainage lines and erosion-prone soils (Martinick and Associates 1984).

Martinick and Associates (1984; Appendix 3) estimated times of maturation of dominant vegetation at various sites, and the time between which these areas could carry fire. The following locations were present within the survey area:

Table 1: Vegetation associations and their estimated maturation time and estimated highest frequency before the stand could carry fire (from Martinick and Associates 1984)

Location	Description	Est. Maturation Time (yrs)	Est. Highest Fire Frequency
12	*E. transcontinentalis* mallee on sandplain	45	15
13	E. *salmonophloia* woodland on broad valley	100	nil
14	*E. tetragona* mallee on sandplain	50	15
16	*E. annulata* low woodland/forest on sandplain	60	20
17	*E. redunca* mallee on sandplain	50	15

The problem of weed invasion into frequently-burned native vegetation was discussed by Crook and Burbidge (1982). This includes the problem of increased weed invasion, particularly of grassy species, in areas of sandy soil that are frequently burnt, which has been experienced in other wheatbelt reserves. Fuel reduction areas comprising of frequently burnt vegetation are not usually recommended for perimeter firebreaks due to this problem (Crook and Burbidge 1982). The Lake Magenta area experiences strong north-westerly and south-easterly winds, which may bring weed seeds and fertiliser from nearby paddock areas, in particular to areas on the northern and southern boundaries.

The possible use of residual, pre-emergence herbicides was also discussed by Crook and Burbidge (1982), and included a trial programme over a five to ten year period to determine the effects of herbicide use on native vegetation.

Coates (1987) recorded weedy species including **Hordeum leporinum*, **Pentaschistis airoides* and **Centaurium erythraea* on the firebreaks within the Lake Magenta Nature Reserve, and a couple of metres into native vegetation. **Dittrichia graveolens*, **Carduus pynocephalus* and **Cirsium vulgare* have also been recorded in the Reserve (Coates 1987). These species may cause weed infestation problems if they manage to invade into native vegetation, particularly on sandy soils.

Crook and Burbidge (1982) noted the very slow rate of re-growth of *Eucalyptus platypus* (Moort) stands within the Lake Magenta Nature Reserve. Approximately 16 years after fire, one particular stand of *Eucalyptus platypus* had only reached a height of 2m, although unburnt stands can reach upwards of 4m. *Eucalyptus platypus* communities are slow-growing, and are unlikely to have developed in areas experiencing regular or frequent fires. Unburnt stands of *Eucalyptus platypus*, with a sparse understorey and thin layer of leaf and bark litter are habitat for Malleefowl.

Potential wind erosion problems were noted by Coates (1987), if native vegetation is removed from susceptible areas, which include sandy soils. Sand may be picked up by wind in exposed areas that are greater than 15m in width (Coates 1987). Areas highlighted by Coates included the current Lake Magenta South section, and the eastern extent of the Lake Magenta North section, past junction C3. These areas are of sandy soils and are on flat topography.

1.2 Previous Botanical Studies within the Survey Area

Several botanical studies have been conducted within the survey area, including vegetation mapping by Beard (1976), Coates (1987) and Martinick and Associates (1984). Other surveys include a summary of the vegetation, flora and fauna and an associated management plan for the Lake Magenta Nature Reserve (Crook and Burbidge 1982); a small-scale vegetation survey of Lake Magenta Nature Reserve undertaken by Kitchener (1971), and descriptions of vegetation associations within the Shire of Kent (McKenzie 1973).

The fuel reduction survey area is situated within the Roe Botanical District (Mallee Region) of the South-West Botanical Province (Beard 1990). The survey area is located between the Hyden and Chidnup Vegetation Systems as mapped by Beard (1976).

The Chidnup System occurs inland of the coastal Jerramungup and Qualup Systems, and forms a watershed between the Swan-Avon basin and the coastal rivers to the south. The greatest proportion of this system is covered by mallee, with some mallee-heath on rises, with major valleys and small lakes and pans bearing eucalypt woodland (Beard 1976). Two main mallee associations are mapped in the Hyden Vegetation System, the *E. eremophila – E. oleosa* association, found on lateritic soils, and the *E. redunca – E. uncinata* association, which is found in the valleys and lower ground areas. These two associations can intermingle in intermediate country. Other mallee vegetation

associations are dominated by *Eucalyptus platypus* and *Eucalyptus falcata*, the latter forming larger trees up to 9m tall emerging from mallee. Both of these vegetation associations need long periods of time without fire (Beard 1976).

Mallee-heath dominated by *Eucalyptus tetragona* (now *Eucalyptus pleurocarpa*) without deep sand patches of *Banksia*, *Nuytsia* and *Lambertia* (common to the Jerramungup and Qualup Systems), and winter-wet depressions with *E. occidentalis* and/or *Melaleuca parviflora*, with sparse *E. salmonophloia*, are also found in the Chidnup System (Beard 1976).

The Hyden System is found inland from the Chidnup System, and is characterised by a gently undulating terrain, with scrub-heath on rises of deep yellow sand or sand over laterite, mallee over yellow earths on granite in mid-slope areas and eucalypt woodlands on red loams on valley floors, with salt flats and playa lakes on depression areas (Beard 1976). Scrub-heath areas are dominated by *E. tetragona* and other mallee species, over an understorey dominated by species of the Proteaceae family. *E. eremophila, E. oleosa*, *E. redunca* and *E. uncinata* are the dominant species in mallee areas. *E. falcata* and *E. gardneri* also occur, however appear mainly as saplings due to the frequency of fire. *E. platypus*, *E. annulata* and *E. spathulata* form dense stands of low trees (Beard 1976).

Samphire, surrounded by Boree dominated by *Melaleuca thyoides* surround salt pans, which is in turn surrounded by a mix of *M. pauperiflora*, *E. salmonophloia* and *E. longicornis*, with a mix of other *Eucalyptus* species coming in outside of this zone.

Five vegetation associations were mapped by Beard (1976) over Lake Magenta Nature Reserve, Dunn Rock Nature Reserve and the UCL (3030):

xSZc:	Scrub heath, Mixed Proteaceae - Myrtaceae
e_8Mi:	Salmon Gum, *Eucalyptus salmonophloia*
e_{26}SZc:	Mallee-heath, *Eucalyptus tetragona* community
e_{15}Si:	Mallee on lateritic soil, *E. eremophila – E. oleosa* association
m_1Si:	Borree Scrub, *Melaleuca thyoides* community

Of these associations, the first four were mapped over the entire fuel reduction survey area (Beard 1976)

Kitchener (1971) assessed the vegetation of Hall's Track, which is situated on the northern section of the Lake Magenta Nature Reserve. A total of five vegetation formations were described which were split into 18 plant associations. Of these 18 plant associations, four were open mallee sub-formations, three were closed mallee sub-formations, three were Low arid woodland sub-formations, two were Shrub woodlands sub-formations, two were arid scrub formation, and one each of Heath and Halophyte sub-formations. The mallee communities present within the Lake Magenta Nature Reserve were described as exceptionally diverse, in comparison to other nearby areas, due to the varied substrate on the reserve (Kitchener 1971).

Coates (1987) mapped vegetation types along existing tracks within the Lake Magenta Nature Reserve, including all tracks within the current survey area. This mapping extended to a distance of 400m, or 200m either side of the tracks surveyed. A total of 25 vegetation types were mapped during this survey, consisting of seven Woodland Associations, three Open Mallee Associations, nine Mallee Associations, five Heath and Thicket Associations and one Samphire Association. The Mallee associations were the most common surveyed, with most being described as 'mixed mallee' comprising of *Eucalyptus eremophila*, *E. phaenophylla*, *E. uncinata* and *E. flocktoniaea* being recorded at most survey sites. It was noted during this survey that the structure of the vegetation is complex, changing within a few metres, and that fires throughout the reserve have made these changes even more complex (Coates 1987). Vegetation associations mapped by Coates (1987) in the survey area are listed in Table 2, with a short description of each vegetation type given below.

Table 2: Vegetation Types mapped within the survey area (Coates 1987)

Section	Vegetation Type
Lake Magenta South	bM
	M2
	M4
	xH
Lake Magenta North	iW
	pW1
	dW
	tM
	vM
	M1
	M2
	M3
	M5
	M6
	mM
	aM
	sH
	pT

Woodland

iW: *Eucalyptus incrassata* Woodland
Vegetation type iW was described as dense trees and some mallee of *Eucalyptus incrassata* (dominant), *E. flocktoniaea* and *Eucalyptus scyphocalyx* over a sparse understorey.

pW1: *Eucalyptus platypus* (Moort) Woodland

Vegetation type pW1 was described as typical stands of sparse to mid-dense *Eucalyptus platypus*, which have not been burnt for a long period of time, over scattered shrubs.

dW: *Eucalyptus densa* Woodland
Vegetation type dW was described as mid-dense to dense trees of *Eucalyptus densa*, with some *E. xanthonema* and *E. spathulata* over an understorey of sparse mixed *Melaleuca* species.

Open Mallee

tM: Open Tallerack Mallee over Mixed Low Heath (tM)
Vegetation type tM was described as a very sparse upper stratum of *Eucalyptus tetragona* (now *Eucalyptus pleurocarpa*) over mid-dense mixed shrubs to 0.5m in height. This vegetation type was noted as being rich in species.

bM: Open Mallee over Scrub
Vegetation type bM was described as mainly a mixture of *Eucalyptus tetragona*, *Eucalyptus incrassata*, *Eucalyptus falcata*, *Eucalyptus phaenophylla* and *Eucalyptus uncinata* Shrub Mallee with very sparse cover (2-10%) over a variable understorey.

vM: Open Mallee over *Hakea varia* Heath
Vegetation type vM was described as a very sparse upper stratum of Shrub Mallee of *Eucalyptus scyphocalyx*, *E. phaenophylla* ms, *E. uncinata* and *E. eremophila*, over a mid-dense lower stratum of mixed shrubs to 0.5m, with *Hakea varia* to 2m scattered throughout.

Mallee

M1: Mixed Mallee – Type 1
Vegetation type M1 was described as a sparse to mid-dense upper stratum of shrub mallees of varying heights, including *Eucalyptus eremophila*, *E. flocktoniaea, E. spathulata*, *E. conglobata*, *E. pileata* and *E. phaenophylla* ms, over a sparse lower stratum of mixed species to 0.5m in height, with sometimes a sparse stratum of *Melaleuca uncinata* to 1.5m.

M2: Mixed Mallee – Type 2
Vegetation type M2 was the most common type encountered, and consisted of a mid-dense to sparse mixed Shrub Mallee including *E. aspratilis* ms, *E. eremophila, E. flocktoniaea*, *E. phaenophylla* ms, *E. incrassata*, *E. scyphocalyx*, *E. uncinata, E. spathulata* and *E. xanthonema*, over a mid-dense understorey layer to 0.5m. Changes in density of both upperstorey and understorey layers were noted in this vegetation type.

M3: Mixed Mallee *Hakea multilineata*

Vegetation type M3 was described as a sparse to very sparse upper stratum of mixed shrub mallee including *Eucalyptus eremophila*, *E. flocktoniaea*, *E. phaenophylla* ms, *E. scyphocalyx*, *E. tetragona* and *E. uncinata*, over a mid-dense to sparse lower stratum of mixed shrubs to 1m. This vegetation type was characterised by the presence *of Hakea multilineata* and *Gastrolobium crassifolium*.

M4: Mixed Mallee over Scrub
Vegetation type M4 was described as a sparse Shrub Mallee including *Eucalyptus falcata*, *E. incrassata*, *E. phaenophylla*, *E. scyphocalyx*, *E. tetragona* and *E. uncinata* over a mid-dense understorey up to 0.5m in height.

M5: Mixed Mallee over *Melaleuca* 'Thicket'
Vegetation type M5 was described as a sparse upper stratum of Shrub Mallee varying in height of mixed *Eucalyptus* species including *Eucalyptus annulata*, *E. aspratilis* ms, *E. calycogona*, *E. conglobata*, *E. flocktoniaea* and *E. incrassata* (and others) over a mid-dense to dense lower stratum of mixed *Melaleuca* shrubs including *Melaleuca subtrigona*, *M. uncinata*, *M. lateriflora*, *M. holosericea* and *M. acuminata*.

M6: Mixed Mallee over *Melaleuca uncinata* Scrub
Vegetation type M6 was described as sparse shrub mallee including *E. flocktoniaea, E. phaenophylla* ms, *E. scyphocalyx*, *E. spathulata* var. *grandiflora* and *E. xanthonema* over a mid-dense lower stratum dominated by *Melaleuca uncinata*, to 1.5m in height.

mM: Dense Mixed Mallee – Type 1
Vegetation type mM was described as a mid-dense upper stratum of shrub mallee including *Eucalyptus eremophila*, *E. flocktoniaea*, *E. conglobata*, *E. uncinata and E. incrassata*, over scattered shrubs.

aM: *Eucalyptus annulata* Mallee
Vegetation type aM was described as mid-dense mixed shrub mallee with *Eucalyptus annulata* (and other *Eucalyptus* species) over a variable sparse lower stratum.

Heath and Thicket Associations

xH: *Xanthorrhoea nana*/*Hakea baxteri* heath
Vegetation type xH was described as mid-dense mixed shrubs to 0.5m with scattered *Eucalyptus tetragona*. Some species recorded were *Xanthorrhoea nana*, *Hakea baxteri*, *Banksia caleyi*, *Astroloma sprengeloides*, *Verticordia densiflora*, *Andersonia parvifolia* and *Isopogon trilobus*.

sH: Low Scrub with emergent *Santalum acuminatum*

Vegetation type sH was described as a very sparse upper stratum to 1.0m in height of shrubs over a sparse lower stratum to 0.5m in height, with *Santalum acuminatum* to 2m scattered throughout.

pT: *Eucalytpus platypus* (Moort) 'Thicket'
Vegetation type pT is described as 'recently' burnt mid-dense to dense *Eucalyptus platypus* stratum of a height varying from 0.5 – 2m, over no understorey, but some scattered shrubs. Scattered *Eucalyptus salmonophloia* can also be present.

Coates (1987) listed a number of vegetation associations that were infrequently encountered during the survey of the Lake Magenta Nature Reserve. These associations may not be restricted to small areas within the reserve as a whole, however the predominance of mallee associations throughout the reserve mean that by comparison these associations are comparatively rare. These associations includes Woodland and Heath vegetation associations described during the survey, the following of which are present over the survey area:

- *Eucalyptus incrassata* Woodland
- *Eucalyptus densa* Woodland
- *Eucalyptus platypus* (Moort) Woodland
- *Xanthorrhoea nana/Hakea baxteri* Heath
- Low Scrub with emergent *Santalum acuminatum*

Other vegetation associations described by Coates (1987) as rare included:

- *Eucalyptus salmonophloia* (Salmon Gum) Open Woodland
- *Eucalyptus occidentalis* (Flat Topped Yate) Woodland
- *Eucalyptus falcata* (Silver Mallet) Woodland
- *Banksia baueri* Heath
- *Eucalyptus platypus* (Moort) Dense Woodland
- Samphire

Coates (1987) recorded 304 species during her survey, and it was noted that this is not a complete list of species in the area surveyed. Species rich areas included heath and Open Mallee over heath areas. Several geographically restricted species were listed, including *Bossiaea divaricata*, *Melaleuca apodocephala*, *Thysanotus acerifolius*, *Allocasuarina pinaster* and *Oxylobium microphyllum*. Of these, *Bossiaea divaricata* now holds a P3 status, and *Thysanotus acerifolius* a P2 status (CALM, 2002)

Martinick and Associates (1984) examined a proposed firebreak system to determine the impacts on vegetation associations of the Reserve. This survey examined the majority of the survey area of the Dunn Rock section of this report. Thirty-seven vegetation types in total were determined over the entire Reserve, of which five were mapped over the survey area. Vegetation associations mapped included:

KS.SB (1): Mixed spp. Mallee – Broombush (*Melaleuca uncinata*), usually with heath

KS.SD (1): *Eucalyptus tetragona* (now *Eucalyptus pleurocarpa*) Mallee Heath

KS.SC: *Eucalyptus transcontinentalis* (now *Eucalyptus neutra*) Mallee Heath

M.S: Salmon Gum (*Eucalyptus salmonophloia*) Woodland, generally a mosaic with *Eucalyptus flocktoniaea* Woodland, *Eucalyptus occidentalis* Woodland, Teatree (*Melaleuca*) Tall Shrubland and Open Mallee Heath (TS)

LA.SA: Silver Mallet Low Woodland (was *Eucalyptus falcata*; now is *Eucalyptus argyphea*)

Mosaics of KS.SB (1)/KS.SD (1) and KS.SB (1)/KS.SC were mapped over large areas. Locations 12 – 17 were located within the Dunn Rock section, and a short description of each is given below (Martinick and Associates 1984).

Location 12: *Eucalyptus transcontinentalis* Mallee on sandplain (drainage line on sandy loam). KS.SB (1)/KS.SC

This location was described as Mixed Open Shrub Mallee of *Eucalyptus transcontinentalis*, *Eucalyptus eremophila* and *Eucalyptus celastroides* over Dense Low Heath D of *Melaleuca bracteosa*, including *Melaleuca cardiophylla*, *Melaleuca subfalcata, Acacia glaucoptera*, *Hakea commutata*, *Grevillea pectinata.*

Location 13: *Eucalyptus salmonophloia* Woodland on broad valley (drainage line of alluvium). M.S.

This location was described as Open Woodland of Salmon Gum *(Eucalyptus salmonophloia*) over Very Open Shrub Mallee of *Eucalyptus pileata*, over Open Dwarf Scrub D including *Templetonia sulcata*, *Acacia* spp. and *Daviesia benthamii* subsp. *benthamii.*

Location 14: *Eucalyptus tetragona* Mallee on sandplain (colluvial sand sheet). KS.SC

This location was described as Very Open Shrub Mallee of Tallerack (*Eucalyptus tetragona*) over Dwarf Scrub D including *Beaufortia micrantha*, *Calothamnus gracilis*, *Dryandra ferruginea*, *Hakea* spp., over very Open Low Sedges *Mesomelaena stygia*, *Harperia lateriflora.*

Location 15: Mallet Low Forest. LA.SA.

This location was described as Low Forest A of *Eucalyptus falcata, Eucalyptus astringens*, *Eucalyptus gardneri* and *Eucalyptus incrassata*, over Low Open Scrub A of *Melaleuca uncinata* and *Hakea laurina*, over Dwarf Scrub D of *Acacia laricina* and *Spyridium cordatum.*

Location 16: *Eucalyptus annulata* Low Woodland/Low Forest on sandplain (old peneplain of clay loam). LA.SA

This location was described as Low Forest B of *Eucalyptus annulata*, over Open Dwarf Scrub C, including *Exocarpos aphyllus*, *Hakea commutata* and *Cryptandra* sp.

Location 17: *Eucalyptus redunca* Mallee on sandplain (old slopes). LA.SA.

This location was described as Mixed Shrub Mallee of *Eucalyptus redunca*, *Eucalyptus uncinata*, *Eucalyptus eremophila* over Low Scrub B of *Melaleuca uncinata* and *Daviesia benthamii* subsp. *benthamii*, over Dwarf Scrub D of *Spyridium cordatum*, and very Open Low Sedges, including *Lepidosperma drummondii*.

2 AIMS AND OBJECTIVES

The main aim of this project is to provide advice to CALM regarding plant communities present within the fuel reduction buffer strips; the conservation significance of these communities and flora located within these areas; the sensitivity of the flora and plant communities to fire and other disturbances; and the likelihood of other associated problems within these nature conservation areas, such as weed invasion and soil degradation. The objectives are to:

- Describe and characterise vegetation units and map their occurrence and distribution on a scale of 1:25 000 within the proposed fuel reduction buffers;
- Determine and document the presence of rare or threatened plant taxa within the buffers;
- Compile an inventory of the vascular flora within the buffers;
- Assess the environmental impact of the proposed fire buffers on conservation values of the reserves;
- Monitoring the recovery of the fuel reduced buffers and resilience of the reserves to the disturbance.

3 METHODOLOGY

The tasks to complete the project aims and objectives and the various methodologies adopted for each are detailed below. All methodologies to be used were detailed in the Consultants Brief (418 6/02), or discussed with the CALM Project Manager.

3.1 Mapping of Vegetation Units

Vegetation unit boundaries were initially mapped using colour and black and white aerial photographs, at a scale of 1:25 000. All aerial photography was supplied by CALM, with the photography over Lake Magenta flown in October 1997, over Dunn Rock (black and white) in 1992, and over the UCL (3030) in December 1998. Vegetation unit boundaries were delineated from these aerial photographs and subsequently digitised using ArcView version 3.2. Vegetation units were initially mapped at an Association Level (National Land and Water Resources Audit 2000).

Ground-truthing of the initial map was undertaken on the 1st – 5th and 29th July, 2002. Ground truthing consisted of traversing tracks present on the edges of the fuel buffer areas, and recording detailed plant and vegetation information at sites located along the buffer areas. At least one recording site was conducted in each vegetation unit. These recording sites included listing the presence, height and cover of all species present within a radius of approximately 20m of the site, as well as recording of opportunistic species noted whilst traversing tracks, and near recording sites. Detailed species lists of each vegetation unit were compiled from this information, and information gained through the establishment of permanent McDonald Plots (see section 3.2 below). Vegetation structure descriptions at these recording sites, and for each vegetation unit description was undertaken using Muir's methodology (1977).

Plant collecting was undertaken both at recording sites and opportunistically, to determine species present within the fuel reduction buffers. The plant specimens were taken to the Western Australian Herbarium (WAHerb) for identification. Degraded and/or Modified Vegetation Units were also determined during ground truthing. These consisted of areas used for gravel/sand extraction.

Changes due to further refinement of the initial map during ground-truthing were undertaken using ArcView version 3.2, with the final map presenting all Vegetation Units, and McDonald plot locations. The map was supplied with a title, scale bar, north arrow and data directory. Each vegetation unit polygon has been given a unique identifier number, and appropriate information entered in theme tables within the ArcView file.

3.2 McDonald Plots

McDonald Plots (McDonald *et. al.* 1990) were established for two reasons within the fuel buffer survey areas. Firstly, they are designed as monitoring plots to determine changes in species presence and cover, and vegetation structure as a result of the fuel reduction chaining and burning. Secondly, they have been used to aid in characterisation of vegetation units and provide information on species presence within the survey area.

Ten plots were established and monitored in August 2002, in dominant and representative vegetation units present within the survey area. Site selection for these monitoring plots was undertaken after ground truthing of the initial map was completed, and sites were selected as per Table 3 below. Vegetation units that were dominant (widespread) over the survey area, as well as several other vegetation units that were less dominant but contained different suites of species were targeted, as well as areas that contained priority or declared rare flora. Vegetation units containing species sensitive or dependant upon fire were prioritised. Shrub Mallee vegetation units dominate the list of units sampled, due to their prevalence over the survey area. Plots were also scattered over the entire survey area, in order to examine as wide a range of environments as possible. This included placing plots in areas that have the greatest potential for weed invasion. Plots were not established in Woodland areas (excepting W3), as these vegetation units will not be included in the fuel reduction programme.

Table 3: Site selection for McDonald Plots within the Fuel Reduction Buffer Areas

Plot	Section	Veg. Unit	Comments
FR0201	LM South	SM3	This vegetation unit has a high species richness, occurs over a widespread area on the fuel reduction buffer survey area, and the plot is located in an area which potentially may become weed infested, due to the closeness of paddocks.
FR0202	LM North	SM15	This vegetation unit occupies a very small area, however it contains the Declared Rare Flora species *Acacia leptalea*.
FR0203	LM North	W3	This vegetation unit is the dominant Woodland mapped and potentially contains a large number of understorey species. *Eucalyptus platypus* is sensitive to fire, forming dense thickets when disturbed. The plot was located in one such low area, to gain data on growth rates and species succession within *Eucalyptus platypus* dominated Woodlands.
FR0204	Dunn Rock	SM6	This vegetation unit was the most widespread mapped over the survey area, and potentially contains a high species richness. This unit contains *Hakea*, *Banksia* and *Callitris* species, which are fire-sensitive and/or fire-dependant.
FR0205	LM North	SM10	This vegetation unit is a widespread unit within the survey area, and contains a large range of both *Eucalyptus* and *Melaleuca* species. Little information on the effect of fire on *Melaleuca*-dominated vegetation in this region is available.
FR0206	UCL	H1	This vegetation unit is one of the four Heaths/Thickets mapped during this project, and is the largest in extent. It is dominated by *Callitris tuberculata*, which is a fire sensitive species. Priority 3 species *Dryandra xylothemelia* is also present in this vegetation unit. The area in which this plot was placed also has a greater potential to become weed-infested due to its location near paddocks.
FR0207	Dunn Rock	SM6	This vegetation unit was the most widespread mapped over the survey area, and potentially contains a high species richness. The Priority 1 species *Melaleuca sculponeata* was recorded within this vegetation unit. This unit contains *Hakea*, *Banksia* and *Callitris* species, which are fire-sensitive and/or fire-dependent.
FR0208	UCL	SM4	This vegetation unit was widespread throughout the survey area, and has potentially a high understorey

Plot	Section	Veg. Unit	Comments
			species richness. Fire-sensitive and/or dependent *Hakea*, *Banksia* and *Callitris* species are present within this vegetation unit.
FR0209	Dunn Rock	H4	Although this vegetation unit is only present over a minor area within the survey area, it has a high species richness, and monitoring the effects of fuel reduction operations on heath areas is essential.
FR0210	LM North	SM5	This vegetation unit was mapped over a smaller portion of the survey area than other vegetation units mentioned in this list, however the species composition differs significantly due to the presence of laterite. *Hakea*, *Banksia* and *Callitris* species are also present in this unit, which are fire sensitive and/or dependant.

Each plot was set up on a north-south, east-west axis, with the north-west corner permanently marked by a steel star-picket. The steel star-picket was marked using a stamped metal tag with a unique site identifier, or plot number, consisting of two alpha characters (FR) and four numerical characters (02XX), (i.e. plot number 1 was given the identity number FR0201). A photograph of each plot was taken from the north-west corner, facing 135° towards the south-east corner, using a SLR camera with 400 speed film. Digital images were also shot using a Canon Powershot S30, to a resolution of 2048 x 1536 pixels. A Garmin 12 Personal Navigator GPS was used to fix the location of the north-west corner peg, and fixes were averaged over the period of time required to complete the tasks at the site, which was on average 2 - 2.5hrs.

At each plot, the following information was recorded (all page numbers refer to McDonald *et. al.* 1990):

- Date
- Surveyor Names
- Unique Site Identifier
- Location (utilising GPS)
- Air Photo Reference (p. 7)
- Aspect (p. 87)
- Elevation, both means and value (p. 87-88) (utilising GPS)
- Disturbance of Site (p. 88)
- Soil Texture Grade (p. 118-120)
- Soil Condition (p. 141)
- Soil-Landscape Unit (Lantzke 1992)
- Vegetation Name (Muir; Beard; McDonald; Woodman Environmental Consulting Unit Name [WEC])
- Evidence/No evidence of fire, estimate of number of years since fire
- Percentage of litter cover
- Percentage of bare ground

McDonald Plots consist of two nested quadrats, a 10m x 10m ($100m^2$) quadrat within the north-west corner of a 20m x 20m ($400m^2$) quadrat. Within the $100m^2$ quadrat, up to five dominant/co-dominant species from each stratum, within or overhanging the quadrat were recorded, with dominant/co-dominant species being determined as those with the greatest biomass within the quadrat, or indicator/diagnostic species. Any extra dominant/co-dominant species within the tallest stratum present within the $400m^2$ quadrat were also noted, and detailed as being present within the $400m^2$. All other species within the $100m^2$ quadrat were also recorded.

The following were recorded for each of the dominant/co-dominant species in the tallest stratum within $400m^2$, and for all other stratum within $100m^2$;

- Growth Form (p. 64-66)
- Average Height (p. 66, 67, 73)
- Height Class and Name (p. 66-67)
- Crown Cover Class for each stratum

The height, cover and health of all species within the $100m^2$ quadrat, and for upper strata species in the $400m^2$ were also recorded. Heights were recorded in centimetres, and cover as a percentage of the quadrat. Health recordings followed the following:

1: Very healthy, no deaths, possible minor stress
2: Healthy, some stress (i.e. dead leaves, branches, coppicing) but no deaths
3: Stressed, some deaths but not more than one third
4: Very stressed, more than one third of individuals of species dead
5: Major deaths, very few healthy individuals

Vegetation Cover as per McDonald *et. al.* (1990) was not measured. This method is very time intensive and not altogether accurate, depending upon the type of vegetation measured, and the information gained from this exercise was determined to be of limited value.

Vegetation was described to the Sub-Association Level, being the five most dominant species in each of five strata present within the vegetation unit (National Land and Water Resources Audit 2000). The McDonald Vegetation Name is determined by using a combination of floristics and structure of the vegetation, including the dominant species, growth form, height class and cover class of up to five stratum present within the plot (McDonald *et. al.* 1990; pg. 74-76).

Appendix A details all vascular plant species recorded during this survey, and Appendix B details which vegetation unit each species was recorded in. Appendix C presents photographs taken of each McDonald Plot. Appendix D gives field sheets of the McDonald plots established in the fuel reduction buffer sections.

3.3 Declared Rare and Priority Flora Species

There was no requirement in the project to undergo a full search for Declared Rare (DRF) and Priority Flora within the survey area. However, when such flora were recorded, the following information was recorded and entered into the Access Database:

- Species
- TaxonID
- Status
- GPS – easting and northing
- Number of Individuals
- Number of Adults
- Number of Seedlings
- Number of Dead
- Condition of population

The Declared Rare and Priority Flora List (CALM 2002; current as at 3/5/2002) was used to determine the status of all species recorded during the survey. Specimens of each DRF/Priority species were taken for formal identification and to be submitted to the WAHerb. Appropriate Rare Flora Report Forms will also be submitted with these specimens.

3.4 Weed Cover

All remnants were classed into separate weed cover class polygons, based on weed cover ascertained at time of survey. These classes were:

- 0% - 20%
- 20% - 50%
- 50% - 80%
- 80% - 100%

All weed cover class polygons were given separate individual polygon identification numbers, and data entered into both the GIS system and Access database. Data such as species, GPS location and extent of opportunistically recorded serious environmental weed populations were also entered.

3.5 Other Data

Opportunistic data on fauna species, and Indigenous and Non-Indigenous sites identified during the course of the survey, have been provided within the Access Database.

3.6 Data Collation and Storage

3.6.1 MAX Database and MAX Collecting Book

MAX database version 2.0.5.105 was used to validate all plant taxonomic names during entry into the Access Database, for both quadrat and DRF/Priority information. . All

voucher specimens for both the CALM Katanning District Office and the WAHerb will be recorded within the MAX Collecting Book. Two tables, including a Collecting Book with all specimen details, and a Supplementary Master List, will be provided at the conclusion of this project.

3.6.2 Access 97 Database

All information collected has been collated into a Microsoft Access 97 database, including all survey data, polygon data (both non-degraded and degraded and/or modified vegetation units), point data (McDonald plots), boundary fencing data, weed cover class data, plot data, photo data, DRF/Priority Species data and Fauna data. These have been collated into tables to fit into the existing Reserves Values Database, held by CALM.

3.6.3 ArcView version 3.2

Each vegetation unit polygon has been given a unique polygon identifier, and the area (ha) and perimeter (m) calculated. These, as well as information such as vegetation name, have been supplied in polygon themes, with location of plots (with relevant information such as easting and northings) being provided as point themes. Photographs have been scanned and stored as .jpeg files, to be hotlinked with the relevant ArcView themes, with filename pathways provided.

3.7 Limitations to Survey

Limitations to the botanical survey of this survey were introduced through the scale (1:2000) and age (from 1992) of aerial photography used during the initial interpretation, however the majority of these limitations were rectified through appropriate ground-truthing methods. Although a large number of field recording sites, in combination with opportunistic collecting and the use of McDonald Plots has created a reasonable species list for the survey area, it is by no means definitive and cannot be treated as such. A complete Declared Rare and Priority Flora search was also not conducted as part of this survey, and species recorded were done so only opportunistically and therefore cannot be regarded as a total list.

The timing of survey (July - August) meant that annual species, such as from the families Asteraceae and Orchidaceae, are not well represented. Additional introduced ('weed') species would also be more likely to be identified in Spring. Identifications of non-flowering or non-fruiting species were also difficult to obtain, and species with 'sp.' or '?' in the attached Appendices reflect this.

4 RESULTS

4.1 Overall Survey Area

4.1.1 Flora

A total of 348 native vascular plant species were recorded over the entire survey area during July – August 2002, and are listed in Appendix A. One hundred genera and 38 families are represented in this total. The family Myrtaceae had the greatest number of species recorded, with 109 species. Other well-represented families were Proteaceae (62 species), Papilionaceae (31 species) and Epacridaceae (21 species). This compares favourably with the 304 species recorded in the Lake Magenta Nature Reserve (Coates 1987) and the 183 species recorded by Martinick and Associates (1984) in the Dunn Rock Nature Reserve. The families Myrtaceae (especially genera *Eucalyptus* and *Melaleuca*), Proteaceae and Papilionaceae were also well represented in surveys by Coates (1987) and Martinick and Associates (1984).

One DRF, potentially two Priority 1, two Priority 2, five Priority 3 and one Priority 4 species were recorded during this survey. These are listed in Table 4.

Table 4: DRF and Priority Species Recorded during the Survey

Status	Species	Section	Veg. Unit	Plot
DRF	*Acacia leptalea*	LM North	SM15	FR0202
P1	*Melaleuca sculponeata*	Dunn Rock	SM6	FR0207
	Melaleuca sculponeata	Dunn Rock	SM10	
	Hibbertia ?carinata	LM North	SM10	FR0205
P2	*Leucopogon florulentus*	LM North	SM10	FR0205
	Rinzia affinis	UCL	SM4	FR0208
P3	*Bossiaea divaricata*	LM North	SM5	FR0210
	Calectasia obtusa ms	Dunn Rock	SM6	FR0204
	Calectasia obtusa ms	Dunn Rock	SM6	FR0207
	Dryandra xylothemelia	UCL	H1	FR0206
	Lepidosperma pruinosum	Dunn Rock	H3	
	Lepidosperma ?pruinosum	UCL	H1	
	Schoenus calcatus	UCL	H1	FR0206
P4	*Verticordia integra*	UCL	SM4	FR0208

According to a list of known priority species in the Dunn Rock and Lake King Nature Reserves provided by CALM, all of these populations in these areas are new.

Several other species were noted as being of significance, and to be submitted to the WAHerb. These include *Astroloma* affin. *recurvum*, *Leucopogon* sp. Lake King (A. J.

Wilson 65), *Thomasia microphylla* and *Baeckea* affin. *crispiflora*. The collection of *Thomasia microphylla* constitutes a range extension for this species, *Baeckea* affin. *crispiflora* and *Astroloma* affin. *recurvum* are unusual specimens, and *Leucopogon* sp. Lake King (A. J. Wilson 65) is poorly collected. Specimens of all DRF and Priority Flora will also be lodged at the WAHerb at the conclusion of the project.

Only one weed species was noted during the survey, being *Brassicaceae sp (probably **Raphanus raphanistrum*). This species was only seen as dried seed heads trapped against native vegetation and fencelines adjoining pasture on the Lake Magenta South and Dunn Rock sections, and not actually growing within native vegetation.

Some common names for species encountered during the project include:

Eucalyptus argyphea	Silver Mallet
Eucalyptus platypus	Moort
Eucalyptus salmonophloia	Salmon Gum
Eucalyptus occidentalis	Flat-Topped Yate
Eucalyptus pleurocarpa	Tallerack
Melaleuca affin. *uncinata*	Broombush
Eucalyptus falcata	Silver Mallee
Allocasuarina pinaster	Compass Bush

4.1.2 Vegetation Units

A total of 26 intact vegetation units were mapped within the entire survey area in July – August 2002. These consist of six Woodland/Forests, 16 Shrub Mallees and four Heath/Thickets. Shrub mallee vegetation units were also the most commonly mapped units, with area mapped as Woodland or Heath low in comparison. The dominance of Shrub Mallee vegetation units was also reflected in surveys conducted by Coates (1987) and Martinick and Associates (1984). The majority of the Shrub Mallee vegetation units were dominated by several *Eucalyptus* mallee spp., with few units being dominated by one or two *Eucalyptus* spp. The majority of Woodland areas were mapped within the Dunn Rock and UCL (3030) sections, which contained the Woodland/Forests dominated by *Eucalyptus occidentalis*, *Eucalyptus salmonophloia*, *Eucalyptus densa* and the mallet species, *Eucalyptus argyphea*. *Eucalyptus platypus*-dominated vegetation units were only mapped within the Lake Magenta North section, with no Woodland vegetation units mapped within the Lake Magenta South section. Heath vegetation units were also only mapped as occurring within the Dunn Rock and UCL (3030) sections. Detailed descriptions of these vegetation units, and McDonald plots located within these units are given in sections 4.2 to 4.6 below.

One Degraded and/or Modified vegetation unit was mapped over the survey area, being areas utilised for gravel and/or sand extraction (DEG2). None of these areas were mapped within the Lake Magenta or Dunn Rock Sections, with several occurring within the UCL (3030).

The entire fuel reduction buffer survey area was mapped as having a weed cover class of 0 – 20% throughout (Figures 14 – 25). No major infestations of weed were noted during

the survey, despite areas being in close proximity to pasture areas, and past burning of these reserves. The DEG2 areas were also reasonably free of weeds. The dried heads of *Brassicaceae sp., as noted above, was recorded in several areas near pasture, having blown in from infested areas. They have not at present invaded any of the survey area.

4.2 Lake Magenta South

The Lake Magenta South section is located in the south-western corner of the Lake Magenta Nature Reserve, and is 12km in length. This area had very little relief, being mainly flat, and had characteristically brown-grey sandy soils. No drainage lines or rocky (laterite or other) outcrops are located within this area. This section shares a boundary with cleared paddocks, which contain a high level of introduced species (weeds). At present, the section can be classified as weed free (Figures 14 and 15), however disturbance to the soils and vegetation along this boundary may allow weed invasion into this area.

A total of three intact vegetation units were mapped within the Lake Magenta South area, consisting of three Shrub Mallee vegetation units, in July 2002. The two dominant vegetation units in this section, SM2 and SM3, are dominated by *Eucalyptus pleurocarpa*, which commonly grows on deep sand.

4.2.1 Shrub Mallee

SM2 Open Shrub Mallee of *Eucalyptus pleurocarpa* and *Eucalyptus falcata* over Low Heath C dominated by *Xanthorrhoea ?nana*, *Dryandra ?cuneata*, *Beaufortia schaueri* and *Petrophile seminuda* on grey sand

Vegetation unit SM2 was mapped only within the Lake Magenta South section, near the western boundary of the reserve (Figure 2). A high species richness was noted for this vegetation unit. The upper stratum consists of a sparse shrub mallee layer (10% foliage cover), dominated by *Eucalyptus pleurocarpa* (Tallerack) and *Eucalyptus falcata* to a height of 3 – 4m. The mid-dense (50% foliage cover) lower stratum consisted of mixed shrubs, between 0.5 – 1m in height. Species included *Dryandra erythrocephala* var. *erythrocephala*, *Hakea cygna* subsp. *cygna*, *Callitris roei*, *Agonis spathulata*, *Allocasuarina microstachya* and *Hakea pandanicarpa* subsp. *crassifolia*. A total of 27 native plant species were recorded within this vegetation unit, and further surveying would increase this number.

This vegetation unit corresponds with Coates (1987) vegetation type xH (*Xanthorrhoea nana/Hakea baxteri* Heath) within this section. Other species recorded by Coates (1987) in this area included *Hakea varia*, *Hakea prostrata*, *Eremaea pauciflora*, *Acacia pycnocephala*, *Verticordia grandiflora*, *Petrophile divaricata*, *Calothamnus quadrifidus* and *Olax benthamiana*. The height of the lower stratum has risen since Coates' survey, although foliage cover has remained static. Coates also described the Tallerack (*Eucalyptus pleurocarpa*) stratum as being 'scattered', whereas during this survey it was recorded at 10%. Coates' Site 1, although mapped in xH, was described as M2?tM? (Coates 1987). In this survey this area has been mapped as SM3.

SM3 Open Shrub Mallee of *Eucalyptus pleurocarpa* and *Eucalyptus flocktoniaea* over Heath B and Dwarf Scrub D composed of a mix of proteaceous species on sand

Vegetation unit SM3 was mapped in the Lake Magenta South, Dunn Rock and UCL (3030) sections (Figures 2, 3, 8, 10, 12 and 13). Generally, this vegetation unit was characterised by a sparse (10-30% foliage cover) upper stratum dominated by *Eucalyptus pleurocarpa*, over a lower stratum of sparse (10-30% foliage cover) mixed understorey species, to a height of 1.5m, with occasional shrubs to 2m. Other mallee species recorded in this vegetation unit were *Eucalyptus flocktoniaea, Eucalyptus phaenophylla* subsp. *phaenophylla* and *Eucalyptus incrassata*. This vegetation unit recorded high species richness, which is typical of sand-heath areas. A total of 89 native plant species were recorded within this vegetation unit.

Within the Lake Magenta South section, this vegetation unit was the dominant vegetation unit mapped (Figures 2 and 3). It was characterised by sparse shrub mallee of approximately 20% cover, of a mixture of *Eucalyptus pleurocarpa*, with *Eucalyptus flocktoniae* and *Eucalyptus incrassata*, however this varied over short distances. *Eucalyptus falcata* was also recorded in this area. A sparse to mid-dense (20-50% foliage cover) lower stratum of mixed species was present, and included *Allocasuarina microstachya*, *Leptospermum erubescens*, *Calothamnus quadrifidus*, *Dryandra erythrocephala* var. *erythrocephala*, *Melaleuca subtrigona*, *Isopogon teretifolius* subsp. *teretifolius*, and *Beaufortia micrantha*. A sparse layer of lower species such as *Anarthria polyphylla* and *Lepidosperma* sp. A2 Island Flat (G. J. Keighery 7000) was also recorded.

McDonald Plot FR0201 was established in plant community SM3 within the Lake Magenta South area, on yellowish-brown loamy-sand (Figure 2). A total of 47 species were recorded within the plot (100m^2). The following dominant species were recorded:

Muir: Open Shrub Mallee over Open Low Scrub A over Low Heath C over Open Low Sedges
Soil: Yellow-brown sand

U1:	Sparse (10-30%)	*Eucalyptus pleurocarpa*
		Eucalyptus incrassata
M1:	Very Sparse (<10%)	*Callitris roei*
		Hakea corymbosa
M2:	Mid-Dense (30-70%):	*Leptospermum erubescens*
		Calothamnus quadrifidus
		Allocasuarina microstachya
		Isopogon buxifolius
		Daviesia lancifolia
G1:	Sparse (10-30%)	*Anarthria polyphylla*
		Lepidosperma sp. A2 Island Flat (G. J. Keighery 7000)

Other species recorded in this plot included *Lysinema ciliatum*, *Synaphea spinulosa*, *Petrophile seminuda*, *Isopogon buxifolius*, *Dryandra pteridifolia* subsp. *pteridifolia*, *Petrophile glauca* and *Verticordia ?pennigera*.

Vegetation unit SM3 corresponds to a combination of Coates (1987) vegetation types bM (Open Mallee over Scrub) and M4 (Mixed Mallee over Scrub) within this section. The main difference between these two latter vegetation associations is difference in foliage cover, between very sparse (2-10%) and sparse (10-30%), whereas during the present survey these differences were less pronounced. Other species recorded in this area by Coates (1987) included *Eucalyptus uncinata*, *Eucalyptus scyphocalyx*, *Banksia blechnifolia*, *Banksia media*, *Acacia pulchella*, *Baeckea preissiana*, *Coleanthera myrtoides*, *Exocarpus sparteus*, *Acacia fragilis* and *Isopogon trilobus*.

SM6 Shrub Mallee of mixed *Eucalyptus* spp., over Heath B/Low Scrub B of *Melaleuca* affin. *uncinata* over Low Heath C/D of a mix of species including *Melaleuca* spp., *Phebalium* spp. and *Daviesia benthamiana* on sand

Vegetation unit SM6 was mapped over the Lake Magenta South, Lake Magenta North, UCL (3030) and Dunn Rock sections (Figures 2, 4-13). Within Lake Magenta South, it was mapped in one area near the western boundary. In general, this vegetation unit was characterised by a sparse to mid-dense (20-40% foliage cover) upper stratum to four metres of mixed *Eucalyptus* spp, over a mid-stratum dominated by *Melaleuca* affin. *uncinata* of variable foliage cover, over a sparse to mid-dense lower stratum dominated by mixed *Melaleuca* species. Twelve fully identified *Eucalyptus* spp. were recorded within this vegetation unit, the most prominent being *Eucalyptus conglobata*, *Eucalyptus eremophila*, *Eucalyptus flocktoniae* and *Eucalyptus scyphocalyx*. Thirteen fully identified *Melaleuca* spp. were recorded as occurring within the middle stratum, including *Melaleuca rigidifolia, Melaleuca societatis*, *Melaleuca sapientes*, *Melaleuca depauperata* and *Melaleuca coronicarpa*. Other common understorey species identified within this vegetation unit were *Gahnia ancistrophylla*, *Cryptandra pungens*, *Baeckea pachyphylla*, *Beaufortia micrantha* subsp. *micrantha*, *Westringia cephalantha* and *Styphelia intertexta*. A total of 121 native plant species were recorded in vegetation unit SM6.

Vegetation unit SM6 was mapped in one area within the Lake Magenta South section (Figure 2), with a sparse cover of *Eucalyptus conglobata*, *Eucalyptus phaenophylla* subsp. *phaenophylla*, *Eucalyptus flocktoniaea* and *Eucalyptus densa* recorded. *Melaleuca* affin. *uncinata* was recorded as forming only a sparse stratum (2% foliage cover), however this was variable. *Banksia media* (3% foliage cover) was also recorded. Other species forming a sparse lower stratum recorded within this section included *Melaleuca sapientes, Daviesia benthamii*, *Dodonaea amblyophylla*, *Hakea cygna* subsp. *cygna*, *Bossiaea preissii*, *Leucopogon minutifolia*, *Westringia cephalantha* and *Melaleuca spicigera*.

Vegetation unit SM6 corresponds to Coates (1987) vegetation type M2 (Mixed Mallee – Type 2) within this section. Coates recorded the lower stratum to have a mid-dense (30-

70%) foliage cover, but did note that changes in canopy cover were recorded over short distances (Coates 1987; p. 32).

4.3 Lake Magenta North

The Lake Magenta North section is located within the Lake Magenta Nature Reserve, heading east of junction C1 near Townsend Rd, and has a length of 30km. The relief and soil types differed more widely in this section than in the Lake Magenta South section, and ranged from drainage line features with heavier sandy-loam soils, to lateritic hills with shallow grey sand over laterite, to exposed laterite. Grey-clay dominated soils were also encountered in this section, as evidenced by *Eucalyptus platypus*-dominated areas. One very minor breakaway area was encountered. No heavier loam-clay areas supporting woodlands with species such as *Eucalyptus occidentalis* or *Eucalyptus salmonophloia*, or laterite soils supporting mallet species such as *Eucalyptus argyphea* were present. This section is surrounded by intact native vegetation extending for tens of kilometres on both the north and south sides, however is in close proximity with cleared pasture on the western edge.

A total of 13 intact vegetation units were mapped within the Lake Magenta North area, consisting of 2 Woodlands, and 11 Shrub Mallee vegetation units. SM6 (mixed mallee over *Melaleuca* affin. *uncinata* over mixed shrubs on sand/sandy-loam), SM4 (mixed mallee dominated *by Eucalyptus pleurocarpa* over mixed proteaceous and myrtaceous shrubs on sand over laterite) and W3 (*Eucalyptus platypus* on grey clay) were the dominant vegetation units mapped throughout this section.

4.3.1 Woodlands/Forests

W3 Low Forest B of *Eucalyptus platypus* over Dwarf Scrub C dominated by *Melaleuca thyoides*

Vegetation unit W3 was only mapped in the Lake Magenta North section of the survey area, in several locations on medium-heavy grey clay with sand (Figures 4, 5 and 6). This vegetation unit consisted of a very low (approximately 2 – 4m), very dense Forest of *Eucalyptus platypus*, which has been recently disturbed (probably through fire). Very few other native species were recorded within this area, however the studies over several seasons by Anne Coates has demonstrated a high species richness within low *Eucalyptus platypus*-dominated areas, although the foliage cover of these species is very sparse (Coates; pers. comm.) A total of 14 native plant species were recorded within this vegetation unit.

McDonald plot FR0203 was established in plant community W3 within the Lake Magenta North Survey area (Figure 4). The soil was described as grey clay with sand, with quartz pebbles. A total of eight species were recorded within this plot ($100m^2$). The following dominant species were recorded:

Muir: Dense Low Forest B over Open Dwarf Scrub C
Soil: Grey clay-sand with quartz pebbles

U1:	Dense (70 – 100%)	*Eucalyptus platypus*
M1:	Very Sparse (<10%)	*Melaleuca cuticularis*
		Hakea commutata
		Exocarpus aphyllus

Other species recorded in this plot were *Pultenaea ?aduncta*, *Leucopogon* sp. Coujinup (Bergman 1085), *?Kunzea micrantha* subsp. *oligandra* and *Melaleuca rigidifolia*.

This vegetation unit corresponds with Coates (1987) vegetation type pT (*Eucalyptus platypus* (Moort) 'Thicket') and pW1 (*Eucalyptus platypus* (Moort) Dense Woodland). This vegetation association was described as 'recently' burnt (pre 1968 and 1972) *Eucalyptus platypus*, varying from 0.5 to 2m in height, from mid-dense to dense (50-100% foliage cover), with no understorey.

W4 Low Forest B of *Eucalyptus incrassata* over Open Dwarf Scrub C of *Dillwynia divaricata* on brown sandy-clay

Vegetation unit W4 was mapped only within the Lake Magenta North section, in two small areas near the western boundary (Figure 4), on sandy-clay soil. A total of eight native plant species were recorded in this vegetation unit. The mid-dense upper stratum (30–40% foliage cover, 4-5m) was dominated by *Eucalyptus incrassata* mallet, with some *Eucalyptus flocktoniaea* and *Eucalyptus phaenophylla* subsp. *phaenophylla* mallee. A very sparse mid-stratum was present, dominated by *Dillwynia divaricata* and *Grevillea huegelii*, with other species such as *Comesperma scoparium*, *Daviesia nudiflora* and *Dodonaea amblyophylla* present. No McDonald Plot was established in this vegetation unit.

Vegetation unit W4 corresponds to Coates (1987) vegetation type iW *(Eucalyptus incrassata* Woodland. Coates also recorded *Eucalyptus scyphocalyx* in this vegetation association. The foliage cover of the upper stratum has also thinned out since mapping was undertaken by Coates in 1987. Other species recorded by Coates (1987) included *Grevillea patentiloba*, *Dodonaea viscosa* and *Spyridium denticuliferum*.

4.3.2 Shrub Mallee

SM1 Very Open Shrub Mallee of *Eucalyptus perangusta* over Heath A dominated by *Kunzea* sp. on grey/brown sand

Vegetation unit SM1 was mapped in one location on the eastern extent of the Lake Magenta North section (Figure 7). A total of eight native plant species were recorded in this unit. It was characterised by a sparse upper stratum dominated by *Eucalyptus perangustata*, over a lower heath stratum dominated by *Kunzea* sp. (50% foliage cover, 1.6m), *Santalum acuminatum*, *Melaleuca rigidifolia* and *Gahnia trifida* on grey/brown sand. Other species recorded include *Templetonia sulcata*, *Melaleuca depauperata* and *Acacia patagiata*.

Vegetation unit SM1 corresponds to Coates (1987) vegetation type sH (Low Scrub with emergent *Santalum acuminatum*). Coates described this area as a heath, but did record that *Eucalyptus perangusta* was present. Other species recorded by Coates (1987) in this area included *Melaleuca urceolaris*, *Verticordia densiflora*, *Verticordia plumosa*, *Kunzea preissiana* and *Acacia fragilis*.

SM4 Open to Very Open Shrub Mallee of mixed *Eucalyptus* spp. including *Eucalyptus pleurocarpa* over Low Heath C of mixed species including *Beaufortia schaueri*, *Melaleuca thyoides*, *Hakea cygna* subsp. *cygna* and *Dryandra pteridifolia* subsp. *pteridifolia* on sand over laterite

Vegetation unit SM4 was mapped within the Lake Magenta North, Dunn Rock and UCL (3030) sections of the survey area (Figures 5, 6, 8, 11, 12 and 13). The upper stratum is dominated by *Eucalyptus pleurocarpa* (Tallerack) with various other mallee species including *Eucalyptus ?uncinata*, *Eucalyptus ?incrassata* and *Eucalyptus ?phaenophylla* subsp. *phaenophylla* sometimes present. SM4 occurs mainly on lateritic low hills, with *Eucalyptus pleurocarpa* dominating on the crests, and the other mallee species present downslope. The upper stratum has a variable foliage cover, from very sparse (<10% foliage cover) to mid-dense (30% foliage cover), with approximately 3-4m height. The understorey is relatively species rich and is dominated mainly by a mix of Proteaceous and Myrtaceous species, with other species such as *Beaufortia micrantha* subsp. *micrantha*, *Dryandra cuneata*, *Isopogon buxifolius* and *Hakea horrida*, as well as typical sand species such as *Allocasuarina microstachya*, *Lysinema ciliatum*, *Petrophile brevifolia* and *Schoenus brevisetis*. A total of 86 species were recorded within vegetation unit SM4 throughout the survey area.

Vegetation unit SM4 was mapped over several areas on the Lake Magenta North section (Figures 5 and 6), mainly on higher ground dominated by sand over laterite. A typical area of this vegetation unit is found at the crossjunction C2. *Eucalyptus pleurocarpa* dominates the higher ground, and mixes with other *Eucalyptus* species further downslope. A heath layer of up to 70% foliage cover, at a height of up to 2m is present, dominated by species such as *Hakea horrida*, *Melaleuca thyoides, Hakea pandanicarpa* subsp. *crassifolia* and *Isopogon buxifolius*. Other species include *Lysinema ciliatum*, *Eremaea pauciflora*, *Grevillea cagiana*, *Hakea prostrata*, *Allocasuarina pinaster*, *Andersonia caerulea* and *Dryandra cuneata.*

Vegetation unit SM4 corresponds to Coates (1987) vegetation type tM (Open Tallerack Mallee over Mixed Low Heath). It was noted as occurring on sandy and gravelly soils over laterite, and that areas on the east-west firebreak (Lake Magenta North section) are probably long unburnt due to the height of the Tallerack *(Eucalyptus pleurocarpa)*. Other species recorded by Coates (1987) include *Agonis spathulata*, *Calothamnus gracilis*, *Baeckea preissiana*, *Melaleuca subtrigona*, *Verticordia chrysantha* and *Verticordia grandiflora*.

SM5 Shrub Mallee of mixed *Eucalyptus* spp. over Heath B of mixed species including *Hakea multilineata*, *Spyridium microcephalum*, *Melaleuca leptospermoides*, *Dryandra pallida* and *Melaleuca* affin. *uncinata* on sand over laterite

Vegetation unit SM5 was mapped within the Lake Magenta North, Dunn Rock and UCL (3030) sections of the survey area (Figures 4, 5, 8, 11, 12 and 13). It was mapped on higher ground dominated by laterite, and includes the indicator species *Hakea multilineata*. A total of 41 native plant species were recorded within this vegetation unit. In general, the upper stratum is dominated by *Eucalyptus pleurocarpa*, with other mallee species such as *Eucalyptus pileata*, *Eucalyptus phaenophylla* subsp. *phaenophylla* and *Eucalyptus ?olivina*, with a sparse to mid-dense (35%) foliage cover, with a height of up to 4m. *Hakea multilineata* appears sporadically, over a sparse (10-30% foliage cover) heath layer of mixed species including *Melaleuca leptospermoides*, *Isopogon buxifolius*, *Banksia violacea, Spyridium microcephalum*, *Grevillea huegelii*, *Callitris roei*, *Exocarpus aphyllus*, *Allocasuarina pinaster* and *Melaleuca adnata*. *Bossiaea divaricata*, P3, was also recorded in this vegetation unit.

McDonald Plot FR0210 was established in plant community SM5 within the Lake Magenta North survey area (Figure 4). A total of 23 native plant species were recorded within this plot ($100m^2$). The dominant species were:

Muir: Open Shrub Mallee over Open Scrub over Dwarf Scrub D
Soil: Brown loamy-sand with laterite pebbles

U1:	Mid-dense (30-70%)	*Eucalyptus scyphocalyx*	
		Eucalyptus phaenophylla subsp. *phaenophylla*	
		Eucalyptus uncinata	
M1:	Sparse (10-30%)	*Spyridium microcephalum*	
		Melaleuca affin. *uncinata*	
		Grevillea huegelii	
		Dodonaea amblyophylla	
M2:	Sparse (10-30%)	*Daviesia scoparia*	
		Bossiaea divaricata	P3
		Isopogon buxifolius	

Other species recorded in the plot include *Hakea laurina*, *Banksia media, Westringia cephalantha*, *Platysace maxwellii*, *Boronia crassifolia*, *Rinzia communis*, and *Exocarpus aphyllus*. Twenty-five *Bossiaea divaricata* individuals were located within the $100m^2$ quadrat.

Vegetation unit SM5 corresponds to Coates (1987) vegetation type M3 (Mixed Mallee/*Hakea multilineata*). Other species recorded by Coates included *Eucalyptus uncinata*, *Eucalyptus eremophila*, *Gastrolobium crassifolium*, *Leucopogon obtusatus* and *Hakea laurina*.

SM6 Shrub Mallee of mixed *Eucalyptus* spp., over Heath B/Low Scrub B of *Melaleuca* affin. *uncinata* over Low Heath C/D of a mix of species including *Melaleuca* spp., *Phebalium* spp. and *Daviesia benthamiana* on sand

Vegetation unit SM6 was mapped over the Lake Magenta South, Lake Magenta North, UCL (3030) and Dunn Rock sections (Figures 2, 4-13). Within Lake Magenta South, it was mapped in one area near the western boundary. In general, this vegetation unit was characterised by a sparse to mid-dense (20-40% foliage cover) upper stratum to four metres of mixed *Eucalyptus* spp, over a mid-stratum dominated by *Melaleuca* affin. *uncinata* of variable foliage cover, over a sparse to mid-dense lower stratum dominated by mixed *Melaleuca* species. Twelve fully identified *Eucalyptus* spp. were recorded within this vegetation unit, the most prominent being *Eucalyptus conglobata*, *Eucalyptus eremophila*, *Eucalyptus flocktoniaea* and *Eucalyptus scyphocalyx*. Thirteen fully identified *Melaleuca* spp. were recorded within the middle stratum, including *Melaleuca rigidifolia, Melaleuca societatis*, *Melaleuca sapientes*, *Melaleuca depauperata* and *Melaleuca coronicarpa*. Other understorey species identified within this vegetation unit were *Gahnia ancistrophylla*, *Cryptandra pungens*, *Baeckea pachyphylla*, *Beaufortia micrantha* subsp. *micrantha*, *Westringia cephalantha* and *Styphelia intertexta*. A total of 121 native plant species were recorded in vegetation unit SM6.

Within Lake Magenta North, vegetation unit SM6 was mapped at several locations (Figures 4, 5, 6 and 7). The mid-stratum *Melaleuca* affin. *uncinata* foliage cover varies from very sparse (<10% foliage cover) to sparse (25 – 30% foliage cover), under a mid-dense upper stratum (<30% foliage cover) of *Eucalyptus* species, including *Eucalyptus alipes* ms and *Eucalyptus eremophila*. Mid-stratum species included *Melaleuca coronicarpa*, *Melaleuca societatis*, *Grevillea oligantha*, *Exocarpus aphyllus*, *Cryptandra minutifolia* subsp. *brevistyla* and *Hakea comutata*.

Vegetation unit SM6 within the Lake Magenta North section corresponds to a combination of Coates (1987) vegetation types M2 (Mixed Mallee – Type 2) and M6 (Mixed Mallee over *Melaleuca uncinata* Scrub). M2 was described as a sparse upper stratum of shrub mallee species, over a mid-dense mid-stratum layer dominated by mixed *Melaleuca* species, with often a very sparse separate stratum of *Melaleuca uncinata*. M6 was described as a sparse shrub mallee stratum over a lower stratum of *Melaleuca uncinata*, with a sparse layer of mixed shrubs. These two vegetation types usually formed a mosaic in the Lake Magenta North area, and thus were combined.

SM8 Open Shrub Mallee of *Eucalyptus* spp. including *Eucalyptus calycogona* subsp. *calycogona* over Low Heath C dominated by a mix of species including *Melaleuca societatis*, *Leucopogon fimbriatus* and *Hakea horrida* on deep sand

Vegetation unit SM8 was mapped in one location in the Lake Magenta North section (Figure 6). A total of 17 native plant species were recorded, however this unit was noted as being species rich and thus this is not a definitive list. The sparse (10-30% foliage cover) upper stratum was dominated by *Eucalyptus calycogona* subsp. *calycogona*, with a very sparse layer of *Melaleuca* affin. *uncinata*. The lower stratum consisted of a mix of

species, including *Melaleuca societatis*, *Daviesia divaricata*, *Leucopogon fimbriatus*, *Petrophile helicophylla*, *Callitris roei* and *Nemcia punctata*.

This area was originally mapped by Coates (1987) as M2. This particular area was dominated by one species of mallee, and had a mix of understorey species not entirely dominated by *Melaleuca* species.

SM9 Open Shrub Mallee of mixed *Eucalyptus* spp. over Open Scrub of *Banksia media* over mixed Low Scrub including *Melaleuca* affin. *uncinata* on brown loamy-sand

Vegetation unit SM9 was mapped in the Dunn Rock section, in the Lake Magenta North and UCL (3030) sections as a mosaic with vegetation unit SM10 (Figures 5, 8, 9 and 12). This vegetation unit is characterised by the relatively dense *Banksia media* layer, under an upper stratum of various mallee spp. A total of 39 native species has been recorded for this vegetation unit. A mid-dense (30-50%) upper stratum of species such as *Eucalyptus ?olivina* and *Eucalyptus eremophila* covers a lower-upper strata of *Banksia media*, which can range in cover from 5-30%. Other species recorded within this vegetation unit are *Callitris roei*, *Conostephium roei*, *Hakea laurina*, *Melaleuca depauperata, Melaleuca rigidifolia* and *Isopogon buxifolius*.

Within the Lake Magenta North area, vegetation unit SM9 was mapped in one location as a mosaic with vegetation unit SM10 (Figure 5). *Eucalyptus scyphocalyx*, *Eucalyptus ?incrassata* and *Eucalyptus phaenophylla* subsp. *phaenophylla* were recorded within this area, over scattered *Banksia media*. A dense (>70% foliage cover) lower stratum (to 1m) dominated by *Melaleuca societatis*, with scattered *Melaleuca* affin. *uncinata* is present, with scattered other understorey species such as *Gahnia ancistrophylla*, *Acacia ?sphacelata* subsp. *recurva* and *Baeckea crispiflora*.

SM10 Open Shrub Mallee of mixed *Eucalyptus* spp. over Heath B dominated by a mix of *Melaleuca* spp. on grey/brown sandy-loam

Vegetation unit SM10 was mapped in Lake Magenta North, Dunn Rock and UCL (3030) sections (Figures 5, 6, 8, 9, 10, 11, 12 and 13). It was mapped in Lake Magenta North in three areas, one being a mosaic with SM9 (see above). A total of 86 native plant species were recorded within this vegetation unit over the entire survey area. This vegetation unit was characterised by a sparse to mid-dense upper stratum of mixed shrub mallee species, over a dense layer dominated by various *Melaleuca* shrubs. The upper stratum varied from sparse (10% foliage cover) to mid-dense (30-40% foliage cover), at heights between 3-6m. *Eucalyptus* species recorded included *Eucalyptus phaenophylla* subsp. *phaenophylla*, *Eucalyptus eremophila*, *Eucalyptus scyphocalyx*, *Eucalyptus pileata* and *Eucalyptus perangustata*. The middle stratum dominated by *Melaleuca* spp. also varied in density, from mid-dense 45% to dense at greater than 80% cover. The most common dominant *Melaleuca* spp. were *Melaleuca societatis*, Melaleuca rigidifolia and Melaleuca sapientes, with other species such as *Melaleuca coronicarpa, Melaleuca adnata* and *Melaleuca lateriflora* subsp. *lateriflora* being other common, less-dominant species.

Vegetation unit SM10 was mapped over several areas within the Lake Magenta section (Figures 5 and 6). The most common *Eucalyptus* species recorded within the Lake Magenta North section were *Eucalyptus ?sporadica*, *Eucalyptus flocktoniaea* and *Eucalyptus ?phaenophylla* subsp. *phaenophylla*, from 2-3m in height. The foliage cover of the upper stratum was sparse, averaging around 10%. Within the Lake Magenta North section, *Melaleuca societatis* dominated the middle stratum, forming dense heaths from 45 to 80% cover, between 0.5-1m in height. Other species present within the middle stratum were *Daviesia benthamii*, *Leucopogon fimbriatus*, *Melaleuca subfalcata*, *Grevillea huegelii*, *Styphelia intertexta*, *Isopogon buxifolius*, *Grevillea oligantha*, *Melaleuca rigidifolia* and *Dryandra tenuifolia* var. *reptans*. A sparse mid-stratum of *Melaleuca* affin. *uncinata* was also sometimes present.

McDonald Plot FR0205 was established in plant community SM10 within the Lake Magenta North survey area, on brown loamy sand (Figure 6). A total of 44 native plant species were recorded within the plot ($100m^2$). The dominant species were:

Muir: Very Open Shrub Mallee over Open Low Scrub A over Low Heath C
Soil: Brown loamy-sand

U1:	Very Sparse (2-10%)	*Eucalyptus flocktoniaea*
		Eucalyptus alipes (ms)
		Eucalyptus scyphocalyx
M1:	Very Sparse (2-10%)	*Melaleuca* affin. *uncinata*
M2:	Mid-Dense (30-70%)	*Melaleuca societatis*
		Melaleuca rigidifolia
		Melaleuca subfalcata
		Dryandra tenuifolia var. *reptans*

Other species recorded include *Gahnia ancistrophylla*, *Rinzia communis, Phebalium obovatum*, *Gastrolobium crassifolium*, *Hakea marginata*, *Daviesia decipiens, Persoonia teretifolia* and *Phebalium lepidotum*. The possible P1 species, *Hibbertia ?carinata*, and the P2 species, *Leucopogon florulentus*, were also recorded at this plot, in very low densities.

Vegetation unit SM10 correlates with Coates (1987) vegetation type M5. Other species recorded by Coates included *Eucalyptus annulata*, *Eucalyptus calycogona, Eucalyptus spathulata*, *Eucalyptus xanthonema*, *Melaleuca subtrigona*, *Melaleuca holosericea*, *Melaleuca acuminata* and *Melaleuca pentagona*,

SM11 Open Shrub Mallee of *Eucalyptus phaenophylla* subsp. *phaenophylla* and *Eucalytpus alipes* (ms) over Heath B dominated by *Hakea lissocarpha*, *Leptospermum erubescens* and *Melaleuca* affin. *uncinata* on brown sandy clay

Vegetation unit SM11 was mapped in one location within the Lake Magenta North section (Figures 6 and 7), near the eastern end, on brown sandy-clay. A total of 11 native plant species were recorded in this vegetation unit. It is characterised by a sparse upper stratum dominated by *Eucalyptus phaenophylla* subsp. *phaenophylla* and *Eucalyptus*

alipes (ms), over a heath (>50% foliage cover) dominated by *Hakea lissocarpha*, *Melaleuca* affin. *uncinata* and *Leptospermum erubescens*. Other mid-stratum species recorded were *Melaleuca societatis*, *Grevillea disjuncta*, *Hibbertia ?exasperata, Beyeria brevifolia* var. *brevipes*, and emergent *Hakea multilineata*.

Vegetation unit SM11 is correlated with Coates (1987) vegetation association vM (Open Mallee over *Hakea varia* Heath), however *Hakea lissocarpha* was recorded during this survey.

SM12 Open Shrub Mallee dominated by *Eucalyptus phaenophylla* subsp. *phaenophylla* over Low Heath D dominated by *Melaleuca societatis* and *Andersonia* sp. on brown clay-sand

Vegetation unit SM12 was mapped in one location within the Lake Magenta North section (Figure 6). A total of 13 native plant species were recorded in this vegetation unit. This area occurs downslope of a very small breakaway area, and consists of a sparse (10-30% foliage cover) upper stratum to 3m, dominated by *Eucalyptus phaenophylla* subsp. *phaenophylla*, over a low (0-50cm) dense (>70% foliage cover) heath, dominated by *Melaleuca societatis* and *Andersonia* sp. Other species within this stratum include *Petrophile helicophylla*, *Hakea marginata*, *Astartea ambigua* and *Leucopogon fimbriatus*. Scattered *Hakea multilineata*, *Banksia media* and *Hakea pandanicarpa* subsp. *crassifolia* were also recorded.

Vegetation unit SM12 was included within vegetation type M2 (Mixed Mallee – Type 2) by Coates (1987). *Andersonia sprengelioides* was recorded by Coates near this area in 1987.

SM15 Open Shrub Mallee dominated by *Eucalyptus annulata* over Low Scrub B dominated by mixed *Melaleuca* spp. over Dwarf Scrub C.

Vegetation unit SM15 was mapped in two locations within the Lake Magenta North section only (Figures 4 and 6). A total of 36 native plant species were recorded within this vegetation unit. The upper stratum was comprised of a sparse to mid-dense (30-40% foliage cover) mix of *Eucalyptus* species, dominated by *Eucalyptus annulata*. Other *Eucalyptus* species included *Eucalyptus flocktoniaea*, *Eucalyptus platypus* and *Eucalyptus incrassata*, over a middle stratum dominated by *Melaleuca* spp., varying in foliage cover from sparse (20%) to dense (<70%). *Melaleuca* spp. included *Melaleuca adnata*, *Melaleuca rigidifolia*, *Melaleuca coronicarpa* and *Melaleuca societatis*. Other species in this stratum included *Westringia cephalantha*, *Dodonaea bursariifolia*, *Cryptandra minutifolia* subsp. *brevistylis* and *Persoonia teretifolius*. The DRF species, *Acacia leptalea*, was also recorded in this vegetation unit (Figure 4) as a dominant species. A lower-upper stratum of mixed species was also sometimes present, as at Plot FR0202, dominated by *Melaleuca* species and *Hakea newbeyana*.

McDonald Plot FR0202 was established in vegetation unit SM15 within the Lake Magenta North Survey Area, on light brown loam (Figure 4). A total of 25 native plant

species were recorded in this plot ($100m^2$). The following dominant species were recorded:

Muir: Shrub Mallee over Low Scrub A over Low Heath C
Soil: Light brown loam

U1:	Mid-dense (30-70%)	*Eucalyptus scyphocalyx*	
		Eucalyptus annulata	
		Eucalyptus platypus	
		Eucalyptus flocktoniaea	
		Eucalyptus conglobata	
M1:	Sparse (10-30%0	*Melaleuca adnata*	
		Melaleuca affin. *uncinata*	
		Hakea newbeyana	
		Melaleuca rigidifolia	
M2:	Mid-dense (30-70%)	*Acacia leptalea*	DRF
		Astartea ambigua	
		Leucopogon fimbriatus	
		Phebalium tuberculosum	
		Dodonaea bursariifolia	

Other species recorded were *Dillwynia divaricata*, *Melaleuca cardiophylla*, *Acacia erinacea* and *Grevillea oligantha*. A total of 12 *Acacia leptalea* individuals were recorded within the $100m^2$ quadrat, with the population also extending to the northern side of the track.

Vegetation unit SM15 correlates to Coates (1987) vegetation association aM. Other species recorded by Coates include *Baeckea preissiana*, *Cryptandra polyclada*, *Melaleuca subtrigona* and *Daviesia benthamii*. *Acacia* sp. nov. (aff. *multilineata*) is presumably now *Acacia leptalea* (DRF).

SM16 Shrub Mallee dominated by *Eucalyptus calycogona* subsp. *calycogona* over Heath B dominated by *Melaleuca* spp. on drainage lines

Vegetation unit SM16 was mapped only within the Lake Magenta North section (Figures 4, 5 and 7), on low drainage line areas. A total of 17 native plant species were recorded within this vegetation unit. The upper stratum dominated by *Eucalyptus calycogona* subsp. *calycogona* was mid-dense, from 30-70% foliage cover, and ranged from 3-5m in height. *Eucalyptus pileata* and *Eucalyptus conglobata* were also present. The middle stratum varied from 1-2m in height, and from 30-70% foliage cover. Dominating species in this stratum were *Melaleuca* affin. *uncinata*, *Spyridium microcephalum*, *Melaleuca adnata*, *Melaleuca acuminata* subsp. *acuminata* and *Melaleuca depauperata*.

Vegetation unit SM16 correlates to Coates (1987) vegetation association mM (Dense Mixed Mallee – Type 1), dW (*Eucalyptus densa* ms Woodland) and M1 (Mixed Mallee – Type 1). Other species recorded by Coates include *Eucalyptus platypus*, *Grevillea huegelii*, *Melaleuca pentagona*, *Comesperma spinosum* and *Grevillea patentiloba*.

4.4 Dunn Rock Reserve

The Dunn Rock section was located along the southern boundary of the Dunn Rock Reserve, and extended for 19kms. It was also located on an area of low relief, with slight depressions and crests. Some small drainage lines were encountered, including some with heavier loamy-clay soils supporting *Eucalyptus occidentalis* and *Eucalyptus salmonophloia*, as well as areas with more laterite influence supporting *Eucalyptus argyphea*. Sand over laterite areas supporting shrub mallee with laterite-influenced shrubs such as *Hakea multilineata* were mapped, as well as deeper sand over laterite with vegetation dominated by *Eucalyptus pleurocarpa*. No grey-clay areas supporting *Eucalyptus platypus* were present. Soils along this section were dominated by sand/sandy-loam, with a higher clay content in areas supporting *Melaleuca* spp. Heath areas were also mapped on sand, although vegetation unit H2 had a laterite influence.

The majority of this section shares a boundary with cleared pasture, however there are some areas where native vegetation has been left on the private property. No weed infestations were noted within the section, however the dead seed heads of *Brassicaceae sp. (probably **Raphanus raphanistrum*) was noted along the boundary with the pasture throughout the section (Figures 20 – 23). These have blown in from infestations within the pastures, and lodged themselves against the boundary fence and against the dense, intact native vegetation of the reserve. The W5 vegetation unit also had minor **Ursinia anthemoides* and **Aira* sp. present along the boundary track, which had infiltrated from the nearby paddock areas via the drainage line.

A total of 15 vegetation units were mapped over the Dunn Rock Reserve Survey Area, consisting of three Woodland/Forests, nine Shrub Mallees and three Heaths. The greater number of vegetation units mapped within this section in comparison to the other sections is a result of its greater length (30km), and the larger range of soils encountered. Vegetation units SM6 (mixed mallee over *Melaleuca* affin. *uncinata* over mixed shrubs on sand/sandy-loam) and SM10 (mixed mallee over a dense mid-stratum dominated by *Melaleuca* spp.) were the most dominant vegetation units mapped. SM4 (mixed mallee dominated by *Eucalyptus pleurocarpa* over mixed proteaceous and myrtaceous shrubs on sand over laterite) was also commonly mapped.

4.4.1 Woodland/Forests

W1 Low Forest A of *Eucalyptus argyphea* over Dwarf Scrub C, dominated by *Beyeria brevifolia* var. *brevipes* and *Phebalium canaliculatum* on brown sandy-loam

Vegetation unit W1 was mapped in the Dunn Rock and UCL (3030) sections of the survey area (Figures 9, 12 and 13). A total of 34 native plant species were recorded within this vegetation unit. Generally, the upper stratum was dominated by *Eucalyptus argyphea* (Silver Mallet), with a variable foliage cover between 20-50%. Mallee species also recorded within this vegetation unit included *Eucalyptus ?phaenophylla* subsp. *phaenophylla*, and *Eucalyptus uncinata*. The lower stratum was generally sparse in cover, from 10-25%, and also included *Hakea newbeyana*, *Exocarpus aphyllus*, *Daviesia*

benthamii, *Choretrum glomeratum* var. *chrysanthum*, *Callitris roei* and *Leptospermum spinescens*.

Vegetation unit W1 was mapped in one location within the Dunn Rock section (Figure 9), and was characterised by a dense upper stratum of *Eucalyptus argyphea*, to 10m in height, over a very sparse (<10% foliage cover) scrub layer. This layer included *Melaleuca* affin. *uncinata*, *Callitris roei*, *Beyeria brevifolia* var. *brevipes*, *Spyridium cordatum*, *Choretrum glomeratum* and *Acacia laricina* var. *laricina*.

Vegetation unit W1 corresponds to Martinick's vegetation association LA.SA. The mallet form of *Eucalyptus falcata* is now known as *Eucalyptus argyphea*.

W5 Low Woodland A of *Eucalyptus occidentalis* over Heath B dominated by *Melaleuca brophyi* and *Leptospermum erubescens* on brown sand

Vegetation unit W5 was mapped in one location within the Dunn Rock section, at the bottom of a drainage depression (Figure 9). A total of 12 native plant species were recorded within this vegetation unit. The upper stratum was composed of sparse (10-20% foliage cover) *Eucalyptus occidentalis* (Flat-topped Yate), 12-15m, over mid-dense shrubs (>50% foliage cover) to 2m. Other species within the lower stratum included *Melaleuca brophyi*, *Leptospermum erubescens*, *Calytrix tetragona*, *Hakea corymbosa*, *Lambertia inermis* var. *inermis* and *Verticordia densiflora*.

Vegetation unit W5 corresponds to Martinick's (1984) vegetation association M.S., in the centre of the drainage depression.

W6 Open Woodland of *Eucalyptus salmonophloia* over Shrub Mallee of *Eucalyptus eremophila* over Low Scrub B dominated by *Melaleuca acuminata* subsp. *acuminata* over Dwarf Scrub C dominated by *Microcybe multiflora* subsp. *multiflora* and *Acacia erinacea* on brown clay

Vegetation unit W6 was mapped in four locations, including one mosaic, within the Dunn Rock section (Figures 9 and 10). A total of 13 native plant species were recorded within this vegetation unit. It occurred mainly on the upper slopes of drainage depressions, carrying vegetation unit W5. The upper stratum was dominated by a very sparse cover (<10%) of *Eucalyptus salmonophloia* (Salmon Gum) to 20m, over a mid-dense (30-40% foliage cover) shrub mallee secondary upper stratum of *Eucalyptus eremophila* (to 5m). A sparse mid-stratum (<30% foliage cover) dominated by *Melaleuca acuminata* subsp. *acuminata* and including *Santalum acuminatum*, *Templetonia sulcata* and *Melaleuca adnata* overlay a sparse low scrub stratum dominated by *Microcybe multiflora* subsp. *multiflora* and *Acacia erinacea*, and including *Acacia viscifolia* and *Grevillea pectinata*.

Vegetation unit W6 also corresponds to Martinick's (1984) vegetation association M.S.

4.4.2 Shrub Mallee

SM3 Open Shrub Mallee of *Eucalyptus pleurocarpa* and *Eucalyptus flocktoniaea* over Heath B and Dwarf Scrub D composed of a mix of proteaceous species on sand

Vegetation unit SM3 was mapped in the Dunn Rock, UCL and Lake Magenta South sections (Figures 2, 3, 8, 10, 12 and 13). Generally, this vegetation unit is characterised by a sparse (10-30% foliage cover) upper stratum dominated by *Eucalyptus pleurocarpa*, over a lower stratum of sparse (10-30% foliage cover) mixed understorey species, to a height of 1.5m, with occasional shrubs to 2m. Other *Eucalytpus* species recorded in this vegetation unit are *Eucalyptus flocktoniaea, Eucalyptus phaenophylla* subsp. *phaenophylla* and *Eucalyptus incrassata*. This vegetation unit recorded a high species richness, which is typical of sand-heath areas. A total of 89 native plant species were recorded as occurring within this vegetation unit.

Within the Dunn Rock section, vegetation unit SM3 was mapped in three small areas, and thus was not dominant over this section (Figures 8 and 10). *Eucalyptus albida* was also recorded near the eastern end of this section. Martinick and Associates (1984) included these areas in KS.SB(1)/KS.SC (Mixed spp. Mallee – Broombush usually with Heath/*Eucalyptus transcontinentalis* Mallee Heath).

SM4 Open to Very Open Shrub Mallee of mixed *Eucalyptus* spp. including *Eucalyptus pleurocarpa* over Low Heath C of mixed species including *Beaufortia schaueri*, *Melaleuca thyoides*, *Hakea cygna* subsp. *cygna* and *Dryandra pteridifolia* subsp. *pteridifolia* on sand over laterite

Vegetation unit SM4 was mapped within the Dunn Rock, UCL (3030) and Lake Magenta North sections of the survey area (Figures 5, 6, 8, 11, 12 and 13). The upper stratum is dominated by *Eucalyptus pleurocarpa* (Tallerack) with various other species including *Eucalyptus ?uncinata*, *Eucalyptus ?incrassata* and *Eucalyptus ?phaenophylla* subsp. *phaenophylla* sometimes present. SM4 occurs mainly on lateritic low hills, with *Eucalyptus pleurocarpa* dominating on the crests, and the other mallee species present downslope. The upper stratum has a variable foliage cover, from very sparse (<10% foliage cover) to mid-dense (30% foliage cover), with approximately 3-4m height. The understorey is dominated mainly by a mix of Proteaceous and Myrtaceous species, with other species such as *Beaufortia micrantha* subsp. *micrantha*, *Dryandra cuneata*, *Isopogon buxifolius* and *Hakea horrida*, as well as typical sand species such as *Allocasuarina microstachya*, *Lysinema ciliatum*, *Petrophile brevifolia* and *Schoenus brevisetis*. A total of 86 species were recorded within vegetation unit SM4 throughout the survey area.

Vegetation unit SM4 was mapped in three areas within the Dunn Rock section (Figures 8 and 11), with a very sparse (10% foliage cover) upper stratum of *Eucalyptus pleurocarpa*, over a sparse lower stratum dominated by species such as *Leptospermum nitens*, *Isopogon buxifolius, Dryandra pteridifolia* subsp. *pteridifolia*, *Mesomelaena stygia* subsp. *stygia* and *Lysinema ciliatum*.

Martinick and Associates (1984) mapped these areas as either KS.SD(2)/KS.SB(1) (*Eucalyptus albida* Mallee Heath/Mixed spp. Mallee – Broombush usually with Heath) or KS.SB(1)/KS.SC (Mixed spp. Mallee – Broombush usually with *Heath/Eucalyptus transcontinentalis* Mallee Heath).

SM5 Shrub Mallee of mixed *Eucalyptus* spp. over Heath B of mixed species including *Hakea multilineata*, *Spyridium microcephalum*, *Melaleuca leptospermoides*, *Dryandra pallida* and *Melaleuca* affin. *uncinata* on sand over laterite

Vegetation unit SM5 was mapped within the Lake Magenta North, Dunn Rock and UCL (3030) sections of the survey area (Figures 4, 5, 8, 11, 12 and 13). It was mapped on higher ground dominated by laterite, and includes the indicator species *Hakea multilineata*. A total of 41 native plant species were recorded within this vegetation unit. In general, the upper stratum is dominated by *Eucalyptus pleurocarpa*, with other mallee species such as *Eucalyptus pileata*, *Eucalyptus phaenophylla* subsp. *phaenophylla* and *Eucalyptus ?olivina*, with a sparse to mid-dense (35%) foliage cover, with a height of up to 4m. *Hakea multilineata* appears sporadically, over a sparse (10-30% foliage cover) heath layer of mixed species including *Melaleuca leptospermoides*, *Isopogon buxifolius*, *Banksia violacea, Spyridium microcephalum*, *Grevillea huegelii*, *Callitris roei*, *Exocarpus aphyllus*, *Allocasuarina pinaster* and *Melaleuca adnata*. Vegetation unit SM5 was mapped in two small areas within the Dunn Rock section, particularly on the eastern end of the section (Figures 8 and 11). Martinick and Associates (1984) mapped this area as KS.SB(1)/KS.SC (Mixed spp. Mallee – Broombush usually with *Heath/Eucalyptus transcontinentalis* Mallee Heath).

SM6 Shrub Mallee of mixed *Eucalyptus* spp., over Heath B/Low Scrub B of *Melaleuca* affin. *uncinata* over Low Heath C/D of a mix of species including *Melaleuca* spp., *Phebalium* spp. and *Daviesia benthamiana* on sand

Vegetation unit SM6 was mapped over the Lake Magenta South, Lake Magenta North, UCL (3030) and Dunn Rock sections (Figures 2, 4-13). In general, this vegetation unit was characterised by a sparse to mid-dense (20-40% foliage cover) upper stratum to four metres of mixed *Eucalyptus* spp, over a mid-stratum dominated by *Melaleuca* affin. *uncinata* of variable foliage cover, over a sparse to mid-dense lower stratum dominated by mixed *Melaleuca* species. Twelve fully identified *Eucalyptus* spp. were recorded within this vegetation unit, the most prominent being *Eucalyptus conglobata*, *Eucalyptus eremophila*, *Eucalyptus flocktoniaea* and *Eucalyptus scyphocalyx*. Thirteen fully identified *Melaleuca* spp. were recorded within the middle stratum, including *Melaleuca rigidifolia, Melaleuca societatis*, *Melaleuca sapientes*, *Melaleuca depauperata* and *Melaleuca coronicarpa*. Other understorey species identified within this vegetation unit were *Gahnia ancistrophylla*, *Cryptandra pungens*, *Baeckea pachyphylla*, *Beaufortia micrantha* subsp. *micrantha*, *Westringia cephalantha* and *Styphelia intertexta*. A total of 121 native plant species were recorded in vegetation unit SM6.

Vegetation unit SM6 was mapped over several locations throughout the Dunn Rock section (Figures 8, 9, 10 and 11). The upper stratum varied between sparse to mid-dense foliage cover (15-40%), with a mix of mallee species including *Eucalyptus sporadica*,

Eucalyptus conglobata, *Eucalyptus eremophila* and *Eucalyptus uncinata*. The mid-stratum dominated by *Melaleuca* affin. *uncinata* varied between sparse to mid-dense (10-50%), over a lower stratum of variable species including *Melaleuca depauperata*, *Melaleuca glaberrima*, *Melaleuca sculponeata*, *Melaleuca rigidifolia*, *Leucopogon fimbriatus, Hakea lissocarpha*, *Daviesia benthamii* and *Beyeria brevifolia* var. *brevipes*. *Banksia media* was also occasionally present in the mid-stratum.

McDonald Plots FR0204 and FR0207 were established in plant community SM6 within the Dunn Rock Reserve Survey Area. A total of 34 native plant species were recorded within Plot FR0204 ($100m^2$) (Figure 8). The following dominant species were recorded:

Muir: Open Shrub Mallee over Open Low Scrub A over Low Heath D over Very Open Low Sedges
Soil: Brown sand

U1:	Very Sparse (<10%)	*Eucalyptus dissimulata*
		Eucalyptus phaenophylla subsp. *phaenophylla*
M1:	Very Sparse (<10%)	*Melaleuca* affin. *uncinata*
		Santalum acuminatum
		Isopogon buxifolius
M2:	Sparse (10-30%)	*Beaufortia micrantha* var. *micrantha*
		Melaleuca rigidifolia
		Melaleuca tuberculata var. *macrophylla*
		Melaleuca glaberrima
G1:	Very Sparse (<10%)	*Gahnia ancistrophylla*
		Desmocladus myriocladus

Other common species included *Leucopogon tamminensis* var. *australis*, *Andersonia caerulea*, *Daviesia incrassata* subsp. *incrassata*, *Phebalium lepidotum*, *Kunzea ?jucunda* and *Cryptandra minutifolia* var. *brevistyla*. Seven *Calectasia obtusa*, P3, individuals were located within the $100m^2$ quadrat.

McDonald Plot FR0207 was also established within vegetation unit SM6 (Figure 8). A total of 30 native plant species were recorded from within the plot ($100m^2$). The following dominant species were recorded:

Muir: Open Shrub Mallee over Low Scrub B over Low Heath D
Soils: Brown sand

U1:	Very Sparse (<10%)	*Eucalyptus perangusta*	
		Eucalyptus conglobata	
		Eucalyptus sporadica	
M1:	Sparse (10-30%)	*Melaleuca* affin. *uncinata*	
		Santalum murrayanum	
		Daviesia benthamiana	
		Melaleuca glaberrima	
M2:	Sparse (10-30%)	*Melaleuca sculponeata*	P1
		Hibbertia ?exasperata	
		Spyridium microcephalum	
		Gahnia ancistrophylla	
		Beyeria brevifolia var. *brevipes*	

Other species recorded include *Banksia media*, *Acacia sphacelata* subsp. *sphacelata*, *Phebalium obovatum*, *Isopogon buxifolius*, *Kunzea ?jucunda*, *Melaleuca ?bromelioides*, *Olearia exiguifolia*, *Westringia cephalantha*, *Rinzia communis* and *Melaleuca plumea*. *Calectasia obovata*, P3, was recorded as scattered throughout the area, and greater than 100 *Melaleuca sculponeata*, P1, individuals were recorded in the general area.

Vegetation unit SM6 was generally mapped by Martinick and Associates (1984) as KS.SB(1) (Mixed spp. Mallee – Broombush, usually with Heath).

SM7 Shrub Mallee of *Eucalyptus neutra* and *Eucalyptus conglobata* over Heath A of mixed shrubs dominated by *Daviesia benthamii*, *Dodonaea amblyophylla* and *Beyeria brevifolia* subsp. *brevipes*

Vegetation unit SM7 was mapped in one area within the Dunn Rock section (Figure 8). It was characterised by a mid-dense upper stratum of *Eucalyptus neutra* and *Eucalyptus conglobata*, over a heath layer of mixed species including *Coleanthera myrtoides*, *Melaleuca* affin. *uncinata*, *Spyridium minutum* and *Leucopogon cuneifolius*, with emergent *Santalum murrayanum*, on brown sand. A total of 15 native plant species were recorded within this vegetation unit.

Vegetation unit SM7 was mapped as KS.SC (*Eucalyptus transcontinentalis* mallee-heath) by Martinick and Associates (1984). The mallee form of *Eucalyptus transcontinentalis* is now known as *Eucalyptus neutra*.

SM9 Open Shrub Mallee of mixed *Eucalyptus* spp. over Open Scrub of *Banksia media* over mixed Low Scrub including *Melaleuca* affin. *uncinata* on brown loamy-sand

Vegetation unit SM9 was mapped in the Dunn Rock section, in the Lake Magenta North and UCL (3030) sections as a mosaic with vegetation unit SM10 (Figures 5, 8, 9 and 12). This vegetation unit is characterised by the relatively dense *Banksia media* layer, under an upper stratum of various mallee *Eucalyptus* species. A total of 39 native species has

been recorded for this vegetation unit. A mid-dense (30-50%) upper stratum of species such as *Eucalyptus ?olivina* and *Eucalyptus eremophila* covers a lower-upper stratum of *Banksia media*, which ranges in foliage cover from 5-30%. Other species recorded within this vegetation unit are *Callitris roei*, *Conostephium roei*, *Hakea laurina*, *Melaleuca depauperata, Melaleuca rigidifolia* and *Isopogon buxifolius*.

Vegetation unit SM9 was mapped over several small areas on the Dunn Rock section, with *Banksia media* forming a foliage cover of up to 30% (Figures 8 and 9). Within this section it was also mapped as a mosaic with vegetation unit SM14. Within this area, vegetation is currently regenerating from a fire that occurred approximately 5 years ago. Species recorded within the Dunn Rock section include *Melaleuca rigidifolia*, *Isopogon buxifolius, Santalum acuminatum*, *Beyeria brevifolia* var. *brevipes* and *Grevillea oligantha* on brown silty-loam. Mallee species include *Eucalyptus flocktoniaea* and *Eucalyptus sporadica*. The majority of these areas were mapped by Martinick and Associates (1984) as KS.SB(1)/KS.SC (Mixed spp. Mallee – Broombush usually with Heath/*Eucalyptus transcontinentalis* Mallee Heath).

SM10 Open Shrub Mallee of mixed *Eucalyptus* spp. over Heath B dominated by a mix of *Melaleuca* spp. on grey/brown sandy-loam

Vegetation unit SM10 was mapped in Dunn Rock, UCL (3030) and the Lake Magenta North sections (Figures 5, 6, 8, 9, 10, 11, 12 and 13). A total of 86 native plant species were recorded within this vegetation unit over the entire survey area. This vegetation unit was characterised by a sparse to mid-dense upper stratum of mixed mallee *Eucalyptus* species, over a dense layer dominated by various *Melaleuca* shrubs. The upper stratum varied from very sparse (<10% foliage cover) to mid-dense (30-40% foliage cover), at heights between 3-6m. Mallee species recorded included *Eucalyptus phaenophylla* subsp. *phaenophylla*, *Eucalyptus eremophila*, *Eucalyptus scyphocalyx*, *Eucalyptus pileata* and *Eucalyptus perangustata*. The middle stratum dominated by *Melaleuca* species also varied in density, from mid-dense 45% to dense at greater than 80% cover. The most common dominant *Melaleuca* species were *Melaleuca societatis*, *Melaleuca rigidifolia* and *Melaleuca sapientes*, with other species such as *Melaleuca coronicarpa, Melaleuca adnata* and *Melaleuca lateriflora* subsp. *lateriflora* less common.

Vegetation unit SM10 was mapped over several areas throughout the Dunn Rock section (Figures 8, 9, 10 and 11). The upper stratum foliage cover was sparse, varying from between 10-30% foliage cover. Dominant mallee species included *Eucalyptus eremophila*, *Eucalyptus pileata*, *Eucalyptus uncinata* and *Eucalyptus alipes* ms. Foliage cover of the middle *Melaleuca*-dominated stratum varied between 50-70%, and was dominated by a mix of species including *Melaleuca sapientes*, *Melaleuca coronicarpa*, *Melaleuca sapientes* and *Melaleuca rigidifolia*, with some *Melaleuca* affin. *uncinata* and sparse cover of other species such as *Daviesia benthamii*, *Hakea horrida* and *Grevillea oligantha*.

Martinick and Associates (1984) mapped these areas as either KS.SC *(Eucalyptus transcontinentalis* Mallee Heath), or KS.SB(1).KS.SC (Mixed spp. Mallee – Broombush usually with Heath/*Eucalyptus transcontinentalis* Mallee Heath).

SM13 Open Shrub Mallee dominated by *Eucalyptus pileata* over Open Dwarf Scrub C dominated by *Daviesia benthamii* and *Microcybe multiflora* on brown loamy-clay

Vegetation unit SM13 was mapped in two small locations within the Dunn Rock section (Figure 8), and is characterised by a sparse (30% foliage cover) upper stratum dominated by *Eucalyptus pileata*, over a very sparse (<10% foliage cover) middle stratum including *Daviesia benthamii*, *Microcybe multiflora*, *Melaleuca* affin. *uncinata*, *Olearia muelleri*, *Exocarpus sparteus* and *Melaleuca coronicarpa*, on brown loamy-clay. *Eucalyptus goniocarpa* was also recorded within the upper stratum of this vegetation unit. A total of 10 native plant species was recorded within this vegetation unit. Martinick and Associates (1984) mapped these areas as KS.SC (*Eucalyptus transcontinentalis* Mallee Heath).

SM14 Shrub Mallee of *Eucalyptus extensa* over Open Dwarf Scrub C of *Melaleuca halmaturorum* on clay

Vegetation unit SM14 was mapped over several areas within the Dunn Rock section (Figures 9 and 10). It is characterised by a mid-dense shrub mallee stratum dominated by *Eucalyptus extensa* over a variable understorey, from <10%-30%, dominated by *Melaleuca halmaturorum*, with *Exocarpus sparteus*, *Coleanthera myrtoides* and *Melaleuca* affin. *uncinata*. A total of 16 native plant species were recorded within this vegetation unit.

4.4.3 Heaths

H2 Low Scrub A dominated by *Allocasuarina ?campestris* over Low Heath C dominated by *Verticordia chrysantha* and *Verticordia ?eriocephala* on brown sandy loam

Vegetation unit H2 was mapped within the Dunn Rock and UCL (3030) sections (Figures 8 and 13). A total of 22 native plant species were recorded within this vegetation unit. It is characterised by a very sparse to sparse (5-15% foliage cover) upper stratum dominated by *Allocasuarina ?campestris*, over a mid-dense (30-40% foliage cover) mid-stratum of mixed species, including *Verticordia chrysantha*, *Verticordia ?eriocephala*, *Melaleuca lecanantha*, *Hibbertia ?exasperata* and *Leucopogon dielsianus*, on brown sandy-loam over laterite.

Vegetation unit H2 was mapped in one small area within the Dunn Rock section (Figure 8). Species recorded within this area included *Verticordia chrysantha*, *Verticordia ?eriocephala*, *Allocasuarina microstachya*, *Melaleuca plumea, Hakea incrassata*, *Lepidosperma brunonianum*, *Leucopogon dielsianus* and *Melaleuca lecanantha*, on brown sand over laterite.

H3 Low Heath D dominated by *Allocasuarina microstachya* over Open Low Sedges dominated by *Lepidosperma pruinosum* and *Mesomelaena stygia*

Vegetation unit H3 was mapped in one location within the Dunn Rock section (Figure 8). A total of 10 native plant species were recorded within this vegetation unit. It is characterised by a very low, mid-dense (50%) stratum dominated by *Allocasuarina microstachya*, with other species such as *Petrophile seminuda*, *Hakea cygna* subsp. *cygna*, *Baeckea crispiflora*, *Leucopogon dielsianus*, *Hakea incrassata* and *Melaleuca* affin. *uncinata,* over sedges dominated by *Lepidosperma pruinosum* (P3) and *Mesomelaena stygia*, on brown sand.

H4 Heath B dominated by *Melaleuca* sp., *Hakea cygna* subsp. *cygna* and *Verticordia ?eriocephala* on brown sand

Vegetation unit H4 was mapped in one location within the Dunn Rock section (Figure 10). A total of 36 native plant species were recorded within this vegetation unit. A very sparse (<10% foliage cover) upper stratum to 1.5m of *Isopogon teretifolius* subsp. *petrophiloides*, *Hakea cygna* subsp. *cygna* and *Dryandra erythrocephala* var. *erythrocephala*, over a mid-dense (50% foliage cover) lower stratum <1m, dominated by *Melaleuca* sp., *Beaufortia micrantha* var. *micrantha* and *Verticordia ?eriocephala*, and including species such as *Baeckea* affin. *crispiflora*, *Hakea incrassata* and *Melaleuca plumea*, over sedges *Mesomelaena stygia* and *Conostylis ?argentea*, on brown loamy-sand.

McDonald Plot FR0209 was established in plant community H4 within the Dunn Rock section (Figure 10). A total of 30 species were recorded within the quadrat ($100m^2$). The following dominant species were recorded:

Muir: Open Low Scrub B over Low Heath C over Dwarf Scrub D
Soil: Brown loamy-sand

U1:	Very Sparse (<10%)	*Isopogon teretifolius* subsp. *petrophiloides* *Hakea cygna* subsp. *cygna* *Dryandra erythrocephala* var. *erythrocephala*
M1:	Mid-dense (30-70%)	*Beaufortia micrantha* subsp. *micrantha* *Verticordia ?eriocephala* *Allocasuarina microstachya* *Baeckea* affin. *crispiflora* *Melaleuca plumea*
G1:	Very Sparse (<10%)	*Mesomelaena stygia* *Conostylis ?argentea* *Lepidosperma brunonianum*

Other species recorded in this plot included *Hakea incrassata*, *Daviesia ?brachyphylla*, *Psammomoya choretroides*, *Gastrolobium crassifolium*, *Cryptandra leucopogon* and *Daviesia sarissa* subsp. *sarissa*.

4.5 UCL (3030) Survey Area

The UCL (3030) section was located on the southern boundary of the UCL (3030), to the west of the Lake King Nature Reserve, north of the Old Newdegate Rd. This area shares a boundary with cleared pasture on the southern section on the western and eastern sides, and with a section of the Dunn Rock Reserve in the centre. Cleared paddocks are also located to the west of the section. The section is separated from these pasture areas by the Old Newdegate Rd, and Tarco Rd to the west. It has a length of 12 kms.

This area had greater relief than any of the previous sections, and is situated on a greater extent of laterite. Several drainage lines intersect this section, including one supporting *Eucalyptus densa*, however no heavier loamy-clay soils supporting species such as *Eucalyptus occidentalis* or *Eucalyptus salmonophloia* were present. Several drainage line areas on soils with heavier clay contents were also mapped, with mid-stratums dominated by *Melaleuca* spp. A large amount of this section is on sand to various depths over laterite, with crests of sand over exposed laterite overlain by *Eucalyptus pleurocarpa*-dominated vegetation units being encountered. Vegetation units influenced by laterite, such as those dominated by *Eucalyptus argyphea* or ones including *Hakea multilineata* were mapped throughout this section. Several gravel extraction pits were also located and mapped through this area.

No weed invasion was mapped within this section, as the native vegetation was virtually intact and no weeds had invaded even the degraded gravel pit areas (Figures 24 and 25). This is due to a combination of the intact nature of the vegetation, and the low rainfall that is experienced by the region.

A total of 10 vegetation units were mapped within the UCL (3030) survey area, consisting of two Woodland/Forests, six Shrub Mallees and two Heaths. The dominant vegetation unit in this section was SM4 (mixed mallee dominated by *Eucalyptus pleurocarpa* over mixed proteaceous and myrtaceous shrubs on sand over laterite), with SM3 (mallee dominated by *Eucalyptus pleurocarpa* over shrubs on sand), SM6 (mixed mallee over *Melaleuca* affin. *uncinata* over mixed shrubs on sand/sandy-loam) and SM10 (mixed mallee over a dense mid-stratum dominated by *Melaleuca* spp.) also common.

4.5.1 Woodland/Forests

W1 Low Forest A of *Eucalyptus argyphea* over Dwarf Scrub C, dominated by *Beyeria brevifolia* var. *brevipes* and *Phebalium canaliculatum* on brown sandy-loam

Vegetation unit W1 was mapped in the UCL (3030) and Lake Magenta sections of the survey area (Figures 9, 12 and 13). A total of 34 native plant species were recorded within this vegetation unit. Generally, the upper stratum was dominated by *Eucalyptus argyphea*, with a variable foliage cover between 20-50%. Mallee species also recorded within this vegetation unit included *Eucalyptus ?phaenophylla* subsp. *phaenophylla*, and *Eucalyptus uncinata*. The lower stratum was generally sparse in cover, from 10-25%, and also included *Hakea newbeyana*, *Exocarpus aphyllus*, *Daviesia benthamii*, *Choretrum glomeratum* var. *chrysanthum*, *Callitris roei* and *Leptospermum spinescens*.

Within the UCL (3030) section, vegetation unit W1 was mapped in four areas, on both the western and eastern ends (Figures 12 and 13), on brown sandy-loam. The upper stratum was dominated by *Eucalyptus argyphea*, with foliage cover varying between 5-25%, to a height of less than 15m. *Eucalyptus ?phaenophylla* subsp. *phaenophylla* was also recorded within vegetation unit W1 in the eastern end of this section. A sparse (20-30% foliage cover) mid-stratum including species such as *Phebalium canaliculatum*, *Daviesia benthamii*, *Astartea ambigua*, *Callitris roei* and *Lasiopetalum compactum* was also present.

W2 Low Forest A of *Eucalyptus densa* over Open Low Scrub A dominated by *Melaleuca* affin. *uncinata*

Vegetation unit W2 was mapped in one location within the UCL (3030) section (Figure 12), in a drainage line. The upper stratum consisted of *Eucalyptus densa*, to a height of 8m, and foliage cover 40%, over a sparse (12% foliage cover) mid-stratum to 2m, dominated by *Melaleuca* affin. *uncinata*, and including *Melaleuca acuminata* subsp. *acuminata* and *Melaleuca depauperata*, over very sparse *Dianella revoluta* and *Lepidosperma* sp. A2 Island Flat (G. J. Keighery 7000), on brown loamy-sand. A total of seven native plant species were recorded within this vegetation unit.

4.5.2 Shrub Mallees

SM3 Open Shrub Mallee of *Eucalyptus pleurocarpa* and *Eucalyptus flocktoniaea* over Heath B and Dwarf Scrub D composed of a mix of proteaceous species on sand

Vegetation unit SM3 was mapped in the Dunn Rock, UCL and Lake Magenta South sections (Figures 2, 3, 8, 10, 12 and 13). Generally, this vegetation unit is characterised by a sparse (10-30% foliage cover) upper stratum dominated by *Eucalyptus pleurocarpa*, over a lower stratum of sparse (10-30% foliage cover) mixed understorey species, to a height of 1.5m, with occasional shrubs to 2m. Other *Eucalytpus* spp. recorded in this vegetation unit are *Eucalyptus flocktoniaea, Eucalyptus phaenophylla* subsp. *phaenophylla* and *Eucalyptus incrassata*. This vegetation unit recorded a high species richness, which is typical of sand-heath areas. A total of 89 native plant species were recorded as occurring within this vegetation unit.

Vegetation unit SM3 was mapped at several locations in the UCL (3030) section (Figures 12 and 13). Within the UCL (3030) section, it was mainly mapped on the slope of lateritic crests, on brown loamy-sand over laterite. It was characterised by a sparse (20-25% foliage cover) upper stratum to 3m of *Eucalyptus pleurocarpa*, with other mallee species such as *Eucalyptus phaenophylla* subsp. *phaenophylla* and *Eucalyptus ?incrassata*. A species-rich, mid-dense (30-50% foliage cover) mid-stratum of mixed species such as *Melaleuca pungens*, *Beaufortia schaueri*, *Hakea pandanicarpa* var. *crassifolia*, *Hakea cygna* subsp. *cygna*, *Petrophile seminuda*, *Dryandra pallida* and *Isopogon buxifolius* was present. The soils had a slightly higher lateritic content within the UCL (3030) section in comparison to the Lake Magenta South or Dunn Rock sections.

SM4 Open to Very Open Shrub Mallee of mixed *Eucalyptus* spp. including *Eucalyptus pleurocarpa* over Low Heath C of mixed species including *Beaufortia schaueri*, *Melaleuca thyoides*, *Hakea cygna* subsp. *cygna* and *Dryandra pteridifolia* subsp. *pteridifolia* on sand over laterite

Vegetation unit SM4 was mapped within the UCL (3030), Dunn Rock and Lake Magenta North sections of the survey area (Figures 5, 6, 8, 11, 12 and 13). The upper stratum is dominated by *Eucalyptus pleurocarpa* with various other species including *Eucalyptus ?uncinata*, *Eucalyptus ?incrassata* and *Eucalyptus ?phaenophylla* subsp. *phaenophylla* sometimes present. SM4 occurs mainly on lateritic low hills, with *Eucalyptus pleurocarpa* dominating on the crests, and the other mallee species present downslope. The upper stratum has a variable foliage cover, from very sparse (<10% foliage cover) to mid-dense (30% foliage cover), with approximately 3-4m height. The understorey is dominated mainly by a mix of Proteaceous and Myrtaceous species, with species such as *Beaufortia micrantha* subsp. *micrantha*, *Dryandra cuneata*, *Isopogon buxifolius* and *Hakea horrida*, as well as typical sand species such as *Allocasuarina microstachya*, *Lysinema ciliatum*, *Petrophile brevifolia* and *Schoenus brevisetis*. A total of 86 species were recorded within vegetation unit SM4 throughout the survey area.

Vegetation unit SM4 was mapped within several areas of the UCL (3030) section (Figures 12 and 13), and was a dominant vegetation unit within this section. Within the UCL (3030) section, vegetation unit SM4 exhibited a very sparse to sparse (10-30%) upper stratum dominated by *Eucalyptus pleurocarpa*, with other mallee species such as *Eucalyptus sporadica* and *Eucalyptus ?dissimulata* or *Eucalyptus ?albida* present. A mid-dense (40-70% foliage cover) mid-stratum of mixed species including *Beaufortia schaueri*, *Hakea cygna* subsp. *cygna*, *Eremaea pauciflora*, *Isopogon teretifolius, Hakea pandanicarpa* subsp. *crassifolia*, *Hakea prostrata*, *Synaphea spinulosa*, *Dryandra ?pallida*, *Banksia violacea* and *Melaleuca plumea*. *Allocasuarina pinaster* was also more prevalent in this section than in either Dunn Rock or Lake Magenta North.

McDonald Plot FR0208 was established in plant community SM4 within the UCL (3030) survey area (Figure 12). A total of 49 native plant species were recorded within the quadrat (100m^2). The dominant species recorded were:

Muir: Open Shrub Mallee over Low Scrub A over Low Heath D
Soil: Brown loamy-sand

U1:	Very Sparse (<10%)	*Eucalyptus pleurocarpa*
M1:	Sparse (10-30%)	*Hakea prostrata*
		Hakea cygna subsp. *cygna*
		Isopogon teretifolius subsp. *petrophiloides*
		Dryandra ?pallida
		Hakea pandanicarpa subsp. *crassifolia*
M2:	Mid-dense (30-70%)	*Banksia violea*
		Regelia inops
		Melaleuca plumea

Other species recorded within this quadrat included *Dryandra erythrocephala* subsp. *erythrocephala*, *Beaufortia schaueri*, *Isopogon buxifolius*, *Dryandra ferruginea* ?subsp. *ferruginea*, *Gahnia ancistrophylla*, *Petrophile circinata* and *Allocasuarina pinaster*.

SM5 Shrub Mallee of mixed *Eucalyptus* spp. over Heath B of mixed species including *Hakea multilineata*, *Spyridium microcephalum*, *Melaleuca leptospermoides*, *Dryandra pallida* and *Melaleuca* affin. *uncinata* on sand over laterite

Vegetation unit SM5 was mapped within the UCL (3030), Dunn Rock and Lake Magenta North sections of the survey area (Figures 4, 5, 8, 11, 12 and 13). It was mapped on higher ground dominated by laterite, and includes the indicator species *Hakea multilineata*. A total of 41 native plant species were recorded within this vegetation unit. In general, the upper stratum is dominated by *Eucalyptus pleurocarpa*, with other mallee species such as *Eucalyptus pileata*, *Eucalyptus phaenophylla* subsp. *phaenophylla* and *Eucalyptus ?olivina*, with a sparse to mid-dense (35%) foliage cover, with a height of up to 4m. *Hakea multilineata* appears sporadically, over a sparse (10-30% foliage cover) heath layer of mixed species including *Melaleuca leptospermoides*, *Isopogon buxifolius*, *Banksia violacea, Spyridium microcephalum*, *Grevillea huegelii*, *Callitris roei*, *Exocarpus aphyllus*, *Allocasuarina pinaster* and *Melaleuca adnata*.

Vegetation unit SM5 was mapped in three areas within the UCL (3030) section (Figures 12 and 13), on yellow/brown sand over laterite. Within the UCL (3030) section, this vegetation unit was characterised by a mid-dense (35% foliage cover) upper stratum dominated by *Eucalyptus phaenophylla* subsp. *phaenophylla*, with some *Eucalyptus pleurocarpa*, over very sparse *Hakea multilineata*. A sparse (<30% foliage cover) mid-stratum of mixed species including *Melaleuca leptospermoides*, *Dryandra pallida*, *Melaleuca* affin. *uncinata*, *Beaufortia schaueri*, *Allocasuarina acutivalvis* and *Allocasuarina pinaster*.

SM6 Shrub Mallee of mixed E*ucalyptus* spp., over Heath B/Low Scrub B of *Melaleuca* affin. *uncinata* over Low Heath C/D of a mix of species including *Melaleuca* spp., *Phebalium* spp. and *Daviesia benthamiana* on sand

Vegetation unit SM6 was mapped over the Lake Magenta South, Lake Magenta North, UCL (3030) and Dunn Rock sections (Figures 2, 4-13). In general, this vegetation unit was characterised by a sparse to mid-dense (20-40% foliage cover) upper stratum to four metres of mixed *Eucalyptus* spp, over a mid-stratum dominated by *Melaleuca* affin. *uncinata* of variable foliage cover, over a sparse to mid-dense lower stratum dominated by mixed *Melaleuca* species. Twelve fully identified *Eucalyptus* spp. were recorded within this vegetation unit, the most prominent being *Eucalyptus conglobata*, *Eucalyptus eremophila*, *Eucalyptus flocktoniaea* and *Eucalyptus scyphocalyx*. Thirteen fully identified *Melaleuca* spp. were recorded as occurring within the middle stratum, including *Melaleuca rigidifolia, Melaleuca societatis*, *Melaleuca sapientes*, *Melaleuca depauperata* and *Melaleuca coronicarpa*. Other understorey species identified within this vegetation unit were *Gahnia ancistrophylla*, *Cryptandra pungens*, *Baeckea pachyphylla*, *Beaufortia micrantha* subsp. *micrantha*, *Westringia cephalantha* and

Styphelia intertexta. A total of 121 native plant species were recorded in vegetation unit SM6.

Vegetation unit SM6 was mapped over several areas within the UCL (3030) section (Figures 12 and 13), on brown sandy-loam, sometimes overlain with bleached white sand. Within this section, vegetation unit SM6 was characterised by a mid-dense (30-40% foliage cover) upper stratum of mixed species, including *Eucalyptus eremophila*, *Eucalyptus conglobata*, *Eucalyptus scyphocalyx*, *Eucalyptus dissimulata* and *Eucalyptus flocktoniaea*, over a sparse to mid-dense (20-40% foliage cover) stratum of *Melaleuca* affin. *uncinata*. Mixed understorey species included *Phebalium canaliculatum, Daviesia benthamii*, *Hibbertia* affin. *nutans*, *Spyridium microcephalum*, *Leucopogon tamminensis* var. *australis*, *Styphelia intertexta*, *Leptospermum erubescens* and *Melaleuca societatis*.

SM9 Open Shrub Mallee of mixed *Eucalyptus* spp. over Open Scrub of *Banksia media* over mixed Low Scrub including *Melaleuca* affin. *uncinata* on brown loamy-sand

Vegetation unit SM9 was mapped as a distinct unit in the Dunn Rock section and Lake Magenta North , and as a mosaic with vegetation unit SM10 in UCL (3030) (Figures 5, 8, 9 and 12). This vegetation unit is characterised by the relatively dense *Banksia media* layer, under an upper stratum of various mallee *Eucalyptus* species. A total of 39 native species has been recorded for this vegetation unit. A mid-dense (30-50%) upper stratum of species such as *Eucalyptus ?olivina* and *Eucalyptus eremophila* covers a lower-upper stratum of *Banksia media*, which ranges in foliage cover from 5-30%. Other species recorded within this vegetation unit are *Callitris roei*, *Conostephium roei*, *Hakea laurina*, *Melaleuca depauperata, Melaleuca rigidifolia* and *Isopogon buxifolius*.

Within UCL (3030) (Figure 12) this unit had a mid-dense mid-stratum layer of *Melaleuca rigidifolia* (50% foliage cover), however had a distinct upper stratum of *Banksia media* also.

SM10 Open Shrub Mallee of mixed *Eucalyptus* spp. over Heath B dominated by a mix of *Melaleuca* spp. on grey/brown sandy-loam

Vegetation unit SM10 was mapped in the UCL (3030), Dunn Rock and the Lake Magenta North sections (Figures 5, 6, 8, 9, 10, 11, 12 and 13). A total of 86 native plant species were recorded within this vegetation unit over the entire survey area. This vegetation unit was characterised by a sparse to mid-dense upper stratum of mixed mallee *Eucalyptus* species, over a dense layer dominated by various *Melaleuca* shrubs. The upper stratum varied from very sparse (<10% foliage cover) to mid-dense (30-40% foliage cover), at heights between 3-6m. Mallee species recorded included *Eucalyptus phaenophylla* subsp. *phaenophylla*, *Eucalyptus eremophila*, *Eucalyptus scyphocalyx*, *Eucalyptus pileata* and *Eucalyptus perangustata*. The middle stratum dominated by *Melaleuca* species also varied in density, from mid-dense 45% to dense at greater than 80% cover. The most common dominant *Melaleuca* species were *Melaleuca societatis*, *Melaleuca rigidifolia* and *Melaleuca sapientes*, with other species such as *Melaleuca coronicarpa, Melaleuca adnata* and *Melaleuca lateriflora* subsp. *lateriflora* less common.

Vegetation unit SM10 was mapped over several areas within the UCL (3030) section (Figures 12 and 13). It was mapped in one area as a mosaic with vegetation type SM9. Within this section, the foliage cover of the upper stratum varied between 10-30%, and mallee species included *Eucalyptus phaenophylla* subsp. *phaenophylla*, *Eucalyptus eremophila*, *Eucalyptus pileata* and *Eucalyptus flocktoniaea*. The mid-stratum exhibits a mid-dense foliage cover between 40-70%, and included mixed *Melaleuca* spp. such as *Melaleuca societatis*, *Melaleuca adnata*, *Melaleuca rigidifolia*, with other species such as *Exocarpus sparteus*, *Hakea newbeyana*, *Astroloma* affin. *epacridis* and *Daviesia benthamii* contributing a very sparse cover.

4.5.3 Heaths

H1 Heath A dominated by *Callitris tuberculata*, *Melaleuca leptospermoides* and *Beaufortia micrantha*, over Open Low Sedges including *Lepidosperma* sp. A2 Island Flat (G. J. Keighery 2000), with emergent *Eucalyptus* spp., on brown loamy sand

Vegetation unit H1 was mapped in one location within the UCL (3030) section, on the western end near Tarco Rd (Figure 12), on brown loamy-sand. A total of 33 native plant species were recorded within this vegetation unit. It was characterised by a tall (2m), mid-dense (40% foliage cover) Heath, dominated by *Callitris tuberculata*, *Melaleuca leptospermoides* and *Hakea erecta*, over a sparse (to 15% foliage cover) mid-lower stratum including species such as *Beaufortia micrantha*, *Verticordia ?eriocephala*, *Verticordia ?chrysantha*, *Lepidosperma* sp. A2 Island Flat (G. J. Keighery 7000) and *Astroloma serratifolium*.

McDonald Plot FR0206 was established in plant community H1 within the UCL (3030) survey area (Figure 12). A total of 21 species was recorded within the quadrat ($100m^2$), including *Dryandra xylothemelia*, a P3 species. The dominant species recorded were:

Muir: Heath A over Dwarf Scrub C/D
Soil: Brown loamy-sand

U1:	Mid-dense (30-70%)	*Callitris tuberculata*
		Melaleuca leptospermoides
		Hakea erecta
M1:	Very Sparse (<10%)	*Beaufortia micrantha*
		Verticordia chrysantha
		Verticordia ?eriocephala
M2:	Very Sparse (<10%)	*Lepidosperma* sp. A2 Island Flat (G. J. Keighery 7000)
		Gahnia ancistrophylla
		Astroloma serratifolium

Other species recorded within this quadrat included *Lepidobolus ?preissianus, Baeckea crispiflora*, *Leucopogon dielsianus*, *Isopogon scabriusculus* and *Melaleuca plumea*.

H2 Low Scrub A dominated by *Allocasuarina ?campestris* over Low Heath C dominated by *Verticordia chrysantha* and *Verticordia ?eriocephala* on brown sandy loam

Vegetation unit H2 was mapped within the UCL (3030) and Dunn Rock sections (Figures 13 and 8). A total of 22 native plant species were recorded within this vegetation unit. It is characterised by a very sparse to sparse (5-15% foliage cover) upper stratum dominated by *Allocasuarina ?campestris*, over a mid-dense (30-40% foliage cover) mid-stratum of mixed species, including *Verticordia chrysantha*, *Verticordia ?eriocephala*, *Melaleuca lecanantha*, *Hibbertia ?exasperata* and *Leucopogon dielsianus*, on brown sandy-loam over laterite.

Within the UCL (3030) section (Figure 13), vegetation unit H2 was characterised by a sparse (15% foliage cover) upper stratum of *Allocasuarina ?campestris* (to 2m), over a mid-dense (35% foliage cover) mid-stratum dominated by *Verticordia chrysantha* and *Verticordia ?eriocephala*, with other species such as *Leucopogon dielsianus*, *Lepidosperma* sp., *Callitris tuberculata* and *Astroloma serratifolium*, on light brown clay-loam with some laterite.

4.5.4 Degraded and/or Modified Vegetation Units

One type of degraded and/or modified vegetation unit was recognised during this survey.

DEG1: Areas cleared for sand/gravel extraction

These areas were mapped only within the UCL (3030) sections, as the other sections are designated Nature Reserves, and were small in area. They were also free of weed infestation most likely due to the low rainfall experienced by the area.

5 DISCUSSION

5.1 Lake Magenta South Section

The vegetation of the Lake Magenta South section will be sensitive to fire, because a high proportion of the species present in the three vegetation units mapped (SM2, SM3 and SM6) are obligate serotinous seeding species. However, none of the species recorded during the survey will not regenerate after fire, and most serotinous species need fire or other disturbance to stimulate germination of seeds. The main factor to which such species are sensitive is the frequency of the fire or disturbance. Obligate seeder serotinous species present over this section include all *Hakea* spp., of which *Hakea pandanicarpa* subsp. *crassifolia*, *Hakea incrassata*, *Hakea cygna* subsp. *cygna*, *Hakea lissocarpha* and *Hakea corymbosa* are all present within at least two of the three vegetation units mapped in this section. Several *Dryandra* spp. are also obligate seeders, including *Dryandra nivea* subsp. *nivea*, *Dryandra ferruginea* subsp. *ferruginea* and *Dryandra pallida*, however two common species, *Dryandra erythrocephala* var. *erythrocephala* and *Dryandra pteridifolia* subsp. *pteridifolia* are lignotuberous and

therefore may resprout from fire. *Eucalyptus pleurocarpa* (Tallerack), present over all vegetation units in this section, would regenerate from an underground lignotuber after fire, however as with all other mallee species in this region it is slow growing. This resprouting would only occur if the lignotuber remains intact in the ground after chaining.

Vegetation unit SM2 also contains other fire sensitive species such as *Callitris roei* and *Allocasuarina microstachya,* which are obligate serotinous seeders. *Hakea baxteri* was also recorded within this area by Coates (1987), and is a species that also will be killed by fire. Other proteaceous species such as *Isopogon buxifolius, Petrophile seminuda* and *Isopogon trilobus* are also obligate serotinous seeders. *Xanthorrhoea nana* will resprout after fire, however enough time must be given between burns for this species to flower and set seed. Myrtaceous species present in SM2 such as *Agonis spathulata, Calothamnus gracilis* and *Beaufortia schaueri* are obligate seeders that store their seed in the soil.

Vegetation unit SM3 also would be sensitive to fire, as it contains a majority of obligate seeder serotinous species. The other mallee species present within this vegetation unit would also regenerate from fire, depending upon the lignotuber not being destroyed or ripped out of the ground during chaining operations. Of particular importance in this vegetation unit is the relatively high species richness. A long interval between fires is required to ensure that these species have adequate time to regenerate from seed, and set adequate seed before the next disturbance.

Vegetation unit SM6 has a relatively high species richness, with many obligate seeder serotinous species, including *Callitris roei* and *Callitris tuberculata*, as well as *Hakea* spp. and *Banksia media*. However, many *Melaleuca* spp. resprout after fire, including *Melaleuca* affin. *uncinata*, and *Dodonaea amblyophylla* may also do so. Species such as *Daviesia benthamii, Bossiaea preissii* and *Westringia cephalantha* will re-colonise after the fire event from soil-borne seed.

Overall, the resilience of vegetation in the Lake Magenta South section to fire will be dependent upon the frequency of burning. If burns are kept to one every ten to fifteen years, sufficient time will be available for species to either resprout or grow from soil-borne seed, and set seed again. This will also allow time for species richness to increase to pre-fire levels in these vegetation units. Destruction of the topsoil and lignotubers due to chaining operations should be kept to a minimum.

The overall intactness of this section is very good, given that this section is situated along the boundary of the reserve, and runs alongside a cleared fire-break and fenceline. There is a high risk of exposure of this section to weed invasion after chaining, due to the position of the section near cleared paddocks, and the prevailing winds of the area blowing west and south from paddocks towards the reserve. However, some protection to the north of this section will be provided by intact native vegetation. The main aim is to keep the time between disturbance due to chaining, and regeneration of native vegetation to a dense canopy cover as short as possible. This will be reliant on natural phenomena such as rainfall experienced over the region after burning.

The fauna in this area will include restricted species such as malleefowl, and species preferring water or woodland habitats due to the presence of open mallee over generally dense shrubs. The common fauna species noted during the survey was the Common Bronzewing (*Phaps chalcoptera*), and Western Brush Wallabies (*Macropus irma)*and Western Grey Kangaroos (*Macropus fuliginosus)*. As the full extent of these vegetation units was not mapped over the entire reserve, a quantitative estimate of the proportion of each unit within the proposed buffer cannot be made. However, as mallee communities dominate the reserve, it is unlikely that impacts on the fauna due to chaining and burning of these vegetation units will be significant. Initial impacts on the fauna will be on smaller, slow-moving animals (for example lizards) which will not be able to avoid either the heavy machinery or fires, however the width of the section to be disturbed (40m) is small and therefore impacts will be low.

The Lake Magenta South section will have the one of the highest erosion potentials identified in this survey. This is because of the sandy soils present over the section, and the lack of protection on the southern side of the section from the effects of wind due to the cleared paddocks. Erosion potential may be exacerbated by the use of heavy machinery during chaining operations. At present, no significant erosion of the firebreak exists, and the erosion potential of this area will be minimised if there is quick establishment of native vegetation after burning.

5.2 Lake Magenta North Section

The vegetation units over the Lake Magenta North section include both Shrub Mallee and Woodlands. There are differences in fire sensitivity between different vegetation units, with the Shrub Mallee areas less sensitive to fire than Woodland types. The shrub mallee species regenerate through resprouting after fire, whereas most tree *Eucalyptus* species are killed (if the fire is both hot and high enough), resulting in these species regrowing from seed. The majority of this section is covered by Shrub Mallee, and dominated by vegetation units SM6 and SM4. Vegetation unit SM6 is also present within the Lake Magenta South area, and is characterised by *Melaleuca* affin. *uncinata* which will resprout after fire. The majority of the species within this vegetation unit will either resprout or grow from seed, however the frequency of fire will determine whether or not these areas will be viable in the long-term. The fire sensitivities of vegetation units SM1, SM8, and SM11 will be similar to that of SM6, although many species such as *Kunzea* sp., *Acacia patagiata*, *Leucopogon fimbriatus* and *Leptospermum erubescens* will regenerate from seed.

Vegetation units SM4 and SM5 will have similar fire-responses to SM3, as they have a high species richness dominated by obligate seeder serotinous species, as well as obligate seeders with soil-stored seed. The frequency of fire is of higher importance than the effect of one single fire, as fire intervals that are more frequent than the primary juvenile phase of species present within these areas will result in gradual extinction of these species. The P3 species, *Bossiaea divaricata*, was also present within vegetation unit SM5. Individuals of this species will be killed by fire, however will regenerate from soil-stored seed. Species of the family Papilionaceae typically regenerate well after fire, and have relatively short life spans.

Vegetation units SM10, SM12, SM15 and SM16 will all respond similarly to fire, as the understorey layer is dominated by various *Melaleuca* spp., which either show resprouting characteristics, or germinate from seed. Much seed is produced by these species, which is mainly serotinous and therefore needs stimulation from disturbances such as fire for germination. The P1 species *Hibbertia ?carinata*, and the P2 species *Leucopogon florulentus* were recorded within the SM10 vegetation unit. These species will be killed by fire, and will regenerate from seed. It is not recommended that these areas be burnt any more frequently than approximately 10-15 years, to allow time for regeneration from seed and subsequent production of new seed to occur.

Vegetation unit SM9 contains a significant amount of *Banksia media*, which is a strongly obligate seeder species and will be destroyed by fire. However, the frequency of the fire regime is more important in the long term, and longer intervals between fire episodes will enable this species to survive.

Two Woodland vegetation units were mapped over this section, including two small sections of W4 and a large area of W3. One section of W4 contains the DRF species *Acacia leptalea*, which will be killed by fire. At time of survey all plants recorded of this species were adult, and fruiting. *Acacia* spp. generally respond well to fire, with increased germination after fire events, and therefore it is likely that an initial burn will regenerate new individuals. This species is also present on the other side of the current track, and therefore comparisons may be made post-fire of the regenerative effects of fire on this species. It was noted by Brown *et. al.* (1998) that the fire response of this species needs to be examined.

Eucalyptus incrassata has been shown to regenerate after fire by Wellington and Noble (1984) in their study into post-fire recruitment of mallee eucalypts in Australia. Although fire was shown to increase adult mortality, there was a subsequent increase in seed drop, seed germination and development after a fire episode in *Eucalyptus incrassata*. Therefore, this species will regenerate after fire however this regeneration will be slow.

Vegetation unit W3, which is dominated by *Eucalyptus platypus* is very sensitive to fire. This species will be killed by fire and needs to regenerate from seed. It is also a slow-growing species, which takes many years to reach a tall, closed canopy with open understorey structure, which is favoured by malleefowl as habitat. However, areas dominated by *Eucalyptus platypus* present within Lake Magenta North have previously been disturbed, and have not yet reached this stage. Although the vegetation of the entire Reserve has not been mapped, *Eucalyptus platypus*-dominated areas are not rare locally, and some stands of *Eucalyptus platypus* with a tall, closed canopy with open understorey exist within the Reserve. The impacts of chaining and burning the 40m wide strip proposed within this Lake Magenta section will cause little long-term impact to this vegetation unit.

The vegetation within the Lake Magenta North section is intact, with no weed invasion, or bare areas present. The weed invasion risk within this section is also very low, due to the presence of intact native vegetation for over ten kilometres both north and south of

the section. If weed invasion occurs it will do so on the western side of the section, where it adjoins cleared paddocks. The road reserve on the northern side of Townsend Road (extending to the west of Lake Magenta Reserve) provides a good buffer, however on the southern side of the road the reserve is thin, providing less protection on this side.

The influence on the fauna in this section will be limited to small, slower-moving species (e.g. lizards) which will be disturbed by the initial chaining and burning events. As the area to be disturbed is minimal, other more mobile species such as the majority of birds, reptiles and mammals will be able to move away from these areas. It is unlikely that malleefowl will be present within this section, due to the closed nature of the understorey throughout the section.

The erosion potential of this section is minimal in comparison to the Lake Magenta South section. It has less risk of wind erosion, due to the protection of the native vegetation on either side of the area. Although the majority of this section has sandy soils, most of this also contains clay, such as in areas of SM10, or laterite, such as in areas of SM4. Vegetation unit W3 is also found on heavy grey clay, which may be prone to water erosion (although little evidence was seen on tracks), however it is not prone to wind erosion. The eastern third of the section contained sandier soils, and therefore will be at greater risk of erosion, however the presence of surrounding intact native vegetation within this section will afford some protection.

5.3 Dunn Rock Section

The sensitivity of the Dunn Rock section to fire will be greater than either the Lake Magenta South or North sections, because of the presence of various Woodland vegetation units, and Heath vegetation units. These include woodlands dominated by *Eucalyptus argyphea* (Silver Mallet) (W1), *Eucalyptus occidentalis* (Flat Topped Yate) (W5) and *Eucalyptus salmonophloia* (Salmon Gum) (W6). All of these species are killed by fire, and must regenerate from seed. The maturation time of these vegetation units are also longer than those of Shrub Mallees, with *Eucalyptus salmonophloia* maturing at over 100 years, *Eucalyptus occidentalis* woodland on broad valley depressions at 70 years, and *Eucalyptus falcata* (*Eucalyptus argyphea* at present) woodland/low forest on sandplain at 50 years. These woodlands will all carry fire at approximately one third of maturation time (excluding *Eucalyptus salmonophloia* that was determined not to carry fire at all) (Martinick and Associates 1984).

The Heath vegetation units present within the Dunn Rock section will all be adversely affected by fire, as the majority of species recorded are obligate seeder serotinous species. Vegetation unit H2 is dominated by *Allocasuarina ?campestris*, and also includes other species such as *Allocasuarina microstachya*, *Callitris tuberculata*, *Hakea incrassata* and *Petrophile seminuda* which are all obligate seeder serotinous species. Other dominant species in this vegetation unit such as *Verticordia* spp. and *Leucopogon dielsianus* will regenerate from seed. Vegetation unit H3 is dominated by *Allocasuarina microstachya*, which is also an obligate seeder serotinous species, over the P3 species *Lepidosperma pruinosum*. *Lepidosperma pruinosum*, along with *Mesomelaena stygia*, are rhizomatous species, which will re-sprout after fire. The fire event may also stimulate

germination from seed. As no McDonald plot was placed in this Heath area, it is recommended that surveys for this species be undertaken in the years following the chain and burn procedures to determine the presence of this Priority species. Vegetation unit H4 also includes many obligate seeder serotinous species, such as *Hakea cygna* subsp. *cygna*, *Isopogon buxifolius*, *Isopogon teretifolius* subsp. *petrophiloides*, with *Dryandra erythrocephala* var. *erythrocephala* resprouting after fire. Other obligate seeders such as *Verticordia ?eriocephala*, *Baeckea* affin. *crispiflora* and *Beaufortia micrantha* var. *micrantha* all occur in this heath area.

Shrub Mallee vegetation units will have the same responses to fire as those in Lake Magenta South and North sections. Vegetation units SM6 and SM10 were the most dominant vegetation units mapped, although substantial areas of SM4 were also mapped. Shrub mallee species will resprout after burning, with many of the other species within these vegetation units either resprouting (including *Melaleuca* affin. *uncinata*), or regenerating from seed. The majority of species within the vegetation unit SM4 are serotinous obligate seeders.

The Priority 1 taxon *Melaleuca sculponeata* was recorded in both SM10 and SM6, and the P3 species *Calectasia obtusa* in vegetation unit SM6. Information is not available on whether *Melaleuca sculponeata* will resprout after fire, or only regenerate from seed. As most *Calectasia* spp. are rhizomatous, *Calectasia obtusa* will most likely resprout after fire. At time of survey it was flowering well, and may also regenerate from seed.

The estimated maturation time (Martinick and Associates 1984) of shrub mallees are in the order of 45-50 years, with the age that fire will be carried by these areas averaging around 15 years. One small area within the Dunn Rock Section (mapped SM9/SM14) is currently regenerating from fire, which probably occurred less than five years ago. It is not recommended that this area be burnt during this fuel reduction cycle.

The vegetation of the Dunn Rock section is intact, with little weed invasion occurring. Some weeds have invaded in the W5 vegetation unit, from the nearby paddock. This occurs through the transport of weed seeds during water movement in drainage lines. Large amounts of *Brassicaceae sp. (probably **Raphanus raphanistrum*) dead seed heads were also recorded along the length of the boundary fence, and up against the edge of the intact native vegetation. It is expected that after clearing and burning operations occur along this line, this species may become established to some degree. This will depend upon the season that the operations are undertaken in, and conditions such as rainfall at time of burning. Increased weed invasion in the W5 vegetation unit may also be experienced if this area is burned.

It is unlikely that malleefowl are present within the survey area, as the habitat includes mainly dense understorey stands which are not the preferred habitat of this species. It is unlikely that significant impacts on fauna will occur within the Dunn Rock section as a result of the planned fuel reduction operations, as the area of specialised habitats such as Woodlands and Heaths encountered were small.

The erosion potential of the soils within this section vary. Within the Woodland and Heath vegetation units the soils are mainly sandy-loam, include vegetation units such as SM7, SM9, SM10 and SM13. Areas covered by vegetation units SM3 and SM6 were predominantly sandy, with more sand in the soil in SM6 areas in the Dunn Rock section than in the Lake Magenta South or North sections. It is recommended that the time between chaining and vegetation regrowth in these areas be minimised by burning in autumn, to increase early vegetation regrowth.

5.4 UCL (3030)

Dominant vegetation units mapped on the UCL (3030) section were Shrub Mallees, and included SM4, with SM3, SM6 and SM10 also common. Mallee eucalypt species will resprout after a fire event, as long as the chaining operation doesn't disturb the lignotubers. The vegetation within SM4 was dominated by serotinous obligate seeders, including *Isopogon buxifolius*, *Dryandra cuneata*, *Hakea horrida* and *Allocasuarina microstachya*. These will be adversely affected by a high-frequency burning regime, however if managed properly the extinction of these species can be prevented. Responses to the chaining and burning operations of other shrub mallee vegetation units, such as SM3, SM5, SM6, SM9 and SM10, will be similar to those in the other sections where mapped.

Two Woodland vegetation units were mapped in the UCL (3030) section, dominated by *Eucalyptus argyphea* (Silver Mallet) and *Eucalyptus densa* (on a drainage line). Both *Eucalyptus argyphea* and *Eucalyptus densa* are sensitive to fire, and will regenerate from seed. It is not recommended that either of these areas be burnt.

The Heath vegetation units H1 and H2 will also be sensitive to fire, particularly H1, which is dominated by *Callitris tuberculata*. *Callitris tuberculata* is a serotinous obligate seeder, which will be killed by fire, although some of the larger, older individuals may survive. Therefore the time between seedling establishment and subsequent seed production must be shorter than the interval between fires. *Dryandra xylothemelia*, a P3 species, was also recorded in this vegetation unit. It is lignotuberous, and therefore will resprout after fire. The majority of species in the vegetation unit H2 are also serotinous obligate seeders, including *Allocasuarina ?campestris* and *Callitris tuberculata*. Other species such as *Verticordia chrysantha*, *Verticordia ?eriocephala* and *Leucopogon dielsianus* will regenerate from seed.

The vegetation of the UCL (3030) section is intact, with little weed invasion throughout, including edges of the existing gravel pits. There is a potential for weed invasion to occur after the chaining and burning operations, due to the close proximity of cleared paddocks along the southern boundary on both the eastern and western ends of the section. Impact on the fauna of the UCL (3030) section will be minimal due to the large extent of typical shrub mallee vegetation throughout the section, and the relatively small area which will be disturbed during the chaining and burning operations. The impact to fauna will also be minimised by avoiding operations in Woodland areas.

The majority of the UCL (3030) section occurs on soils which are either a sandy-loam, or underlain by laterite, with significant patches of laterite outcropping in some areas. The erosion potential of these areas is not significant. Vegetation units SM3 and SM6 contained greater amounts of sand than other shrub mallee units, and therefore have the greatest risk of erosion. The large extent of intact native vegetation to the north of the section may afford this area some protection from winds that blow mainly from the west. It is important that the time between initial chaining and regrowth of vegetation is minimised over all areas, and particularly in areas with sandier soil.

6 RECOMMENDATIONS

The following recommendations are made based on the results of the flora and vegetation survey.

- During chaining operations, the disturbance of topsoil must be minimised as far as practicable by minimising vehicle and machine traffic through the vegetation. This includes the minimisation of disturbance of mallee eucalypt lignotubers. Although this cannot be totally avoided, minimisation of disturbance to the topsoil will result in less chance of weed invasion.
- The time between initial chaining and regrowth of vegetation must be minimised. This includes a short time between chaining and burning (no more than six weeks), and in a season that is suitable for regrowth, preferably in autumn. This is prior to the winter rains which will help seedling growth, and will result in reduced water stress for seedling survival.
- Vegetation units W1, W5 and W6 not to be chained or burnt. This may require management at time of burning to prevent the control burn leaving the designated areas. Vegetation unit W3 covers large areas of the Lake Magenta North section and is a result of previous burns. Although this vegetation unit is slow growing, it is well represented in other areas of the reserve, and would be very difficult to exclude from the fuel reduction operations.
- Chaining operators must be notified of the locations of the established McDonald plots, to avoid destruction of the north-west peg. It is recommended that prior to chaining a small wooden dumpy peg be positioned in this corner. This is less likely to be lost during the chaining.
- An appropriate frequency of burning must be determined. This should take into account both regrowth of the sections, life-history of the dominant species and potential negative effects of high-frequency burning. Data from previous studies on serotinous obligate seeders shows that these species are the ones most at risk from high-frequency fires, but also require some burning to stimulate new growth to avoid complete senescence. It is recommended that a minimum 15 year interval be kept between burning episodes.
- Established McDonald plots should be re-surveyed in the spring following the initial chaining and burning. This will include recording the foliage cover, health and height of all species within the $100m^2$ quadrat, the presence and foliage cover of upper stratum species within the $400m^2$ quadrat, and a Muir description of the vegetation at that time.

- It is recommended that the McDonald plots are monitored during spring every year for the first five years, then every two years thereafter. All species that appear in these plots should then be recorded, along with their cover, to produce a record of the succession of the vegetation within each of these units. This will provide information on the length of time various species require before re-establishing themselves, and the appearance of new species after fire.
- Particular attention must be paid to the population of the DRF species *Acacia leptalea*, which is present in the Lake Magenta North section. It is predicted that this species will be killed outright by the fire, but will regenerate from soil-stored seed, and may increase in number after the fire event. The response to fire (or any other disturbance) is not known at present and therefore difficult to predict.
- The risk of problems such as weed invasion and erosion are the least within the Lake Magenta North section, with all other sections sharing significant boundaries with cleared paddocks. Weed invasion may become a problem in the other three areas if the ground is left open for a considerable period of time, especially in spring. The fuel reduction area within the UCL (3030) section will only need to be chained and burned if the existing Old Newdegate Rd which separates the UCL (3030) from the Dunn Rock Nature Reserve is not wide enough to act as an effective fire barrier, in which case managment will need to consider a narrower width, for example 20m.
- Statistical comparison of post chaining and burning data with the pre-operation data should be conducted. Comparisons should initially focus on species presence to identify re-colonisation patterns, with *t* tests conducted annually on total cover and species richness for each quadrat. Full comparison of pre and post operation foliage cover data should be undertaken using *t* test methods for significant species at the 5 year monitoring and each monitoring after that to determine recovery of post operation communities. In addition to the *t* test methods, generation of similarity indices for each quadrat comparing pre and post operation data, utilising the full dataset, will provide a measure of progress toward pre operation condition.

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Appendix C: Photographic Record of McDonald Plots, Fuel Reduction Survey Area

Photograph 1: Plot FR0201, vegetation unit SM3

Photograph 2: Plot FR0202, vegetation unit SM15

Appendix C: Photographic Record of McDonald Plots, Fuel Reduction Survey Area

Photograph 3: Plot FR0203, vegetation unit W3

Photograph 4: Plot FR0204, vegetation unit SM6

Appendix C: Photographic Record of McDonald Plots, Fuel Reduction Survey Area

Photograph 5: Plot FR0205, vegetation unit SM10

Photograph 6: Plot FR0206, vegetation unit H1

Appendix C: Photographic Record of McDonald Plots, Fuel Reduction Survey Area

Photograph 7: FR0207, vegetation unit SM6

Photograph 8: FR0208, vegetation unit SM4

Appendix C: Photographic Record of McDonald Plots, Fuel Reduction Survey Area

Photograph 9: Plot FR0209, vegetation unit H4

Photograph 10: Plot FR0210, vegetation unit SM5

APPENDIX D: FIELD SHEET INFORMATION

PLANT IDENTIFICATIONS

Number	Species Name
FR0201-1	*Hakea corymbosa*
FR0201-2	*Hakea corymbosa*
FR0201-3	*Hakea obliqua* subsp. *obliqua*
Fr0201-4	*Calothamnus quadrifidus*
FR0201-5	*Petrophile squamata* subsp. *squamata*
FR0201-6	*Petrophile seminuda*
FR0201-7	*Allocasuarina thuyoides*
FR0201-8	*Daviesia lancifolia*
FR0201-9	*Acacia consanguinea*
FR0201-10	*Daviesia incrassata* subsp. *incrassata*
FR0201-11	*Cryptandra pungens*
FR0201-12	*Verticordia ?endlicheriana*
FR0201-13	*Verticordia ?pennigera*
FR0201-14	*Melaleuca pungens*
FR0201-15	*Melaleuca tuberculata* var. *macrophylla*
FR0201-16	*Petrophile glauca*
FR0201-17	*Petrophile teretifolia*
FR0201-18	*Leucopogon* sp. Coujinup (Burgman 1085)
FR0201-19	*Chamaescilla spiralis*
FR0201-20	*Acacia stenoptera*
FR0201-21	*Lepidobolus chaetocephalus*
FR0201-22	*Anarthria polyphylla*
FR0201-23	*Conostylis deplexa*
Fr0201-24	?*Neurachne alopecuroidea*
Fr0201-25	*Lepidosperma* sp. A2 Island Flat (G.J. Keighery 7000)
FR0201-26	*Chamaexeros serra*
FR0201-27	*Mesomelaena stygia* subsp. *stygia*
FR0201-28	*Laxmannia ?paleacea*
FR0201-29	*Verticordia* sp.
Fr0201-30	*Grevillea dolichopoda*
FR0201-31	*Jacksonia racemosa*
FR0201-32	*Hibbertia gracilipes*
FR0201-33	*Lepidosperma brunonianum*
FR0201-34	?*Tricoryne tenella*
FR0201-35	*Eucalyptus incrassata*
FR0201-36	*Verticordia ?pennigera*
FR0201-37	*Calytrix leschenaultii*
FR0201-38	*Grevillea wittweri*

Number	Species Name
FR0202-1	*Melaleuca* affin. *uncinata*
FR0202-2	*Hakea newbeyana*
FR0202-4	*Acacia patagiata*
Fr0202-5	*Grevillea oligantha*
Fr0202-6	*Acacia leptalea*
FR0202-7	*Phebalium tuberculosum*
FR0202-8	*Dillwynia divaricata*
FR0202-9	*Cryptandra minutifolia* subsp. *brevistyla*
Fr0202-10	*Hibbertia gracilipes*
FR0202-11	*Westringia cephalantha*
FR0202-12	*Leucopogon fimbriatus*
FR0202-13	*Trymalium elachophyllum*
FR0202-14	*Grevillea patentiloba* subsp. *patentiloba*
Fr0202-15	*Dodonaea amblyophylla*
FR0202-16	*Rinzia communis*
FR0202-17	*Eucalyptus conglobata*
FR0202-18	*Eucalyptus scyphocalyx*
FR0202-19	*Eucalyptus annulata*
FR0202-20	*Eucalyptus conglobata*
FR0202-21	*Eucalyptus phaenophylla* subsp. *phaenophylla*
FR0203-1	*Melaleuca cuticularis*
Fr0203-2	*Hakea commuta*
FR0203-3	*Pultenaea ?adunca*
FR0203-4	*?Kunzea micrantha* subsp. *oligandra* or *Melaleuca* sp.
FR0203-5	*Melaeluca rigidifolia*
FR0204-1	*Eucalyptus dissimulata*
FR0204-2	*Eucalyptus phaenohylla* subsp. *phaenophylla*
FR0204-3	*Adenanthos glabrescens* subsp. *glabrescens*
FR0204-4	*Phebalium lepidotum*
FR0204-5	*Beaufortia micrantha* var. *micrantha*
FR0204-6	*Melaleuca rigidifolia*
FR0204-7	*Melaleuca glaberrima*
FR0204-8	*Melaleuca tuberculata* var. *macrophylla*
FR0204-9	*Acacia lasiocarpa* var. *bracteolata*
FR0204-10	*Kunzea ?jucunda*
FR0204-11	*Conostephium drummondii*
FR0204-13	*Leucopogon tamminensis* var. *australis*
FR0204-14	*Cryptandra minutifolia* subsp. *brevistyla*

Number	Species Name
FR0204-15	*Melaleuca depauperata*
FR0204-16	*Desmocladus pyriocladus*
FR0204-17	*Grevillea dolichopoda*
FR0204-18	*Rinzia communis*
FR0204-19	*Billardiera sericea*
FR0204-20	*Cassytha glabella* forma *dispar*
FR0204-21	*Eucalyptus ?phaenophylla* subsp. *phaenophylla*
FR0204-22	*Eucalyptus ?scyphoclayx*
FR0205-1	*Eucalyptus flocktoniaea*
FR0205-2	*Eucalyptus alipes* ms
FR0205-3	*Eucalyptus ?phaenophylla* subsp. *phaenophylla*
FR0205-4	*Eucalyptus scyphocalyx*
FR0205-5	*Eucalyptus* sp.
FR0205-6	*Melaleuca societatis*
FR0205-7	*Melaleuca rigidifolia*
FR0205-8	*Melaleuca subfalcata*
FR0205-9	*Leucopogon florulentus*
FR0205-10	*Daviesia decipiens*
FR0205-13	*Baeckea* affin. *corynophylla*
FR0205-15	*Dryandra tenuifolia* var. *reptens*
FR0205-16	*Grevillea huegelii*
FR0205-17	*Hibbertia ?carinata*
FR0205-19	*Thomasia microphylla*
FR0205-20	*Lomandra micrantha* subsp. *teretifolia*
FR0205-22	*Stylidium ?repens*
FR0205-23	*Hibbertia ?carinata*
FR0205-24	*Melaleuca lateriflora* subsp. *lateriflora*
FR0205-25	*Persoonia teretifolia*
FR0205-26	*Hibbertia ?gracilipes*
FR0205-27	*Phebalium lepidotum*
FR0205-28	*Eucalyptus conglobata*
FR0205-29	*Eucalyptus scyphocalyx*
FR0205-30	*Eucalyptus phaenophylla* subsp. *phaenophylla*
FR0206-1	*Callitris tuberculata*
FR0206-2	*Mirbelia multicaulis*
FR0206-3	*Lepidosperma brunonianum*
FR0206-4	*Acacia multispicata*
FR0206-5	*Comesperma volubile*

Number	Species Name
FR0206-6	*Isopogon scabriusculus*
FR0206-7	*Melaleuca plumea*
FR0206-8	*Calytrix ?breviseta* subsp. *stipulosa*
FR0206-9	*Schoenus calcutus*
FR0206-10	*Dryandra xylothemelia*
FR0207-1	*Eucalyptus perangusta*
FR0207-2	*Eucalyptus conglobata*
FR0207-3	*Eucalyptus sporadica*
FR0207-4	*Santalum murrayanum*
FR0207-5	*Melaleuca glaberrima*
FR0207-6	*Melaleuca sculponeata*
FR0207-7	*Spyridium microcephalum*
FR0207-8	*Acacia sphacelata* subsp. *sphacelata*
FR0207-9	*Melaleuca ?bromelioides*
FR0207-10	*Phebalium obovatum*
FR0207-11	*Olearia exiguifolia*
FR0207-12	*Rinzia communis*
FR0207-13	*Westringia rigida*
FR0207-14	*Melaleuca plumea*
FR0208-1	*Hakea prostrata*
FR0208-2	*Hakea cygna* subsp. *cygna*
FR0208-3	*Isopogon teretifolius* subsp. *petrophiloides*
FR0208-4	*Dryandra ?pallida*
FR0208-5	*Petrophile circinata*
FR0208-6	*Dryandra erythrocephala* subsp. *erythrocephala*
FR0208-7	*Regleia inops*
FR0208-9	*Melaleuca* sp.
FR0208-10	*Petrophile cyathiforma*
FR0208-11	*Isopogon villosus*
FR0208-12	*Verticordia integra*
FR0208-13	*Gastrolobium crassifolium*
FR0208-14	*Daviesia audax*
FR0208-15	*Dryandra ferruginea* ?subsp. *ferruginea*
FR0208-16	*Pultenata ?verruculosa*
FR0208-17	*Hibbertia ?verrucosa*
FR0208-18	*Verticordia sp.*
FR0208-19	*Hibbertia gracilipes*
FR0208-20	*?Verticordia* sp.

Number	Species Name
FR0208-21	*Cryptandra leucopogon*
FR0208-23	*Conostylis argentea*
FR0208-24	*Rinzia affinis*
FR0208-25	*Schoenus* sp.
FR0208-26	*Hakea horrida*
FR0208-27	*Eucalyptus ?dissimulata* or *Eucalyptus ?albida*
FR0209-1	*Grevillea shuttleworthiana subsp. obovata*
FR0209-2	*Verticordia ?chrysantha* or *Verticordia ?chrysanthella*
FR0209-3	*Verticordia ?eriocephala*
FR0209-4	*Melaleuca plumea*
FR0209-5	*Baeckea* affin. *crispiflora*
FR0209-6	*Daviesia sarissa* subsp. *sarissa*
FR0209-7	*Allocasuarina microstachya*
FR0209-8	*Dampiera* sp.
FR0209-9	*Allocasuarina microstachya*
FR0209-10	*Stylidium squamellosum*
FR0209-11	*Cryptandra leucopgon*
FR0209-12	*Verticordia* sp. or *Calytrix* sp.
FR0209-13	*Lepidosperma brunonianum*
FR0209-14	*Daviesia ?brachyphylla*
FR0209-15	*Gastrolobium crassifolium*
FR0209-16	*Conostylis ?argentea*
FR0209-17	*Leucopogon dielsianus*
FR0209-18	*Chorizema aciculare* subsp. *aciculare*
FR0209-19	*Olax benthamiana*
FR0209-20	*Psammomoya choretroides*
FR0209-21	*Calectasia grandiflora* subsp. Wheatbelt (A.M.Coates 4315)
FR0209-23	*Grevillea cagiana*
FR0209-24	*Leptospermum nitens*
FR0210-1	*Eucalyptus scyphocalyx*
FR0210-2	*Eucalyptus phaenophylla* subsp. *phaenophylla*
FR0210-3	*Eucalyptus scyphocalyx*
FR0210-4	*Eucalyptus scyphocalyx*
FR0210-5	*Spyridium microcephalum*
FR0210-6	*Grevillea patentiloba* subsp. *patentiloba*
FR0210-7	*Hakea laurina*
FR0210-8	*Lasiopetalum* sp.
FR0210-9	*Bossiaea divaricata*

Number	Species Name
FR0210-10	*Daviesia scoparia*
FR0210-11	*Platysace maxwellii*
FR0210-12	*Acacia bidentata*
FR0210-13	*Hibbertia* sp.
FR0210-14	*Westringia cephalantha*
FR0210-15	*Cassytha melantha*
FR0210-16	*Boronia crassifolia*
FR0210-17	*Lepidosperma* sp.
FR0210-18	*Leucopogon fimbriatus*
FR0210-19	*Eucalyptus uncinata*