*August 2008*

# KOOLANOOKA – BLUE HILLS DIRECT SHIPPING ORE (DSO) MINING PROJECT SIGNIFICANT FLORA MANAGEMENT PLAN

*Providing sustainable environmental strategies, management and monitoring solutions to industry and government.*

ecologia ENVIRONMENT

Midwest Corporation Limited

# KOOLANOOKA AND BLUE HILLS

# SIGNIFICANT FLORA MANAGEMENT PLAN

Midwest Corporation Limited

**August 2008**

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# 1.0 ISSUE

Midwest Corporation Limited (Midwest) proposes to develop two areas where iron ore mines were abandoned in the 1970s. One of the areas is the old Koolanooka mine pit at Koolanooka Hills, and the other is the Mungada iron ore pits and waste dumps at Blue Hills. Koolanooka Hills is located in the Shire of Morawa in the Wheatbelt Region and Blue Hills in the Shire of Perenjori in the southern Murchison Region in Western Australia. Both project areas are on Banded Iron Formation (BIF) ranges.

Mining is proposed to resume at Tenement Numbers M70/1012, M70/1013 and M70/1014 at Koolanooka Hills (4.46 ha total area), and M59/0595 and M59/0596 at Blue Hills (52.5 ha of newly and previously disturbed land). As part of the mine feasibility studies, and to facilitate the environmental legal approvals processes, an assessment of the flora and vegetation of the proposed project areas was required. Midwest commissioned *ecologia* Environment Pty Ltd (*ecologia*) to carry out a vegetation and flora survey in two specific areas proposed for clearing to permit an extension of both the Koolanooka and Blue Hills mine sites. The vegetation and flora of the proposed mine sites were surveyed in July, September and October 2006 and in February, June and August 2007. A total of 20.75 person days was invested in the survey work. The floristic field survey involved a combination of systematic flora sampling using quadrats, and ground truthing using a series of linked field traverses to maximise coverage of the areas.

The survey methods adopted by *ecologia* were formulated on the basis of the Environmental Protection Authority's Guidance Statement No. 51: Guidance Statement for Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia (Table S.1), and in consultation with DEC and regional experts.

One threatened ecological community at Koolanooka, and five species of conservation significance were recorded in remnant vegetation at Blue Hills in the areas planned to be cleared for the mines. One Declared Rare Flora species was recorded, *Acacia woodmaniorum*, one Priority 1 species, *Micromyrtus acuta* Rye and two Priority 3 species *Micromyrtus trudgenii* and *Persoonia pentasticha* (*ecologia*, 2007).

The objective of this plan is to maintain the abundance, diversity, geographic distribution and productivity of the significant flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.

# 2.0 CURRENT STATUS

**Koolanooka Hills**

The Koolanooka mine site is located within the Shire of Morawa approximately 165 km east-south-east of the Port of Geraldton. Surrounding lands covered by the Project mining leases are generally held freehold by local farmers and pastoralists.

The mine site is at the north-western end of Koolanooka Hills, which rise approximately 140 m above the surrounding undulating plain striking north north-west to south south-east for 13 km. These hills are composed of BIF, which is preferentially resistant to erosion.

The Koolanooka mine site was previously mined from 1966 to 1972 as part of the Geraldton Operations Joint Venture (GOJV) and a large proportion of the land north of Koolanooka Springs Road has been previously disturbed.

The plains surrounding Koolanooka Hills are generally used for agriculture, predominantly wheat and sheep farming.

**Blue Hills**

The Blue Hills mine is located on Karara Station within the Shire of Perenjori approximately 220 km east of Geraldton and 60 km east of Koolanooka. The Blue Hills range also consists of BIF and the name given to this ridge line is Windaning Ridge. Dips are generally steep and where the ironstones outcrop the topography is often rugged.

Exploration was conducted for iron ore deposits in the area in the 1960s and 1970s and two high grade iron ore deposits, Mungada East and Mungada West, were mined between 1970 and 1972. Records show that the Mungada West mine was still in high grade ore when mining ceased following the satisfaction of the supply contracts then in place.

The area surrounding Blue Hills was formerly a pastoral lease, but is now CALM (now DEC) Purchased Lease (CPL) 16 (Karara Station) vested with the Conservation Commission, and is under direct management by the Department of Environment and Conservation; a Conservation Park is proposed for the area.

## 2.1 Climate

The general area, within which both project areas lie, has an annual average minimum temperature range of 12-15˚C and an annual average maximum temperature range of 21-24˚C. The area experiences a low to moderate indexed rainfall variability; with an average of 300-400 mm of rain falling per annum (BoM accessed online 02/04/08).

**Koolanooka Hills**

The climate at Koolanooka Hills is considered semi-arid or warm Mediterranean (Beecham, 2001) with mild, wet winters and hot, dry summers. Winter rains are generally associated with frontal systems from the south-west, which weaken considerably when they reach the Morawa district, while summer rains are associated with isolated thunderstorms (ATA, 2004b).

The mean annual rainfall (measured at Morawa) is 326.6 mm, and the average monthly rainfall ranges from 9 mm in December to 60 mm in June. The mean monthly maximum daily temperatures range from 18˚C in July to 37˚C in January (BoM accessed online 02/04/08).

**Blue Hills**

Blue Hills lies in the semi-desert Mediterranean bioclimatic region and experiences mild, wet winters and hot, dry summers. According to Bennett (2004) the nearest weather recording station is at Paynes Find. The mean annual rainfall at Paynes Find is 239.4 mm and the average monthly rainfall ranges from 10 mm in October to 43 mm in June. The mean monthly maximum temperatures range from 18˚C in July to 37˚C in January (BoM accessed online 02/04/08).

## 2.2 Topography and Landforms

**Koolanooka Hills**

The Koolanooka Hills occur in the Avon Wheatbelt subregion of the Southwest Botanical Province (Interim Biogeographic Regionalisation for Australia - IBRA) (FloraBase, 2008). The Avon Wheatbelt is an area of active drainage on residual lateritic uplands and derived sandplains in the Yilgarn Craton and this particular subregion is rich in endemics.

Three land systems are associated with the Koolanooka area;

- Koolanooka Land System (comprises the Koolanooka Hills)

- Noolagabbi Land System (associated with the level and gently inclined flats and lower slopes surrounding the Koolanooka Land System and is often associated with a saline drainage network); and

- Pindar Land System (associated with the gently undulating sandplain with long, gentle slopes to the southeast of the Koolanooka Hills) (ATA, 2004b)

The Koolanooka Hills occur in the Perenjori geographical region (Hocking *et al*., 1982) and form a range of rolling to very steep low hills. The iron ore deposit occurs at the northern end of Koolanooka Hills that form a 13 km long zone of Archaean rocks with a sedimentary sequence overlain by, and interbedded with, various banded iron formations (BIF). The BIF at Koolanooka is more than 200 m thick and the iron content is higher in the weathered surface zones than in the primary banded iron formation. The soils of Koolanooka Hills are generally rocky with gradational red, gravely loams and are characterised by sand over gravel and shallow soils on granite or gneiss (ATA, 2004a). Prominent ridges such as the Koolanooka Hills reach up to 450 m AHD, about 100 m above plain level (Rockwater Pty Ltd, 2004).

**Blue Hills**

Blue Hills occur in the Yalgoo IBRA bioregion of the Eremaean Province (FloraBase, 2008). The Yalgoo bioregion is an interzone between the South-western Bioregions and the Murchison. This subregion, in the western Yilgarn Craton, typically has earth to red sandy earth plains and is particularly rich in ephemerals (Desmond & Chant, 2001) and falls within the Tallering Land System (Payne *et al*., 1998). The Yalgoo bioregion has two subregions; the Edel subregion (YAL1) and the Tallering subregion (YAL2) within which Blue Hills lies (EPA, 2006).

The main Land Systems in close proximity to the Blue Hills mine sites are the Tallering, Yowie and Pindar Land Systems (Payne *et al*., 1998).

The Yowie Land System is dominated by loamy plains and has soils of variable depth that include red clayey sands, hardpan loams and red earths on hardpan. Smaller areas of variable depth red clayey sands with ferruginous gravel over hardpan and deep red earths and juvenile alluvial deposits occur on the gravely plains and narrow drainage tracts of the land system (Payne *et al.*, 1998).

The Pindar Land System is associated with loamy plains surrounded by sandplain. Soils of the loamy plains are deep and shallow red earths on hardpan and occasionally shallow red clayey sands on hardpan. The soils of the sand sheet areas are deep red clayey sands (Payne *et al*., 1998).

The Tallering Land System is comprised predominantly of ridges and hills (generally linear) of Archaean BIF, dolerite and sedimentary rocks (including schist, mantles of platy cobbles and stones). These ridges and hills support Bowgada (*Acacia ramulosa*) [syn. *Acacia linophylla*] and other *Acacia* shrublands with undershrubs such as *Thryptomene* and *Eriostemon* species. The geographic relief of the system can be up to 200 m but is generally much less (Payne *et al*., 1998) and in the central Tallering Land System relief ranges from 30 m to 300 m. In this area the BIF and other meta-sedimentary rocks are associated with the Warriedar Fold Belt (Markey & Dillon, 2006). Prominent ridges occurring in the eastern sector (such as Blue Hills) have the highest elevations and exceed 500 m AHD (Rockwater Pty Ltd, 2004).

## 2.3 Geology

The geology of both the study areas is similar being Archaean granites with infolded metamorphics of the Yilgarn Craton (Beard, 1976). The Yilgarn Craton is composed mainly of granites and gneisses, with minor infolded belts of metamorphic and sedimentary rocks. The metamorphic rocks are older than the granite and consist of a wide variety of rocks, including chemical sedimentary rocks of banded ironstone, and tend to form (mineralised) ranges of hills (Beard, 1976). The low ranges of hills are formed from outcrops of Archaean metamorphic rocks and include highly ferrous banded ironstone ridges tending SW-NE (Beard, 1976). Chains of salt lakes, reflecting an ancient drainage system, now only function in very wet years and occur on an ancient peneplain with low relief and have no connected drainage (Beecham, 2001).

## 2.4 Hydrology and Soils

Groundwater recharge from rainfall may vary depending on rainfall conditions such as seasonal and annual variations in total rainfall and the intensity, duration and frequency of rainfall events. It is also affected by topography and drainage, soil cover, rock-types, land-use and other factors (Australian Natural Resources Atlas, [online] (a)). Large groundwater supplies are not uncommon on the Yilgarn Craton. Small water supplies are provided from bores and wells located to access groundwater from the Cainozoic sediments or weathered bedrock at hydrogeologically favourable sites (Rockwater Pty Ltd, 2006).

Drainage is mainly weak and low-gradient, predominantly to the palaeodrainage system which passes a few kilometres to the north of Koolanooka Hills, and includes the Yarra Yarra Lakes to the west of Carnamah. The major surface-water palaeodrainage would almost certainly have an associated palaeochannel sand aquifer (buried channel) containing hypersaline groundwater generally at depths of 50 to 100 m (Rockwater Pty Ltd, 2004).

Yarra Yarra Lakes (Figure 2-1 below), in an area of low relief land, cover the central west inland catchment, (Australian Natural Resources Atlas, n.d.(b)), in which Koolanooka Hills and Blue Hills both occur, fresh groundwater is uncommon, generally being associated with hilly areas. Groundwater salinity generally increases markedly towards the lower parts of the landscape and with depth in bores (Rockwater Pty Ltd, 2006). In times of flood, the palaeodrainage carries surface water southwards to Moora; in normal years the lakes are local surface-water and groundwater sinks (Rockwater Pty Ltd, 2004).

The Koolanooka Mine is located 50 km east of the Darling fault. Fresh groundwater is uncommon, and is generally associated with hilly areas. The Koolanooka pit is reported to have produced water (at an unknown rate) when it was operated by Western Mining Corporation (Rockwater Pty Ltd, 2004).

At Blue Hills, negligible to small groundwater yields of fresh to marginal quality water were obtained from bores near Mungada West pit (Rockwater Pty Ltd (2006).

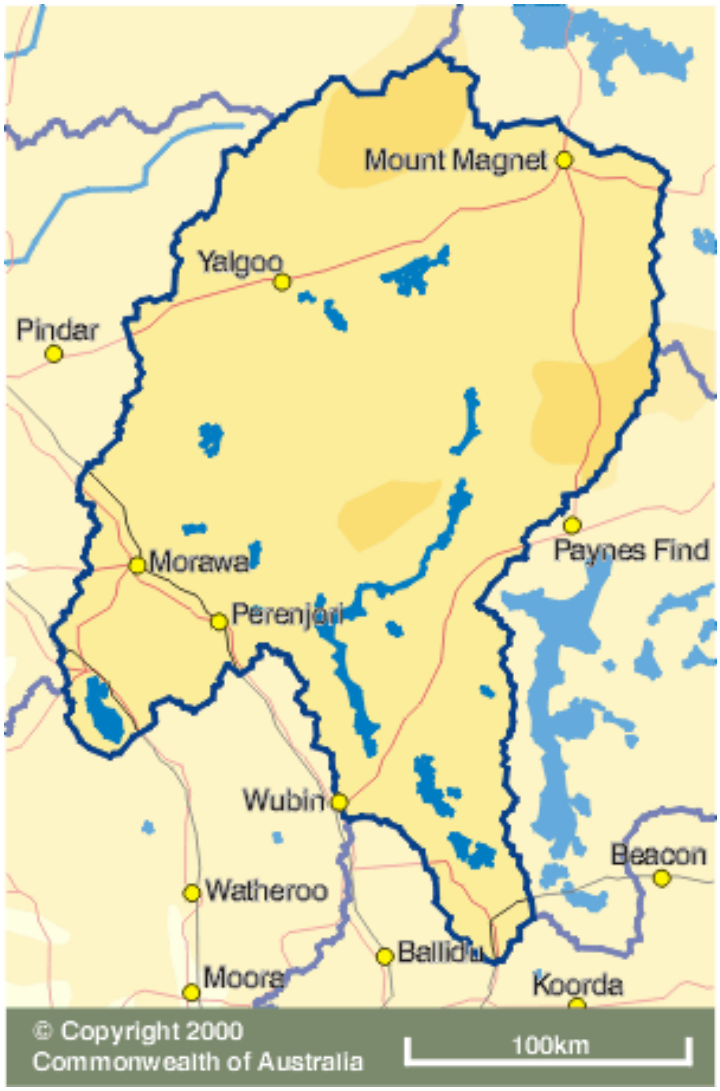



**Figure 2-1**: Yarra Yarra Lakes: Central west inland catchment (Sourced from: Australian Natural Resources Atlas n.d. (b))

## 2.5 Biogeography

The bioregions are defined on the basis of climate, geology, landforms, vegetation and fauna.

**Koolanooka Hills**

The Koolanooka Hills are located in the Avon Wheatbelt Bioregion (which has two subregions; Avon Wheatbelt 1 (AW1) of ancient drainage and Avon Wheatbelt 2 (AW2) of re-juvenated drainage) (Figure 2-2) occurring in the Southwest Botanical Province (FloraBase, 2008).

The Avon Wheatbelt 1 subregion, within which the Koolanooka Hills occur, is characterised by proteaceous shrub heaths on uplands and sandplains, mixed eucalypt, (*Allocasuarina huegeliana* and *Eucalyptus loxophleba*) woodlands on quaternary alluvials and eluvials (Beecham, 2001). This subregion is considered to be under high continental landscape stress, i.e. a high priority for the Comprehensive, Adequate and Representative (CAR) terrestrial reserve system. Two percent of this Interim Biogeographic Regionalisation of Australia (IBRA) subregion is protected (NRM Agencies, 2003), and 93% of native vegetation in the Avon-Wheatbelt bioregion has already been cleared (DoE, 2004). The total area of the AW1 subregion is 6,566,022 ha and 1.63% of this subregion is under formal conservation reserve (EPA, 2006).

**Blue Hills**

Blue Hills occurs in the IBRA Yalgoo Bioregion (which more recently has been divided into two subregions; the Edel subregion (YAL1) and the Tallering subregion (YAL2) (Figure 2-2) occurring within the Eremaean Botanical Province (EPA, 2006). The Yalgoo Botanical Province is characterised by low to open woodlands of *Eucalyptus, Acacia* and *Callitris* on red, sandy plains. This bioregion is considered to be under less continental stress (with respect to the CAR system) however, this lower rating is influenced by one large reserve in the extreme northern end (Toolanga Nature Reserve) and is not comprehensive or representative in terms of ecosystem representation. Tallering Peak (occurring at the northern end of the Tallering Land System) represents a rare range of ironstone and jaspilite that has unique vegetation complexes on it with low shrublands of *Thryptomene decussata* and *Eriostemon sericeus* which are classified as vulnerable (Desmond and Chant, 2001). Only 11.6% of the total Yalgoo Bioregion area is in the International Union for the Conservation of Nature (IUCN) conservation reserve (however the majority of this figure comes from the conservation reserve in the Edel subregion - YAL 2) and no vegetation complexes of the Tallering Peak ironstone range are held in reserve so are a high priority for ecosystem reservation (Desmond & Chant, 2001). The area of the Yalgoo Bioregion is 4,858,849 ha.

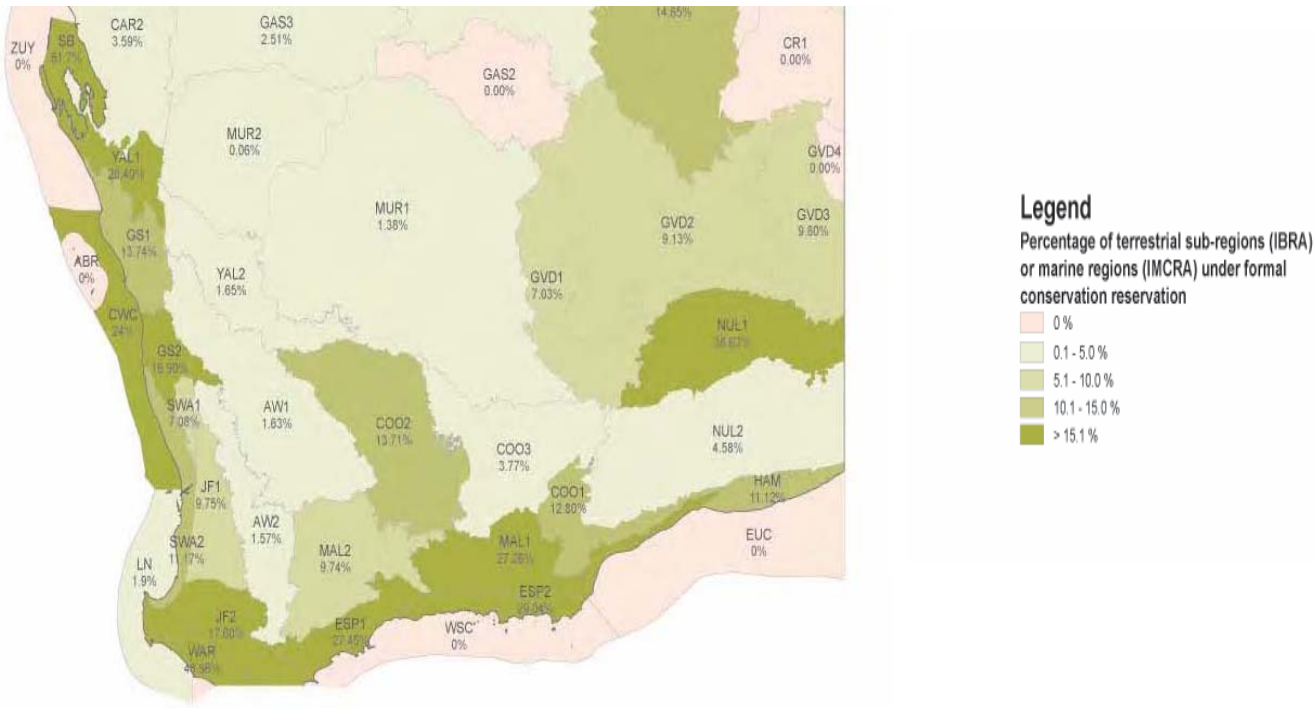



**Figure 2-2:** The proportion of terrestrial and marine subregions in Western Australia's formal conservation reserve system, June 2005.

Data source: Department of Conservation and Land Management in Environmental Protection Authority (2006).

## 2.6 Land use History

The typical landuse in the Yarra Yarra Lakes inland catchment has been cattle grazing on pastoral leases and some cereal production. Much of the land is vacant crown land (Australian Natural Resources Atlas, n.d. (b)).

The DeGrey - Mullewa Stock Route was the early access way taken by men and stock in the 1870s. This trail, which is now the main road north for vehicular traffic, features original Government wells and natural rockholes. The stock route went as far south as Tallering Peak, which is in the northern end of the Tallering Land System (Heritage Council, 1988).

# 3.0 FLORA AND VEGETATION

## 3.1 Previous Surveys

**Koolanooka Vegetation**

Beard's (1976) vegetation classification of Western Australia is commonly used to assist with the description of regional vegetation. The Koolanooka System is in Beard's Greenough Region within the Irwin Botanical District and this botanical district is in the southern Murchison Region of the Southwestern Botanical Province (Beard, 1976).

The vegetation associated with the Koolanooka System is described as consisting of several vegetation types (Beard, 1976). Vegetation Type 1 comprises open woodland of sheoak. Vegetation Type 2 comprises the mallee *Eucalyptus ebbanoensis, Acacia acuminata* and *Dodonaea inaequifolia* interspaced with thickets of *Allocasuarina campestris*. Vegetation Type 3 comprises *Acacia acuminata* thicket with *Grevillea stenostachya, Melaleuca cordata, M. nematophylla* and *M. radula,* and Vegetation Type 4 comprises *Eucalyptus loxophleba* (York Gum) woodland interspaced with the same thicket, which forms the vegetation pattern on the footslopes of Koolanooka Hills, while the granite outcrops support mixed *Acacia* spp. (*A. tetragonophylla, A. quadrimarginea* and *A. ramulosa*) (Beard, 1976).

In 2003 a vegetation and flora survey of Midwest's lease area in the Koolanooka Hills was undertaken by ATA. A total of 220 taxa, belonging to 117 genera and 43 families, were recorded from the Koolanooka Hills study area. This total included 207 native and 13 introduced or non-endemic species. The dominant plant families recorded were Asteraceae (26 taxa), Mimosaceae (21 taxa), Myrtaceae (21 taxa) and Poaceae (19 taxa) (ATA, 2004b). The vegetation of the project area was described in ATA's report as closed tall shrub dominated by *Acacia assimilis* subsp. *assimilis*, *Allocasuarina campestris* and *Melaleuca filifolia* over herbland of mixed species and bare rock (ATA, 2004).

A 2005 flora survey by DEC of the Koolanooka & Perenjori Hills recorded a total of 238 taxa, of which 217 were native and 21 were weed species (Meissner and Caruso, 2006). The dominant families were Asteraceae (39 species, three weeds), Myrtaceae (21), Poaceae (21 species, 11 weeds), Mimosaceae (19) and Chenopodiaceae (11). Eight priority species, five undescribed species and five taxa of interest were found during this survey. Five endemic species were identified, three of which were collected for the first time in this area (Meissner & Caruso, 2006). Five community types (one with two sub-types) were identified with differences attributed to changes of landform type and soil fertility.

Five plant assemblages of the Koolanooka System are now listed as Threatened Ecological Communities (TECs) by the Department of Environment and Conservation (DEC). Beecham (2001) lists the TECs as: *Allocasuarina campestris* shrub over red loam on hill slopes; shrubs (such as *Acacia* spp.) and emergent mallees on shallow red loam over massive ironstone on steep rocky slopes; *Eucalyptus ebbanoensis* subsp. *ebbanoensis* mallee and *Acacia* spp. scrub with scattered *Allocasuarina huegeliana* over red loam and ironstone on the upper slopes and summits; *Eucalyptus loxophleba* woodland over scrub on the footslopes; and mixed *Acacia* spp. scrub on granite.

## Blue Hills Vegetation

Blue Hills is close to the Irwin Botanical District and the Austin Botanical District Boundary, therefore it lies in the South-western Interzone, a marginal area in the southern Murchison Region, which is particularly rich in ephemerals (Beard, 1976).

In Beard's (1976) vegetation classification, Blue Hills occurs in the Yalgoo Subregion of the Austin Botanical District within the Eremaean Botanical Province. The Yalgoo Subregion is a transitional area from the Eremaean Province where the vegetation is mostly Eremaean in character but with a slight shift due to an increase in rainfall. The major vegetation types of the Yalgoo Subregion include heath on granite outcrops (*Borya, Thryptomene, Baeckea* and *Calycopeplus*), *Acacia* scrub (*Acacia acuminata, A. ramulosa* and *A. quadrimarginea*), *Acacia-Melaleuca* thicket (*Acacia ramulosa, A. acuminata, Melaleuca uncinata* with variations including *M. nematophylla*), scrub with scattered trees (*Acacia ramulosa, A. acuminata, Hakea preissii, Eucalyptus loxophleba, E. oleosa, Callitris columellaris, Bursaria spinosa* and *A. aneura*) and salt flats (surrounded by samphire e.g. *Halosarcia* spp., teatree e.g. *Melaleuca / Leptospermum*, and *Acacia-Eremophila* scrub).

The vegetation of the Yalgoo Subregion becomes lower and denser towards the South-western Botanical Province as *Acacia aneura* (mulga - adapted to intermittent rainfall) starts to disappear and is replaced by other *Acacia* species. In the inland part of the Yalgoo Subregion the vegetation is mixed *Acacia* scrub with scattered *A. aneura* on the plains, scrub of *A. ramulosa* / *A. acuminata* on the hills and of *A. ramulosa* / *A. murrayana* on the sand-plains at higher levels, and scrub of *A. sclerosperma* / *A. eremaea* with *Atriplex* and *Maireana* on lower-lying flats. On stony hills *Acacia ramulosa* and *A. acuminata* become dominant and are joined by *A. quadrimarginea* and *A. stereophylla*. The understorey vegetation includes *Allocasuarina campestris*, *Melaleuca uncinata* and *Thryptomene australis*.

Adjacent to Rothsay in the south of the Yalgoo Subregion, steep ridges of Archaean metamorphic banded ironstone rocks occur. These formations are covered with shrublands of *Acacia quadrimarginea* and *A. acuminata* that are in general dominated by *A. ramulosa, Casuarina* sp. and *Melaleuca uncinata* sometimes with scattered trees of *Eucalyptus loxophleba* and *Allocasuarina dielsiana* (syn. *Casuarina dielsiana* referred to by Beard, 1976). The valleys in this part of the Yalgoo Subregion (adjacent to Rothsay where steep ridges trend SW-NE) have *Acacia* scrub with scattered trees, whereas in the south-west of the region the valleys are mapped as eucalypt woodland. Various prominent hills and ranges remain to be described but the vegetation of Tallering Peak (a massif of banded ironstone and jaspilite) in the northwest of the subregion has been described as sparse and including shrubs of *Acacia quadrimarginea, A. ?coolgardiensis, Eremophila leucophylla, Thryptomene johnsonii,* a smaller *Baeckea* or *Thryptomene* sp. and *Ptilotus obovatus* (Beard, 1976). However at Beard's scale of 1:100 000 little difference was noted between communities on granitoids and metamorphic sedimentary rocks (Markey & Dillon, 2006).

More broadly, the Austin Botanical District is characterised by mulga (*Acacia aneura*) low woodland on the plains, shrubs on the hills, and *Eucalyptus* species and *Triodia basedowii* on the sand plains (ATA, 2004a).

## 3.2 Ecologia Surveys

**Koolanooka Hills**

Forty-five taxa from 25 families and 35 genera were recorded during *ecologia's* Koolanooka survey. Of these taxa, one was identified to family level only, one to a query genus level and one to a query species within a known genus; two weed species were recorded during the survey.

**Blue Hills**

Ninety-four taxa from 34 families and 52 genera were recorded during *ecologia*'s survey at Mungada East. Of these taxa, one was identified to family level only and two were confirmed to genus level only; four alien (weed) species were recorded during the survey.

Eighty-three taxa from 29 families and 43 genera were recorded during *ecologia's* survey of Mungada West, and of these taxa, one was identified to family level only and seven were confirmed to genus level; no alien (weed) species were recorded during the survey.

## 3.3 Legislative Requirements

Currently the Koolanooka-Blue Hills DSO Project is in the pre-PER submission phase.

In addition to the State's environmental approvals process, the *Commonwealth Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) requires that any actions with significant impact on listed threatened species be approved by the Department of Environment and Heritage (DEH). No Declared Rare Flora (DRF) taxa occurring in the area are currently protected by this act. DRF taxa are also protected under the Western Australia Wildlife Conservation Act 1950. One flora taxon occurring in the area is currently classified as a DRF, *Acacia woodmaniorum* ms, and is therefore protected by this act.

The Agriculture and Related Resources Protection Act, 1976 (ARRP Act (1976)) is also relevant; however, no weeds of significance were recorded at either Koolanooka or Blue Hills.

## 3.4 Conservation Significant Flora Known in the Area

Four species of nationally threatened flora are known from the vicinity of the Koolanooka Hills project area (Dept of the Environment and Water Resources, 2007); *Eremophila viscida* and *Eremophila nivea* (Endangered), *Halosarcia bulbosa* (Vulnerable) and *Eucalyptus synandra* (Vulnerable). *Eremophila viscida* and *Halosarcia bulbosa* (now listed as *Tecticornia bulbosa* in Western Australia) were recorded by ATA in an earlier survey of the greater area (2004b).

One species of nationally threatened flora is known from the vicinity of the Blue Hills project area (Dept of the Environment and Water Resources, 2007); *Eucalyptus synandra* (Vulnerable) and it has been recorded as occurring along Emu Fence Road on Karara Station (Woodman, 2006b).

Five species of state threatened flora are known from the vicinity of the Koolanooka Hills project area (Wildlife Conservation (Rare Flora) Notice 2008). *Eremophila viscida* (Rare) and *Tecticornia bulbosa* (syn. *Halosarcia bulbosa*) (Rare) were recorded by ATA (2004b), *Eucalyptus synandra* (Rare) and *Eremophila nivea* (Rare) have been recorded near Morawa (FloraBase, 2008), and *Eremophila rostrata* subsp. *trifida* has been recorded at Perenjori (ATA, 2006b; FloraBase, 2008). None of these taxa was recorded during the *ecologia* surveys. One state-listed TEC has been recorded within the survey areas – the Koolanooka Hills System TEC.

DEC listed Rare and Priority flora have been recorded during previous surveys undertaken at both Koolanooka Hills and Blue Hills.

**Koolanooka Hills**

Six hundred and sixty Rare and Priority flora taxa are recorded as occurring in the Avon Wheatbelt bioregion (FloraBase, 2008). One hundred and sixty two Rare and Priority taxa were recorded as occurring in the Avon-Wheatbelt 1 Sub-bioregion (NRM Agencies, 2003), and 30 Declared Rare (DRF) and Priority Flora species have been recorded previously in the vicinity of Koolanooka Hills.

During a survey of Koolanooka Hills and of the road and rail areas within the Midwest mining leases (ATA, 2004a) two DRF taxa were recorded, *Eremophila viscida* and *Halosarcia bulbosa* (now *Tecticornia bulbosa*), and five Priority Flora taxa; *Baeckea* sp. Three Springs (M.E. Trudgen 5368) (P2), *Acacia acanthoclada* subsp. *glaucescens* (P3)*, *Frankenia glomerata* (P3), *Grevillea stenostachya* (P3) and *Persoonia pentasticha* (P3). This previous survey encompassed a much larger area including the plains to which *Eremophila viscida* and *Halosarcia bulbosa* (now *Tecticornia bulbosa*) (DRF) are restricted.

The following eight Priority Flora were recorded during the DEC's survey of Koolanooka and Perenjori Hills; *Melaleuca barlowii* (P1), *Millotia dimorpha* (P1), *Rhodanthe collina* (P1), *Baeckea* sp. Perenjori (J.W. Green 1516) (P2), *Stenanthemum poicilum* (P2), *Acacia acanthoclada* subsp. *glaucescens* (P3), *Gunniopsis rubra* (P3) and *Persoonia pentasticha* (P3) (Meissner and Caruso, 2006).

* Prioirty rankings listed above are those indicated in the reports cited and they have not been changed to reflect the current listings. However the following changes apply under the current listing.

- *Acacia acanthoclada* subsp. *glaucescens* (P3) is no longer a priority taxa

**Blue Hills**

One hundred and six Rare and Priority taxa are known to occur in the Yalgoo bioregion (FloraBase, 2008) and 31 Declared Rare (DRF) and Priority Flora species have previously been recorded in the vicinity of Blue Hills (Table B-2, Appendix B).

Blue Hills, as well as the surrounding Karara Station, was surveyed by Bennett (Bennett Environmental Consulting, 2004). Two Priority Flora taxa were recorded on hill slopes in particular on BIF rocks, and these were; *Cryptandra imbricata* (P3)* and *Persoonia*

*pentasticha* (P3). (It is probable that *Stenanthemum poicilum* (P2) was also recorded but the specimen had no reproductive material necessary for full taxonomic confirmation.)

During the DEC's 2005 survey of the central Tallering Land System the following six Priority Flora were found; *Austrostipa blackii* (C.E. Hubb.) S.W.L. Jacobs & J. Everett (P3), *Calytrix uncinata* Craven (P3), *Gunniopsis rubra* Chinnock (P3), *Micromyrtus cuensis* J.W. Green ms (P1)*, *Millotia dimorpha* P.S. Short (P1) and *Polianthion collinum* Rye [syn. *Genus* sp. Yalgoo (J.M. Ward s.n. 11/7/1999)] (P1)*. Current Priority Flora lists (Atkins, Dec 2006) also include *Acacia woodmaniorum* (DRF) - listed as *Acacia* sp. Blue Hill Range RJ Cranfield 8582 in Atkins 2006(2)) and *Acacia karina* (formerly *Acacia* sp. Karara (C. Godden 14)) (P2), which were collected during DEC's 2005 survey but have only recently been listed.

A number of surveys have been conducted in the vicinity of Blue Hills which included Midwest leases across Blue Hills (including Mungada Ridge) but also south, west and north-west of Mt. Karara (Woodman, 2004, Woodman, 2006b). At Mungada Ridge the following Priority Flora were identified; *Chamelaucium* sp. Yalgoo (Y Chadwick 1816) (P1), *Grevillea subtiliflora* (P1), *Gunniopsis divisa* (P1), *Hydrocotyle* sp. Warriedar (PG Wilson 12267) (P1), *Melaleuca barlowii* (P1), *Micromyrtus cuensis* ms (P1)*, *Micromyrtus* sp. Warriedar (S Patrick 1879A) (P1)*, *Millotia dimorpha* (P1), *Rhodanthe collina* (P1), *Acacia* sp. Karara (C. Godden 14) (P2)*, *Acacia woodmaniorum* (P2; under consideration for listing as a DRF)*, *Stenanthemum poicilum* (P2), *Acacia acanthoclada* subsp. *glaucescens* (P3)*, *Austrostipa blackii* (P3), *Cryptandra imbricata* ms (P3)*, *Grevillea globosa* (P3), *Grevillea scabrida* (P3), *Persoonia pentasticha* (P3), *Polianthion collinum* [syn. Genus sp. Yalgoo (JM Ward s.n. 11/7/1999)] (P3) and the new taxa *Acacia* aff. *coolgardiensis*, *Calotis* aff. *cuneifolia* (A. Markey & S. Dillon 3447) (recommended for Priority listing), *Drummondita* aff. *microphylla* (recommended for Priority listing) and *Lepidosperma* sp. Karara BIF (A. Markey & S. Dillon 3468).

*Prioirty rankings listed above are those indicated in the reports cited and they have not been changed to reflect the current listings. However the following changes apply under the current listing.

- *Cryptandra imbricata* (P3) is no longer a priority taxa.
- *Micromyrtus cuensis* J.W. Green ms (P1) = *Micromytrus acuta.*
- *Polianthion collinum* Rye [syn. *Genus* sp. Yalgoo (J.M. Ward s.n. 11/7/1999)] (P1) is now P3
- *Micromyrtus* sp. Warriedar (S Patrick 1879A) = *Micromytrus trudgenii* Rye (P1)
- *Acacia* sp. Karara (C. Godden 14) = *Acacia karina* (P2)
- *Acacia woodmaniorum* now a Declared Rare Flora

*Acacia acanthoclada* subsp. *glaucescens* isno lonfer a priority taxa

## 3.5 Significance of the Priority Flora

Species that are known from only a few collections, or a few sites, but which have not been adequately surveyed are included on a conservation list called the Priority Flora List. This flora may be rare or threatened, but cannot be considered for declaration as rare flora until such survey has been undertaken (DEC, 2008).

Three categories of priority flora cover these poorly known species. The categories, 1-3, are arranged to give an indication of the priority for undertaking further surveys based on the number of known sites, and the degree of threat to those populations. Category 4 priority flora is included for those species that have been adequately surveyed and are considered to be rare but not currently threatened (DEC, 2008).

Special consideration should be given to the management of these priority species.

### 3.5.1 Flora of Conservation Significance

**Environment Protection and Biodiversity Conservation Act**

At a National level, flora is protected under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act (1999))*. The Act contains a list of species that are considered Critically Endangered, Endangered, Vulnerable, Conservation Dependent, Extinct or Extinct in the Wild (Table 3.1).

**Table 3-1:** Definition of categories described under the *EPBC Act (1999).*

| Conservation Category | Description |
|---|---|
| Extinct | A species is extinct if there is no reasonable doubt that the last member of the species has died. |
| Extinct in the wild | A species is categorised as extinct in the wild if it is only known to survive in cultivation, in captivity or as a naturalised population well outside its past range; or if it has not been recorded in its known/expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form. |
| Critically Endangered | The species is facing an extremely high risk of extinction in the wild in the immediate future. |
| Endangered | The species is likely to become extinct unless the circumstances and factors threatening its abundance, survival or evolutionary development cease to operate; or its numbers have been reduced to such a critical level, or its habitats have been so drastically reduced, that it is in immediate danger of extinction. |
| Vulnerable | Within the next 25 years, the species is likely to become endangered unless the circumstances and factors threatening its abundance, survival or evolutionary development cease to operate. |
| Conservation Dependent | The species is the focus of a specific conservation program, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within a period of 5 years. |

### 3.5.2 Wildlife Conservation Act

Declared Rare Flora (DRF) is also protected under the Western Australian Wildlife Conservation (Rare Flora) Notice 2005 of the *Wildlife Conservation Act 1950*. The notice lists flora taxa that are extant and considered likely to become extinct or rare. These taxa are legally protected and removal or impact to their surroundings cannot be conducted without ministerial approval obtained specifically on each occasion for each population. The Department of Environment and Conservation (DEC) also maintains a list of taxa which are considered to be poorly known, uncommon, or under threat, but for which there is insufficient justification on the basis of known distribution and population sizes for inclusion on the DRF schedule. These are classified as Priority Flora, each of which is assigned to one of four Priority categories (Table 3.2).

**Table 3-2:** Definition of Declared Rare and Priority Categories.

| Code | Definition |
|---|---|
| DRF | Declared Rare Flora - Extant Taxa.<br>Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection. |
| 1: Priority One | Poorly Known Taxa.<br>Taxa which are known from one or a few (generally <5) populations which are under threat. |
| 2: Priority Two | Poorly Known Taxa.<br>Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat. |
| 3: Priority Three | Poorly Known Taxa.<br>Taxa which are known from several populations, at least some of which are not believed to be under immediate threat. |
| 4: Priority Four | Rare Taxa.<br>Taxa which are considered to have been adequately surveyed and which whilst being rare, are not currently threatened by any identifiable factors. |

(From Atkins, K.J., Declared Rare and Priority Flora List February 2008, DEC)

## 3.6 Flora of conservation significance recorded during the ecologia surveys

### 3.6.1 Threatened Ecological Communities

Five plant assemblages of the Koolanooka System are now listed as Threatened Ecological Communities (TECs) by the Department of Environment and Conservation (DEC). Beecham (2001) lists the TECs as: *Allocasuarina campestris* shrub over red loam on hill slopes; shrubs (such as *Acacia* spp.) and emergent mallees on shallow red loam over massive ironstone on steep rocky slopes; *Eucalyptus ebbanoensis* subsp. *ebbanoensis* mallee and *Acacia* spp. scrub with scattered *Allocasuarina huegeliana* (c.f. *Allocasuarina acutivalvis*, see above) over red loam and ironstone on the upper slopes and summits; *Eucalyptus loxophleba* woodland over scrub on the footslopes; and, mixed *Acacia* spp. scrub on granite.

The Koolanooka Hills TEC occurs over two areas totalling 5419 ha (M. Morley, DEC, pers.comm. 18th Dec 2006), which is 25 ha less than the 5444 ha stated in the Koolanooka Interim Recovery Plan (Hamilton-Brown, 2000).

The vegetation of the TEC will be managed as per the Management Strategy detailed in Section 4.4 and Table 4.3.

### 3.6.2 Declared Rare Flora

**Koolanooka Hills**

No DRF flora taxa were recorded during the survey at Koolanooka.

**Blue Hills**

One DRF taxon, *Acacia woodmaniorum*, was recorded at Blue Hills.

### 3.6.3 Priority Flora

**Koolanooka Hills**

No Priority Flora taxa were recorded during the survey of the proposed impact area at Koolanooka Hills.

**Blue Hills**

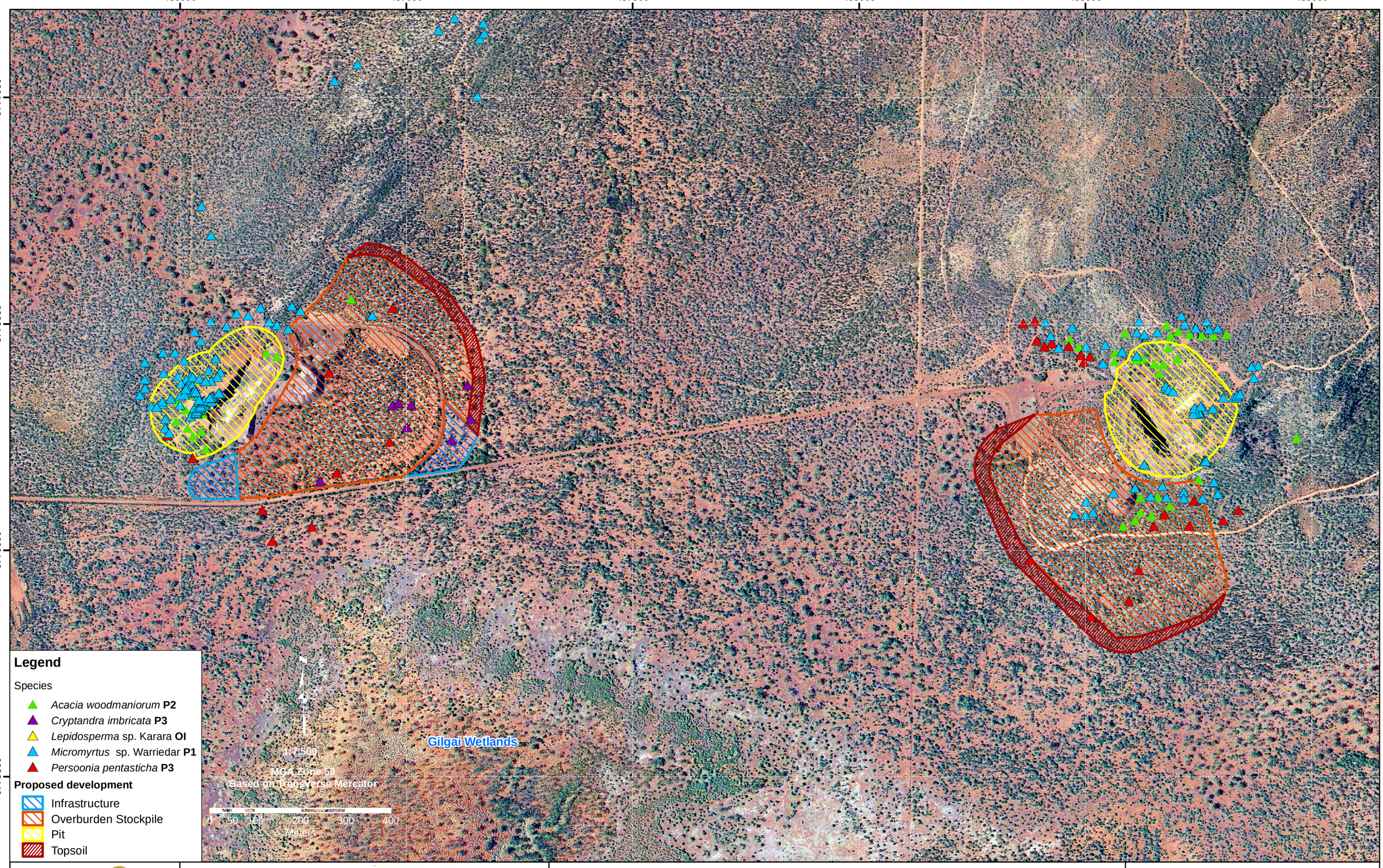
Four Priority Flora taxa were recorded during *ecologia*'s surveys of the proposed mining disturbance areas at Blue Hills. One Priority 1 species, *Micromyrtus acuta* (identified originally as *Micromyrtus placoides*) and two Priority 3 species *Micromyrtus trudgenii* and *Persoonia pentasticha.* These taxa are described below, with a brief population impact assessment in Table 3.3.

**Table 3-3:** The populations of flora of conservation significance recorded at the Midwest Corporation Ltd project areas surveyed at Koolanooka and Blue Hills and the likely impact on these taxa due to proposed clearing of those areas.

| Species | Cons. code | Number of plants counted by ecologia outside impact area | Number of plants in vicinity (within 5 km) but outside impact area – from FloraBase, Woodman, DEC and Bennett reports | Total number known plants outside impact area | Number of plants in impact area | Total number of known plants | Percentage of known plants to be Impacted |
|---|---|---|---|---|---|---|---|
| **Koolanooka** | | | | | | | |
| No Priority Flora taxa recorded | | | | | | | 0.00% |
| **Blue Hills** | | | | | | | |
| **Mungada West** | | | | | | | |
| *Micromyrtus acuta* Rye | P1 | 60 | 270++ | 330 | 10 | 340 | 2.94% |
| *Micromyrtus turdgenii* | P3 | 379 | 6055 | 6434 | 1121 | 7555 | 14.84% |
| *Acacia woodmaniorum* | DRF | 171 | 11829 | 12000 | 83 | 12083 | 0.69% |
| *Persoonia pentasticha* | P3 | 8 | 278 | 286 | 6 | 292 | 2.05% |
| **Mungada East** | | | | | | | |
| *Micromyrtus acuta* Rye | P1 | 60 | 270++ | 330 | 4 | 334 | 1.19% |
| *Micromyrtus trudgenii* | P3 | 379 | 6055 | 6434 | 1798 | 8232 | 21.84% |
| *Acacia woodmaniorum* | DRF | 171 | 11829 | 12000 | 728 | 12728 | 5.72% |

| Species | Cons. code | Number of plants counted by ecologia outside impact area | Number of plants in vicinity (within 5 km) but outside impact area – from FloraBase, Woodman, DEC and Bennett reports | Total number known plants outside impact area | Number of plants in impact area | Total number of known plants | Percentage of known plants to be Impacted |
|---|---|---|---|---|---|---|---|
| *Persoonia pentasticha* | P3 | 8 | 278 | 286 | 25 | 311 | 8.04% |
| *Lepidosperma* sp. Blue Hills | New species | 130 | Not available | 130 (at least) | 2 | 132 | 1.52% (at most) |
| Blue Hills combined impacts | | | | | | | |
| *Micromyrtus acuta* Rye | P1 | 60 | 270++ | 330 | 14 | 344 | 4.07% |
| *Micromyrtus trudgenii* | P3 | 379 | 6055 | 6434 | 2919 | 9353 | 31.21% |
| *Acacia woodmaniorum* | DRF | 171 | 11829 | 12000 | 811 | 12811 | 6.33% |
| *Persoonia pentasticha* | P3 | 8 | 278 | 286 | 31 | 317 | 9.78% |
| *Lepidosperma* sp. Blue Hills | New species | 130 | Not available | 130 (at least) | 2 | 132 | 1.52% (at most) |

Note: The number of plants in recorded populations is not always provided on FloraBase, therefore an average number of plants has been calculated based on those populations where plant numbers and cover are given; this average has then been multiplied by the number of populations recorded




ecologia ENVIRONMENT

Midwest Corporation Limited

# Blue Hills Priority Flora Locations

A3

**Drawn: J Gilovitz**
**Date: 1/5/2008**
**1:7,500**
*Coordinate System*
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

**Figure:3.1**
**Project ID: 693.3**

### 3.6.3 Conservation Significant Flora Information

## *Acacia woodmaniorum*. Family: Mimosaceae

**Conservation Status:**

*Acacia woodmaniorum* is currently listed as a Declared Rare Flora.

DRF taxa are:

Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection.

**Description:**

*Acacia woodmaniorum* (**DRF)** (Mimosaceae) is a species that appears to be restricted to the Blue Hills area. This species is described below by an adapted version of that provided by Bruce Maslin (*Acacia* specialist) for the holotype specimen (PERTH 07414897) at the Western Australian Herbarium.

*Acacia woodmaniorum* (**DRF)** is an intricately branched prickly harsh shrub 1-1.5 (-2) m tall. The bark is grey and slightly rough. The new shoots are red when first initiated. The branchlets are light green or yellow at extremities, the decurrent phyllodes are glaucous and more or less lightly pruinose. The marginal nerve of phyllodes is red (young), ageing to yellow. Three spines occur on angles of the free portion of the phyllodes, and are pale red when young, aging to brown. The dead decurrent phyllodes are grey and persist on branches below living crown. The peduncles are often ringed red and the wattle flowers are yellow (Maslin & Buscumb, 2007).

The individuals of *A. woodmaniorum* ms that were recorded by *ecologia* fit the above descriptions (Plates 3-1 & 3-2).

**Plate 3-1:** *Acacia woodmaniorum* ms (DRF).

**Plate 3-2** *Acacia woodmaniorum* ms (DRF)

**Flowering period:** predominantly July, but commencing late June and persisting until August.

## Known Populations:

*Acacia woodmaniorum* is known from three populations, spanning an area of 40 km$^2$, which have been divided into 15 sub-populations. Two of these populations contain much smaller numbers than the main population which comprises several to many thousand individuals. The total population number is estimated to be 12,000 individuals. The population data for this taxon was sourced primarily from Nuytsia (Maslin & Buscumb, 2007) and a consultant's report (Woodman, 2007), and from FloraBase records.

**Table 3-4**:Known populations of *Acacia woodmaniorum* (not including *ecologia* records)

| Location | Co-ordinates | | No. Plants | Condition | Comments |
|---|---|---|---|---|---|
| Karara Station | 29° 8' 21.0" S | 116° 54' 32.0" E | | | |
| Mungada Ridge | 29° 11' 23.0" S | 116° 54' 5.2" E | | | |
| Karara Station | 29° 8' 21.0" S | 116° 54' 32.0" E | | | |
| Jasper Hill | 29° 5' 30.8" S | 116° 54' 14.9" E | Sparse | | |
| N of Jasper Hill | 29° 5' 11.3" S | 116° 54' 29.1" E | Common | | |
| Mungada Ridge | 29° 7' 59.3" S | 116° 54' 32.8" E | Common | | |
| Mungada Ridge | 29° 8' 31.2" S | 116° 51' 41.7" E | Common | | |
| West Mungada Ridge | 29° 8' 11.5" S | 116° 54' 15.9" E | Frequent | | |
| Mungada Ridge | 29° 8' 24.7" S | 116° 54' 33.5" E | Common | | |
| Blue Hills Range, Windaning Hill | 29° 8' 12.9" S | 116° 54' 23.9" E | | In flower | DEC survey |
| Blue Hills Range, Windaning Hill | 29° 8' 25.7" S | 116° 53' 1.6" E | Very sparse | In flower | DEC survey |
| 2.5 km WSW of Windaning Hill | 29° 8' 27.0" S | 116° 52' 59.0" E | Common | | |
| Mungada Mine, Blue Hills | 29° 8' 21.5" S | 116° 51' 53.2" E | Scattered | In flower | |
| Mt Mungada | 29° 8' 10.5" S | 116° 54' 20.7" E | Sparse | | |
| Blue Hill Range | 29° 8' S | 116° 52' E | Frequent | | |

(FloraBase, 2008)

## Distribution:

A species distribution map has been produced by Woodman (2007).

- The distribution range is approximately 9 km north – south, and 6 km east –west within the Mungada area.
- The area of the distribution range is 40 km$^2$.

## Habitat:

Geographical interpretation:

All of the known populations occur within a very restricted habitat, about 1 to 5 km apart on the Blue Hill Range, about 80 km east of Morawa on Karara Station (between Perenjori and Paynes Find). The common characteristics of its habitat include:

- Rocky, Banded Ironstone Formation (haematite);
- Crests and steep slopes.

Direct habitat observation:

Direct habitat observations recorded during the population surveys and herbarium specimen collecting were collated. However, inconsistencies in the observations hinder detailed analysis.

The species habitat preferences appear to incorporate the following aspects:

- *Acacia woodmaniorum* occurs on exposed ironstone ridges.

**Ecology:**

Observation of the species growing lushly at disturbed sites, such as at locations around the old Mungada West mine, suggests the species may respond positively to disturbance.

**INTERPRETATION**

Interpretation of the information currently available on *Acacia woodmaniorum* indicates:

- The species appears to be restricted to a small area of the Blue Hills Range;
- The low number of populations recorded to date has resulted in its listing as a DRF. The populations occur on tenure associated with disturbance (i.e. mining areas) and may therefore be subject to significant threat.

The species appears to be a disturbance opportunist based on field observations.

## *Micromyrtus acuta* Rye. Family: Myrtaceae

### Conservation Status:

*Micromyrtus acuta* is currently listed as a Priority 1 taxon.
Priority 1 taxa:

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

### Description:

*Micromyrtus acuta* is an erect shrubby perennial to 2 m high, single stemmed at base or multi-branched from ground level or just above. Leaves are antrose, (turned forward) with oblong to obovate leaf blades that are very thick, broadly obtuse, and have 4-6 prominent oil glands in each longitudinal row on the underside of the leaf. The flowers occur in racemes, and have persistant bracteoles. The flowers tend to be recurved and are 4-5 mm in diameter. The sepals are fairly erect in the flowers and fruit, are white, rather scarious and broadly to depressed ovate. The petals are widely spreading in the flowers. The fruit are deciduous, elliptic to ovate, 1.5-2 mm long and there are two ovules in ovary (Rye, 2006). Plate 3-3.

**Plate 3-3 Micromyrtus acuta Rye (P1)**

**Flowering period:** September - October

### Known Populations:

*Micromyrtus acuta* is known from 18 population sites. The population data below was sourced from FloraBase records.

**Table 3-5**: Known populations of *Micromyrtus acuta* (not including *ecologia* records)

| Location | Co-ordinates | | No. Plants | Condition | Comments |
|---|---|---|---|---|---|
| Jasper Hill, Blue Hills | 29° 5' 6.1" S | 116° 54' 34.3" E | Isolated plants | In flower | DEC survey |
| Jasper Hill, Blue Hills | 29° 5' 0.1" S | 116° 54' 36.1" E | Moderately dense | In flower | DEC survey |
| Jasper Hill, Blue Hills | 29° 4' 12.7" S | 116° 55' 23.2" E | Moderately dense | In flower | DEC survey |
| Windaning Hill, Blue Hills | 29° 7' 47.4" S | 116° 54' 20.6" E | Isolated plants | In flower | DEC survey |
| Lake Monger Lookout, off Rabbit Proof Fence Road | 29° 29' 27.3" S | 116° 37' 17.6" E | | Vegetative | |
| Whitewells Station | 29° 35' 45.6" S | 116° 56' 31.1" E | 100+ | Healthy | |
| Whitewells Station | 29° 35' 42.5" S | 116° 56' 33.8" E | 30+ | Healthy | |
| 20 km SW of Paynes Find | 29° 16' 4.0" S | 117° 30' 30.0" E | 20+ | In flower | |
| 14 km W of Warriedar Homestead | 29° 8' S | 117° 4' E | | In flower | |
| 16 km WSW of Payne's Find | 29° 17' S | 117° 34' E | | | |

(Florabase, 2008).

## Distribution

The distribution of *Micromyrtus acuta* occurs around the Blue Hills area, in a band approximately 90 km long, extending from west of Lake Monger east to near Payne's Find (Rye, 2006). The area of occupancy is currently unknown.

## Habitat:

Direct habitat observation:

Direct habitat observations recorded during the population surveys and herbarium specimen collecting were collated. However, inconsistencies in the observations hinder detailed analysis.

The species habitat preferences appear to incorporate the following aspects:

- The collections of *Micromyrtus acuta* to date have always been made on granite and/or lateritic soils.
- The species has been recorded on several different landforms from steep slopes to laterite hills, to rocky outcrops and flats.
- Populations have been recorded as occurring within the *Acacia* shrubland vegetation complex.

## INTERPRETATION

Interpretation of the information currently available on *Micromyrtus acuta* indicates:

- The species appears to be restricted to a 90 km stretch from west of Lake Monger east to Payne's Find, including Blue Hills;
- Within its range it appears to have broad habitat tolerances, as it occurs on granitic and/or lateritic soils, on a number of different landforms and in different shrubland vegetation types;

However, there are several information gaps, which need to be investigated before a comprehensive review of the species conservation status can be undertaken. Specific areas of information deficiency include:

- The accuracy of the current populations designations;
- The size and area of occupancy of population;
- Consistent habitat details and threat information at the known population sites.

## *Micromyrtus trudgenii*. Family: Myrtaceae

**Conservation Status:**

*Micromyrtus trudgenii,* a Priority 1 taxon, was formerly known as *M.* sp. Warriedar and listed as a Priority 1 taxon.

Priority 3 taxa are:

- Considered as poorly known taxa.
- Known from several populations, at least some of which are not believed to be under immediate threat.

**Description**

*Micromyrtus trudgenii* (**P3**) [(syn. *M* sp. Warriedar (S. Patrick 1879A) **(P1)**] **(**Myrtaceae**)** is an erect, open and straggly weeping shrub growing to 0.5 – 2 m tall. This species has small, linear-oblong leaves that tend to grow in dense clusters and then fall as they begin to age. The shrub produces yellow flowers, which have been noted in July and September. The flowers are small and tubular with five lobes and are cream to yellow in colour (Plates 3-4 & 3-5).

**Plate 3-4**: *Micromyrtus trudgenii* (syn. *M.* sp. Warriedar (S. Patrick 1879A)

**Plate 3-5** Micromytrus Trudgenii (syn M sp Warriedar (S Patrick 1879A)

**Flowering period:** June - October

**Known Populations:**

*Micromyrtus trudgenii* is known from 29 records on FloraBase. The population data was sourced from FloraBase records.

**Table 3-6:** Known populations of *Micromyrtus trudgenii* (not including *ecologia* locations)

| Location | Co-ordinates | | No. Plants | Condition | Comments |
|---|---|---|---|---|---|
| Bentley | 29° 4' 12.1" S | 116° 59' 59.9" E | | | |
| St Patricks | 29° 4' 41.5" S | 117° 1' 9.2" E | | | |
| Arsenic Hill | 28° 54' 45.0" S | 116° 57' 47.2" E | | | |
| Riley | 28° 56' 34.6" S | 117° 1' 49.7" E | | | |
| Mungada Ridge | 29° 8' 21.2" S | 116° 54' 31.3" E | | Healthy | |

| Location | Co-ordinates | | No. Plants | Condition | Comments |
|---|---|---|---|---|---|
| Mungada Survey Area, near Blue Hills Range | 29° 14' 53.0" S | 116° 52' 32.4" E | | Healthy | |
| Badja Station c. 5 km SE of Chullar Well | 28° 57' 37.0" S | 116° 56' 27.1" E | Isolated plants | | DEC survey |
| Badja Station c. 3.5 km NE of Chullar Well | 28° 54' 19.3" S | 116° 55' 54.8" E | Isolated plants | | DEC survey |
| Blue Hills Range, Minjar Hill | 28° 48' 13.7" S | 116° 57' 12.7" E | Isolated plants | In flower | DEC survey |
| Badja Station c. 3 km NNW of Minjar Well | 28° 46' 19.6" S | 116° 54' 27.7" E | Very sparse | In flower | DEC survey |
| Warriedar Station c. 8.5 km NW of Warriedar Hill | 29° 2' 49.8" S | 117° 2' 51.5" E | Very sparse | In flower | DEC survey |
| Jasper Hill, Blue Hills | 29° 5' 6.1" S | 116° 54' 34.3" E | Isolated plants | In flower | DEC survey |
| Blue Hills Range, Windaning Hill | 29° 9' 12.2" S | 116° 54' 37.9" E | Isolated plants | In flower | DEC survey |
| Extension Hill | 29° 34' 40.8" S | 117° 9' 50.8" E | Isolated plants | | DEC survey |
| Warriedar Station c. 7.5 km NW of Warriedar Hill | 29° 3' 22.6" S | 117° 3' 29.3" E | Isolated plants | In flower | DEC survey |
| Badja Station | 28° 57' 37.5" S | 116° 57' 1.8" E | 60 - 100 | Healthy | |
| Warriedar Station | 29° 8' 30.8" S | 116° 58' 8.4" E | 3 | | |
| Mt Karara project area, near Blue Hills Range | 29° 9' 42.6" S | 116° 49' 14.6" E | | | |
| Gindalbie Gold | 29° 11' S | 116° 56' E | | | |
| Minjar project area, near Blue Hills Range | 29° 6' 31.2" S | 116° 58' 14.3" E | 20 - 30 | | |
| Minjar project area, near Blue Hills Range | 28° 58' 44.2" S | 116° 57' 24.5" E | | | |
| 20 km S of Golden Grove Mine site | 28° 55' 49.9" S | 116° 58' 12.3" E | Common | | |
| 15 km S of Gossan Hill | 28° 55' 6.7" S | 116° 58' 19.5" E | 500+ | | |
| Gossan Hill | 28° 46' 46.0" S | 116° 57' 56.0" E | 100+ | | |
| E face of Warriedar Hill | 29° 6' S | 117° 6' E | 50+ | In flower | |

| Location | Co-ordinates | | No. Plants | Condition | Comments |
|---|---|---|---|---|---|
| 50 km W of Paynes Find | 29° 10' S | 116° 59' E | | | |

(FloraBase, 2008)

**Distribution:**

The distribution of *Micromyrtus trudgenii* is known from the Blue Hills Range and nearby hills, extending from near Minjar Hill south to Warriedar Station, south-east of Yalgoo (Rye, 2007).

**Habitat:**

Direct habitat observation:

Direct habitat observations recorded during the population surveys and from herbarium specimens were collated.

The species habitat preferences appear to incorporate the following aspects:

- The collections of *Micromyrtus trudgenii* to date have been restricted to banded ironstone or dolerite hills in a small area south-east of Yalgoo (Rye, 2007);
- Occurs in habitat under threat from mining;
- Occurs on the tops and slopes of hills and ridges of banded ironstone or dolerite, in association with *Acacia* spp.; and is,
- Widely recorded by Woodman (2007) on lease areas to the east of Mungada Ridge.

**INTERPRETATION**

Interpretation of the information currently available on *Micromyrtus trudgenii* indicates:

- The species appears to be widespread on rocky areas at Blue Hills;
- The species appears to be a disturbance opportunist as it is frequently found along track edges, growing on old tracks and on other previously disturbed mining areas.

## *Persoonia pentasticha.* Family: Proteaceae

**Conservation Status:**

*Persoonia pentasticha* is currently listed as a Priority 3 taxon.
Priority 3 taxa are:

- Considered as Poorly Known Taxa.
- Known from several populations, at least some of which are not believed to be under immediate threat

**Description:**

*Persoonia pentasticha* **(P3)** (Proteaceae) is an erect, spreading shrub growing to between 0.4 to 1.8 m in height. The flowers are yellow and are produced from August to November. It grows on sandy loam at the base of granite outcrops (Plates 3-6 & 3-7).

**Plate 3-6:** *Persoonia pentasticha* (P3)

**Plate 3-7** Persoonia pentasticha (P3)

[Descriptions by the Western Australian Herbarium, Department of Environment and Conservation. Text used with the permission of DEC FloraBase website: (http://florabase.calm.wa.gov.au/help/copyright). Accessed on Thursday, 13 December 2007].

**Flowering period:** August - November.

**Known Populations:**

*Persoonia pentasticha* is known from 31 records on FloraBase throughout the Yalgoo IBRA bioregion. The population data was sourced from FloraBase records.

**Table 3-7**: Known populations of *Persoonia pentasticha* (not including *ecologia* records)

| Location | Co-ordinates | | No. Plants | Condition | Comments |
|---|---|---|---|---|---|
| Billerangera Hills, Old Three Springs Road | 29° 19' 3.6" S | 115° 53' 1.0" E | 2 to 5 plants | | |
| Gullewa, Mugga Mugga Hill, on Barnong Station | 28° 43' 25.1" S | 116° 13' 54.0" E | isolated plants | | DEC survey |
| Gullewa, Mugga Mugga Hill, on Barnong Station | 28° 42' 11.6" S | 116° 14' 22.2" E | isolated plants | | DEC survey |
| Gullewa, Mugga Mugga Hill | 28° 42' 0.6" S | 116° 15' 28.9" E | isolated plants | | DEC survey |

| Location | Co-ordinates | | No. Plants | Condition | Comments |
|---|---|---|---|---|---|
| Mungada Ridge, c. 60 km S of Yalgoo. | 29° 8' 25.6" S | 116° 53' 22.5" E | | Population healthy. | Potential threat from mining. |
| Mungada Ridge, c. 60 km S of Yalgoo. | 29° 9' 42.9" S | 116° 54' 31.4" E | | Population healthy. | |
| Mungada Survey Area, near Blue Hills Range | 29° 11' 20.2" S | 116° 56' 33.2" E | | Healthy population. | |
| Blue Hills Range, on Badja Station | 28° 57' 38.1" S | 116° 56' 35.2" E | isolated plants. | | DEC survey |
| Blue Hills Range, on Badja Station | 28° 57' 38.1" S | 116° 56' 35.2" E | isolated plants. | | DEC survey |
| Koolanooka Hills,approximately 2 km north along ridge of Koolanooka Hills | 29° 13' 23.4" S | 116° 13' 48.0" E | isolated plants. | | DEC survey |
| Extension Hill (Mt. Gibson) | 29° 29' 8.5" S | 117° 11' 4.2" E | isolated plants. | | |
| Warriedar Station, west of Keronima - Black Dog mining project area | 29° 8' 19.3" S | 116° 44' 15.9" E | Occasional, 2 plants | | |
| Warriedar Station, Highland Chief mining project area | 29° 10' 11.8" S | 116° 57' 37.7" E | 6 plants. | | |
| Oroya Mount Gibson Gold Mine Site | 29° 44' 15.2" S | 117° 10' 32.9" E | 1 mature plant. | | |
| Camel Soak on Number 2 Rabbit Proof Fence Road | 29° 23' 59.5" S | 116° 37' 34.2" E | 1 adult plant only. | | Previously disturbed. |
| Minjar project area, near Blue Hills Range | 28° 58' 37.3" S | 116° 57' 30.9" E | | | |
| Minjar project area, near Blue Hills Range | 29° 1' 48.1" S | 116° 58' 5.7" E | | | |
| Mount Gibson Station, track W of Boundary Well | 29° 35' 15.0" S | 117° 26' 45.9" E | | | |
| Mount Gibson Station, lower NE facing slope of Quartz Hill | 29° 36' 57.5" S | 117° 26' 0.9" E | 3 mature plants. | | |
| Wubin-Paynes Find Road, 70.1 km NE of Wubin | 29° 41' 4.0" S | 117° 6' 15.0" E | only one plant seen. | | |
| S portion of East Yuna Nature Reserve | 28° 25' 40.5" S | 115° 13' 26.1" E | 4 mature plants | | |
| S portion of East Yuna Nature Reserve | 28° 25' 51.4" S | 115° 13' 19.2" E | 3 mature plants | healthy. | |

| Location | Co-ordinates | | No. Plants | Condition | Comments |
|---|---|---|---|---|---|
| West Perenjori Nature Reserve | 29° 27' 40.5" S | 116° 12' 46.2" E | 1 mature plant, flower | | |
| SE of Reserve 40161, E of Morawa | 29° 15' 0.0" S | 116° 23' 0.0" E | 2 mature plants | | |
| Old Pindar Road C. 100 m ENE of bend in Old Yalgoo Road | 28° 31' 4.0" S | 115° 35' 39.0" E | 1 mature plant | | |
| Camel Soak 600 m E of Rabbit Proof Fence Road | 29° 24' 0.5" S | 116° 37' 33.2" E | 1 mature plant, | | |
| Reserve 16491, located on Canna North East road | 28° 53' 41.0" S | 115° 51' 33.0" E | occasional | | Morawa Tree Society |
| 6 km NNE of Pedan Rocks | 29° 48' S | 117° 13' E | frequent. | | |
| 29.6 miles NE of No 2 Rabbit Fence on Wubin - Paynes Find Road | 29° 41' S | 117° 6' E | 6 plants seen. | | |
| Carranya property, ca 15 km direct NW of Morawa | 29° 5' S | 115° 55' E | two plants seen | | Uncleared bush. |
| 210 mile peg, N from Wubin | 29° 43' S | 117° 5' E | | | |
| 6 miles from Mullewa towards Pindar | 28° 32' S | 115° 36' E | (one plant) | | |
| 6 miles from Mullewa towards Pindar | 28° 28' 42.0" S | 115° 35' 11.0" E | (one plant) | | |

(FloraBase, 2008).

## Distribution

Its distribution is widespread with many records at Blue Hills, predominantly along Mungada Ridge, Badja Station, Koolanooka Hills, Warriedar Station and south-west of Yalgoo. The exact area of occupancy is currently unknown.

## Habitat:

Geographical interpretation:

All of the known populations occur over a broad habitat and extend over a variety of soils/landscapes. Some characteristics of these soils/landscapes from records on FloraBase (2008) include:

- Red or red-brown clay, sandy-clay, or loamy clay (sometimes on rocky ground);
- Brown red rocky soil and laterite;
- Shallow yellow-orange brown sandy loam soils;
- Pale orange or brown loam and sandy clay/loam;
- Sandstone sheet; and

- Heavily or lightly lateritised hematite outcrop and granite.

Direct habitat observation:

Direct habitat observations recorded during flora surveys and noted on herbarium specimen records were collated.

The species habitat preferences appear to incorporate the following aspects:

- *Persoonia pentasticha* occurs on a range of soils including clays, sandy clays and clay loams and occasionally on laterite and other rocky soils and less frequently in association with sandstone sheet;
- The species has been recorded on several different landforms from flats and plains, slopes (including breakaway slopes and inclined mid slopes), drainage lines, outcrops (granite and laterite) and undulating plains.
- Populations have been recorded occurring within open to dense *Acacia* spp. shrublands and eucalypt woodlands.

**Ecology:**

The reporting of the species at previously disturbed sites, such as at Camel Soak (Flora Base, 2007) suggests the species may respond to some disturbance.

**INTERPRETATION**

Interpretation of the information currently available on *Persoonia pentasticha* indicates:

- The species appears to occur over a broad range of landscapes;
- Within its range it appears to have broad habitat tolerances, as it occurs on a range of soils, on a number of different landforms and in different vegetation types;
- Many of the populations appear to be on various tenures, including reserves (road reserves and nature reserves), mining areas and private properties and may therefore be less subject to threat from mining.
- The taxon may respond favourable to some disturbance.

## *Lepidosperma* sp. Blue Hills. Family: Cyperaceae

**Conservation Status:**

- *Lepidosperma* sp. Blue Hills is currently a taxon of interest but is not listed as a Priority taxon.

**Description:**

*Lepidosperma* sp. Blue Hills **(status yet to be determined)** (Cyperaceae) is a sedge that grows to less than 1 m high. Its flowers are aggregated in inflorescences that form spikelets (Plates 3-8 & 3-9).

**Plate 3-8:** ***Lepidosperma*** **sp. Blue Hills**

**Plate 3-9 Lepidosperma sp. Blue Hills**

**Flowering period:** observed flowering in February.

**Known Populations:**

*Lepidosperma* sp. Blue Hills is known from three records listed on FloraBase and occurs only at Blue Hills in the Yalgoo IBRA bioregion. It is known to occur on Mt. Karara and Mungada Ridge.

**Table 3-8**: Known populations of *Lepidosperma* sp. Blue Hills (not including *ecologia* records)

| Location | Co-ordinates | | No. Plants | Condition | Comments |
|---|---|---|---|---|---|
| Blue Hills, Mt Karara | 29° 10' 26.2" S | 116° 46' 58.7" E | Sparse cover | In flower | DEC survey |
| Blue Hills, Mt Karara | 29° 11' 18.4" S | 116° 46' 41.6" E | Very sparse cover | In flower | DEC survey |

(FloraBase, 2008)

**Distribution**

Distribution is at Blue Hills. The exact area of occupancy is currently unknown.

**Habitat:**

Geographical interpretation:

All of the known populations are restricted to Blue Hills. FloraBase records are from Mt. Karara but this species has also been collected at Mungada Ridge. Characteristics of these soil landscapes from records on FloraBase (2008) are:

- Red-brown soils on slopes

Direct habitat observation:

Direct habitat observations recorded during flora surveys and on herbarium specimen records were collated.

The species habitat preferences appear to incorporate the following aspects:

- *Lepidosperma* sp. Blue Hills has been recorded on a limited soil type of red-brown soils;
- The species has been recorded only on landforms with slopes
- Populations have been recorded occurring within shrublands sometimes with emergent eucalypts.

**Ecology:**

The reporting of the species at undisturbed sites of magnetite/hematite and banded ironstone, suggests the species may be susceptible to mining.

## INTERPRETATION

Interpretation of the information currently available on *Lepidosperma* sp. Blue Hills indicates:

- The species appears to occur over a limited of landscapes;
- Within its range it appears to have particular habitat tolerances, as it occurs on undisturbed slopes within shrubland vegetation;
- The population sites appear to be on mining tenements, therefore it appears subject to threat from mining.

## 3.7 Threats to priority flora

Current threats to priority flora include mining, being grazed by stock and the spread of weeds. Weed species are problematic as they out-compete native species and increase the risk of fire.

Other threats to flora include:

- Fire
- Dust deposition on vegetation
- Increased salinity and soil acidity

# 4.0 POTENTIAL IMPACTS AND MANAGEMENT

## 4.1 Risk Assessment

The management of impacts associated with the project activities is based on a risk management framework aligned to Australian Standard 4360:2004 Risk Management. This involves the identification of activities that can result in impacts to significant flora in the project area, implementing controls to reduce the risk, and monitoring the effectiveness of controls.

A risk assessment of project activities and potential impacts on significant flora at Koolanooka and Blue Hills has been conducted within the risk management framework. The key project activities that could interface with the pathways and potential events that may impact on populations of significant flora were determined with the associated potential impacts.

The level of risk of the impacts occurring was analysed by determining the consequence severity, likelihood or frequency/probability of consequences being realised and the probability of the pathway resulting in the impact. The severity of the consequences was determined using a Consequences Severity Table (Appendix 1, Table A1) and the likelihood of an impact resulting from a pathway was determined with a Likelihood Ranking Table (Appendix 1, Table A2). The probability of the pathway resulting in the impact, or the level of risk, was determined using a Risk Matrix (Appendix 1, Table A3), which determines the level of risk by the point at which the consequences severity and likelihood / probability rankings intercept in the Risk Matrix.

To prevent or minimise the impacts, controls are placed on the pathways in order of priority:

- Elimination of the risk;
- Substitution with a lower risk;
- Engineering solutions to reduce the impact of the risk;
- Administrative procedures; and
- Clean up or remediation measures to mitigate impacts.

Controls that will be utilised to prevent or minimise the impact from the identified pathways are described in the management strategy table (Table 4.1). Indicators will be monitored to determine the effectiveness of controls and impacts to significant vegetation.

**Table 4-1:** Risk assessment of project activities and impacts on populations of Conservation Significant Flora

| Project Activity | Pathway to Impact | Impact | CS | L | Risk |
|---|---|---|---|---|---|
| Mobilisation of Equipment and Transport of supplies. | Introduction or spread of weed species causing habitat degradation | Reduction in abundance of priority flora and native vegetation | 3 | D | M |
| | Introduction or spread of weeds that increases the susceptibility of vegetation to fire | Reduction in abundance of priority flora and native vegetation | 2 | D | L |
| | Hydrocarbon fuel spill resulting in contamination of soil | Reduction in abundance of priority flora and native vegetation | 2 | E | L |
| Land Clearing | Loss of seed bank of priority flora | Reduction in abundance of priority flora | 3 | C | S |
| | Removal of habitat | Reduction in abundance of priority flora and native vegetation | 3 | A | H |
| | Spread of weeds | Reduction in abundance of priority flora and native vegetation | 3 | D | M |
| Operation of Equipment and Machinery and Infrastructure | Generation of dust | Reduction in abundance and stunted growth of priority flora and native vegetation | 2 | A | S |
| Closure/ Rehabilitation | Inappropriate / inadequate rehabilitation which does not establish a suitable habitat or correct species composition | Reduction in abundance of priority flora and native vegetation | 4 | D | S |

Note: See Appendix 1 for definitions of CS, L and Risk in columns 4, 5 and 6.

## 4.2 Environmental objectives and performance indicators

**Table 4-2:** Environmental objective and performance indicators

| Environmental Objective | Performance Indicators |
|---|---|
| Maintain the abundance, diversity, geographic distribution and productivity of the significant flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge | • Abundance of priority flora that was not in the clearing area<br>• Health of vegetation around the mine sites<br>• Weed abundance |

## 4.3 Management Strategy

**Table 4-3**: Management strategy to control identified pathways from project activities to potential impacts (below)

| Project Activity | Aspect | Controls |
|---|---|---|
| Mobilisation of Equipment and Transport of Supplies to Koolanooka and Blue Hills. | Weeds | • Invasion prevention and control of weed species will be managed as per the Environmental Management Procedure detailed in Section EMP-05 of the Environmental Management Plan. |
| Land Clearing. | Weeds | • Invasion prevention and control of weed species will be managed as per the Environmental Management Procedure detailed in Section EMP-05 of the Environmental Management Plan. |

| Project Activity | Aspect | Controls |
|---|---|---|
| | Habitat removal and fragmentation | • Disturbance to natural vegetation will be minimised.<br>• A Vegetation Disturbance Permit will be completed and authorised prior to clearing activities.<br>• Training in land clearing procedures will be included in the environmental induction and environmental awareness.<br>• No unauthorised off-track driving<br>• Wherever possible, previously rehabilitated access tracks should be utilised in preference to clearing new tracks.<br>• Land disturbance requirements will be included in contracts with all earthmoving and land clearing contactors.<br>• Priority flora near the mine sites should be cordoned off physically, where appropriate. All contractors operating earth moving machinery should be alerted to the requirement to avoid impact to this area. |

| Project Activity | Aspect | Controls |
|---|---|---|
| Plant and Equipment Design | Habitat removal | • The location at which priority flora have been recorded should be cordoned off physically. A buffer zone of at least 50 m should be incorporated around each population. All contractors operating earth moving machinery should be alerted to the requirement to avoid impact to this area. |
| Operation of Equipment and Machinery and Infrastructure | Weeds | • Invasion prevention and control of weed species will be managed as per the Environmental Management Procedure detailed in Section EMP-05 of the Environmental Management Plan. |
| | Fire | • A total fire ban will be in place<br>• Firebreaks of 5 m will surround project infrastructure.<br>• Roads (3 – 4 m) and haul roads (6 m) will act as firebreaks.<br>• Equip hydrocarbon and chemical storage facilities, light vehicles, mobile plant and fixed plant with appropriate fire extinguishers.<br>• Obtain hot works permit for work that |

| Project Activity | Aspect | Controls |
|---|---|---|
| | | has the potential to create ignition sources<br>• Make available adequate fire suppression equipment for all hot works.<br>• Personnel will be trained in the use of fire extinguishing equipment and fire prevention measures in work areas.<br>• An emergency response team will be available to respond where it is safe to do so. |
| | Dust | • Dust generation from project activities will be minimised by engineering controls and use of dust suppression measures, such as water trucks, sprinklers and deluge sprays.<br>• Vehicle speeds will be restricted on cleared tracks to minimise the generation of dust |
| | Hydrocarbons and Chemicals | • Hydrocarbons and chemicals will be stored, used, transported and disposed of in accordance with Dangerous Goods Regulations, Australian Standards and DoCEP |

| Project Activity | Aspect | Controls |
|---|---|---|
| | | guidelines.<br>• Spills of hydrocarbons and chemicals will be immediately cleaned up and contaminated material appropriately disposed of. |
| | Destruction of Priority flora individuals | • No unauthorised off-track driving |
| Waste generation | Waste | • Inert and putrescible waste will be disposed of in a licensed landfill facility<br>• Hazardous waste will be removed from the site and disposed of by a licensed contractor |
| Personnel | Poor Awareness | • Training on the identification and location of priority flora will be included in the environmental induction and environmental awareness sessions (toolbox training presentations). |
| Closure/ Rehabilitation | Habitat removal | • Conduct progressive rehabilitation to minimise the time between disturbance and rehabilitation<br>• Topsoil and vegetation of the area will be stockpiled for later rehabilitation |

| Project Activity | Aspect | Controls |
|---|---|---|
| | | programs<br>• Felled timber will be stored (not mulched) and used in rehabilitation.<br>• Local provenance seed will be used for rehabilitation. |

# 5.0 MONITORING

Monitoring will consist of two components: effectiveness of management controls, and impacts to significant flora. The effectiveness of management controls will be monitored through the Environmental Management System, such as monitoring compliance with the vegetation clearing permit process. Impacts to the significant flora will be assessed through monitoring of abundance of significant flora and weed affected areas.

Vegetation and flora surveys were undertaken over six periods from the 25th to 26th of July, 26th to 27th of September, 25th to 26th of October 2006 and the 28th February, 13th to 20th June and 9th and 10th of August 2007. The surveys targeted proposed disturbance areas specified by Midwest. These surveys were used to gather information on Declared Rare Flora, Priority Flora and weeds.

# 6.0 CONTINGENCIES

If monitoring indicates that a trigger value has been exceeded or is at risk of being exceeded DEC will be immediately notified and an investigation initiated. The investigation will identify the root cause(s) of the event. The root cause(s) may be controls that have failed or controls that have not been identified. Corrective and/or preventative actions will be developed in consultation with DEC.

# 7.0 AUDITING

The Environmental Management System will be internally audited annually by experienced Environmental Auditor

# 8.0 REVIEW AND REVISION

This plan will be reviewed every two years by environmental personnel, unless ongoing monitoring detects that an indicator has been breached or that an indicator is at risk of being breached.

# 9.0 REPORTING

The Annual Environmental Report (AER) will provide a detailed summary on the current status of Significant Flora at Koolanooka and Blue Hills.

# 10.0 REFERENCES

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# APPENDIX A

**Table A-1: Consequence Severity Table.**

| Level | | Consequence<br>*& Example* |
|---|---|---|
| 1 | Insignificant | No detectable impact on population. |
| | | *Individual mortality due to roadkill.* |
| 2 | Minor | Short-term or local impact to population. |
| | | *Removal of a small proportion of habitat for a short period of time.* |
| 3 | Moderate | Long-term detrimental, but recoverable, impact on population. |
| | | *Removal of a large proportion of habitat that will be rehabilitated as suitable habitat in the future.* |
| 4 | Major | Long-term detrimental impact on the population, which may not be recoverable, and the population is threatened with extinction. |
| | | *Removal of habitat to the threshold required to maintain a viable population.* |
| 5 | Catastrophic | Non-recoverable population decline leading to extinction. |
| | | *Excessive removal of habitat beyond the threshold required to maintain a viable population.* |

**Table A-2: Likelihood Ranking Table.**

| Level | | Likelihood |
|---|---|---|
| A | Almost certain | The incident is expected to occur most of the time (*i.e.* every time). |
| B | Likely | The incident will probably occur in most circumstances (*i.e.* regularly, weekly). |
| C | Moderate | The incident should occur at some time (*i.e.* quarterly) |
| D | Unlikely | The incident could occur at some time during the life of the project. |
| E | Rare | The incident may occur only in exceptional circumstances and may never happen. |

**Table A-3: Risk Matrix.**

| | | Consequences | | | | |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| Likelihood | | Insignificant | Minor | Moderate | Major | Catastrophic |
| A | Almost certain | S | S | H | H | H |
| B | Likely | M | S | S | H | H |
| C | Moderate | L | M | S | H | H |
| D | Unlikely | L | L | M | S | H |
| E | Rare | L | L | M | M | S |

Where:

| | | |
|---|---|---|
| H | High impact | Senior management involvement and planning needed, and DEC must be consulted with. |
| S | Significant impact | Senior management attention needed and DEC must be consulted with. |
| M | Moderate impact | Management responsibility must be specified. |
| L | Low impact | Manage by routine procedures. |