

**Steedman's Gum Conservation Management Plan
For Operational and Closure Stages
Spotted Quoll Mine**

April 2014

Prepared for
Western Areas Ltd



Astron Environmental Services

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Abbreviations

Abbreviation	Definition
BOM	Bureau of Meteorology
DEC	Department of Environment and Conservation
DEWHA	Department of Environment Water Heritage and the Arts
DFES	Department of Fire and Emergency Services (formally FESA)
DPaW	Department of Parks and Wildlife
DRF	Declared rare flora
DMP	Department of Mines and Petroleum
DoE	Department of Environment
EPA	Environmental Protection Authority
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
FESA	Fire and Emergency Services Authority (now DFES)
km	Kilometres
m	Metres
WC Act	<i>Wildlife Conservation Act 1950</i>
WSA	Western Areas Limited

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Appendix D: Statement that a proposal may be implemented (pursuant to the provisions of the *Environmental Protection Act 1986*) Statement No: 808

Appendix E: Forresteria *Eucalyptus steedmanii* Monitoring Program Review

1 Introduction

Western Areas Limited (WSA) operates the Spotted Quoll and Flying Fox nickel mines (the Forrestania Project) situated 160 kilometres (km) south of Southern Cross in Western Australia (Figure 1). Approval for the Spotted Quoll Project comprising an open cut mine and associated infrastructure on Mining Lease 77/00583 and the haul road on Mining Lease 77/00545 was granted by the State (Ministerial Statement 808) and Commonwealth Governments (EPBC Ref 2008/4443) in 2009.

The Steedman's Gum (*Eucalyptus steedmanii*) Conservation Management Plan for Operational and Closure Stages (this management plan) provides a framework for the impact assessment and management of this vulnerable listed species. This management plan has been revised and updated to reflect new information on the populations of *E. steedmanii* and to also reflect the current operational practices at the Spotted Quoll Mine (the mine).

1.1 Background

The 'Steedman's Gum Conservation Management Plan - Spotted Quoll Mine, Shire of Kondinin (Coffey 2009a) (Appendix A) was developed in response to project approval conditions applied by the Commonwealth following referral of the Spotted Quoll mine project under the *Environment and Biodiversity Conservation Act 1999* (EPBC Act) (approval number EPBC Ref 2008/4443), (Appendix B).

The '*Eucalyptus steedmanii* Management Plan - Spotted Quoll Mine, Shire of Kondinin' (Coffey 2009b) (Appendix C) was prepared and submitted to the Western Australian Environment Protection Authority (EPA) to meet project approval conditions under Ministerial Statement 808 (Appendix D)

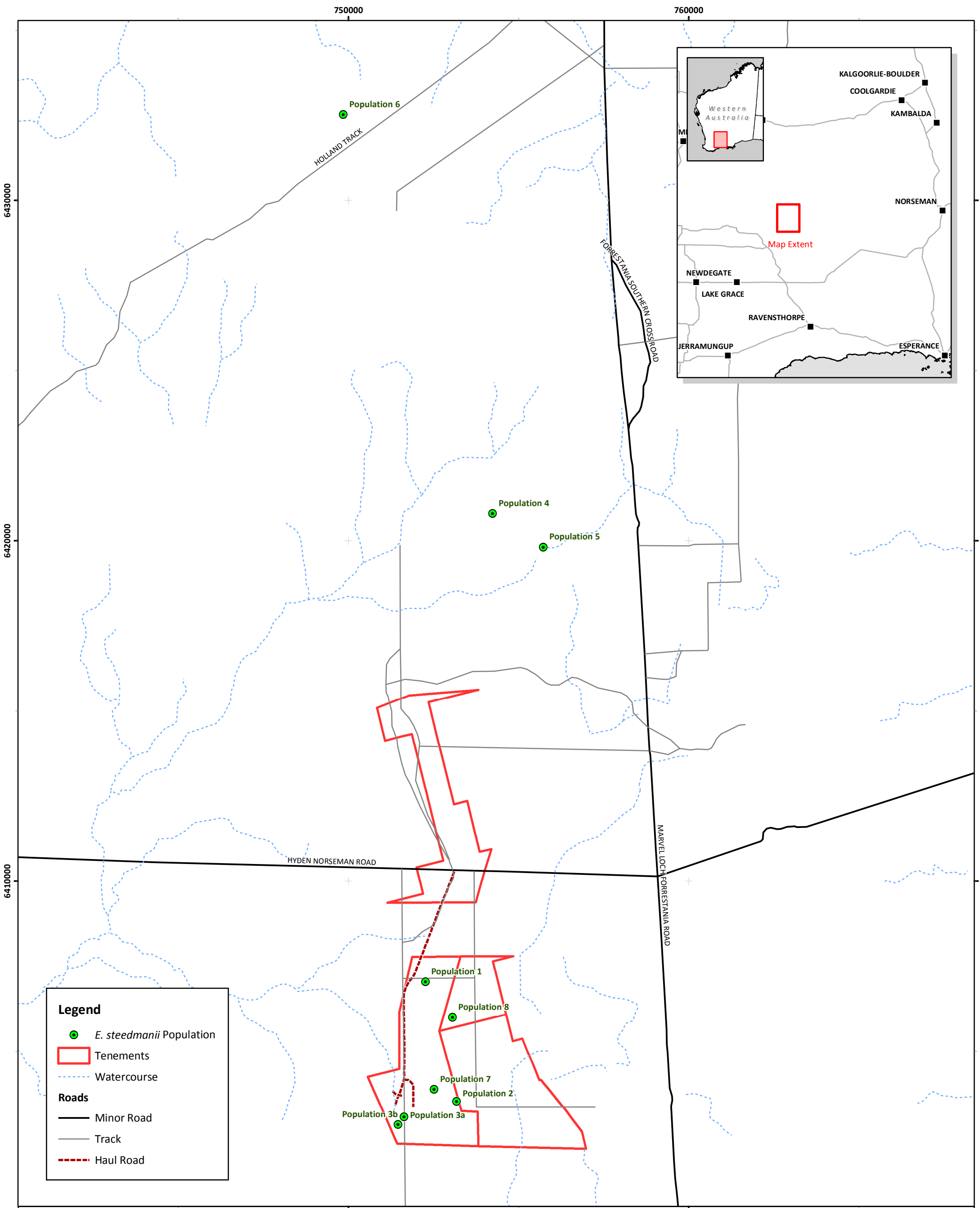
In 2010, mining methods changed from open cut to below-ground. With this change and the availability of several years of monitoring data, WSA decided to update the management plans to reflect the current operational conditions as well as to update information on the condition of *E. steedmanii* populations adjacent to the mine.

This management plan focuses on the current operational stages and later closure stages of the mining operations. Additionally, in order to provide ease of implementation, the requirements of conditions by both the Commonwealth and the State are managed under one document, where previously they were dealt with in two separate documents (Appendix A and Appendix C).

1.2 Purpose and Scope

The purpose of this management plan is to provide measures to ensure the protection of *E. steedmanii* populations within the project area for the operational and closure stages of the Spotted Quoll Mine.

A comprehensive revision of the current monitoring requirements was conducted by Astron Environmental Services (Astron) and reported in the Forrestania *Eucalyptus steedmanii* Monitoring Program Review (Appendix E). This management plan provides the newly developed monitoring program (refer section 5) which incorporates the results from the Monitoring Program Review.



Legend

- *E. stedmanii* Population
- Tenements
- Watercourse

Roads

- Minor Road
- Track
- - - Haul Road

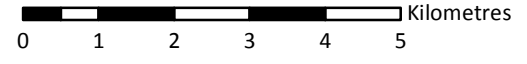
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Figure 1: *E. stedmanii* Population Locations



Author: R. Archibald	Date: 16-01-2014
Drawn: C. Dyde	Figure Ref: 17602-14-GDR-1RevA_20140116_Fig01

Datum: GDA 1994 - Projection: MGA Zone 50 - Scale: 1:100,000 (A3)



1.3 Legislative Requirements

The following sections provide an overview for the legislative requirements for the management and monitoring of *E. steedmanii*. This management plan has been produced to meet both the Commonwealth and Western Australian State Government legislative requirements.

1.3.1 Commonwealth Legislative Requirements

Eucalyptus steedmanii is listed for protection under the EPBC Act. Under the Act the species has been assigned a protection status of 'Vulnerable'. The Spotted Quoll Mine was referred to the Commonwealth for assessment under the EPBC Act and was considered a "Controlled Action".

The resulting assessment and Ministerial Approval (EPBC Ref 2008/443) provides the following conditions relevant to *E. steedmanii*:

"In order to protect the Steedman's Gum (Eucalyptus steedmanii), the person taking the action must:

a) Prior to the clearance of native vegetation, provide for the Ministers approval a detailed Species Conservation Management Plan (the Steedman's Gum Conservation Plan) for monitoring and managing impacts of the Steedman's Gum populations within the Spotted Quoll project (as described in the EPBC referral). The Steedman's Gum Conservation Plan must include a monitoring program and detail measures for ensuring the on-going viability of all Steedman's Gum populations within the Spotted Quoll project.

b) If it is established through the monitoring program that the viability of any Steedman's Gum population within the Spotted Quoll project area is threatened, provide for the Ministers approval a Contingency Plan to outline actions to reduce, mitigate or offset impacts on Steedman's Gum populations within the Spotted Quoll project area.

The approved Steedman's Gum Conservation Management Plan must be implemented.

The approved Contingency Plan (if required) must be implemented."

1.3.2 Western Australian Legislative Requirements

Under the *Wildlife Conservation Act 1950* (WC Act), the Minister for the Environment may declare species of flora to be protected if they are considered to be in danger of extinction, rare or otherwise in need of special protection. Schedules 1 and 2 of the WC Act (rare flora) deal with those species that are threatened and those that are presumed extinct, respectively. *Eucalyptus steedmanii* is declared rare flora under the WC Act.

WSA obtained approval to implement the Spotted Quoll Mine under the *Environmental Protection Act 1986* (EP Act) on 17 September 2009 under conditions set out in Ministerial Statement 808. The conditions relevant to *E. steedmanii* are:

6-1 *The proponent shall not cause the loss of the Declared Rare Flora Eucalyptus steedmanii from the implementation of the proposal.*

6-2 *Prior to ground disturbing activities, the proponent shall undertake baseline monitoring of the health and abundance of the Declared Rare Flora Eucalyptus steedmanii populations 2, 3,*

3b, 7 and population 1. (including in close proximity to the haul road and the population fragment to the west of the haul road) identified in Figure 3, schedule 1.

- 6-3 *The proponent shall monitor impacts on the health and abundance of the Declared Rare Flora *Eucalyptus steedmanii* populations as identified in condition 6-2, from activities undertaken in implementing the proposal. This monitoring shall be carried out to the satisfaction of the Chief Executive Office of the Department of Environment and Conservation.*
- 6-4 *The proponent shall submit annually the results of monitoring required by condition 6-3 to the Chief Executive Officer of the Department of Environment and Conservation.*
- 6-5 *In the event that monitoring required by condition 6-3 indicates a decline in the health or abundance of Declared Rare Flora *Eucalyptus steedmanii* outside the areas to be cleared:*
- 1. the proponent shall report such findings to the Chief Executive Officer of the Department of Environment and Conservation within 21 days of the decline being identified;*
 - 2. provide evidence which allows determination of the cause of the decline;*
 - 3. if determined by Chief Executive Officer of the Department of Environment and Conservation to be a result of activities undertaken in implementing the proposal, the proponent shall submit actions to be taken to remediate the decline to the Chief Executive Officer; and*
 - 4. the actions to remediate the decline of Declared Rare Flora shall be undertaken upon approval of the Chief Executive Officer of the Department of Environment and Conservation.*
- 6-6 *The proponent shall make the monitoring reports required by condition 6-5 publicly available in a manner approved by the Chief Executive Officer of the Department of Environment and Conservation.*

1.4 Objectives

The objectives for this management plan are to:

- prevent potential adverse impacts on *E. steedmanii* populations in or adjacent to the Spotted Quoll mine site
- outline the monitoring program to monitor the impacts on *E. steedmanii* from mining activities
- raise awareness about *E. steedmanii*.

The above objectives will be achieved by:

- documenting the distribution of the species within the project area
- providing detailed species description and its preferred habitat
- identifying threatening processes to the species arising from mining operations
- developing strategies to reduce avoidable adverse impacts on the species

- identifying offsets to mitigate potential adverse impacts on the species
- outlining a monitoring program that aims to detect a decline in the health of local *E. steedmanii* populations associated with the mining activities
- allocating responsibilities for the implementation of this management plan.

1.5 Review of this Management Plan

This management plan will be reviewed every four years or in the advent of any of the following:

- Significant changes to the operations of the mine which may impact on *E. steedmanii*.
- Significant changes to the current information, mapping and census information of *E. steedmanii*.
- Significant changes to the mining footprint including expansion of the mine that would impact on *E. steedmanii*.

2 Site Description

This section provides a brief overview of the site description. More detailed information is documented in the Steedman's Gum Conservation Management Plan – Spotted Quoll Mine, Shire of Kondinin (Coffey 2009a), (Appendix A).

2.1 Overview

A detailed description of the project area can be found in the Environmental Protection Statement (EPS) document that was submitted to the EPA for assessment in 2008.

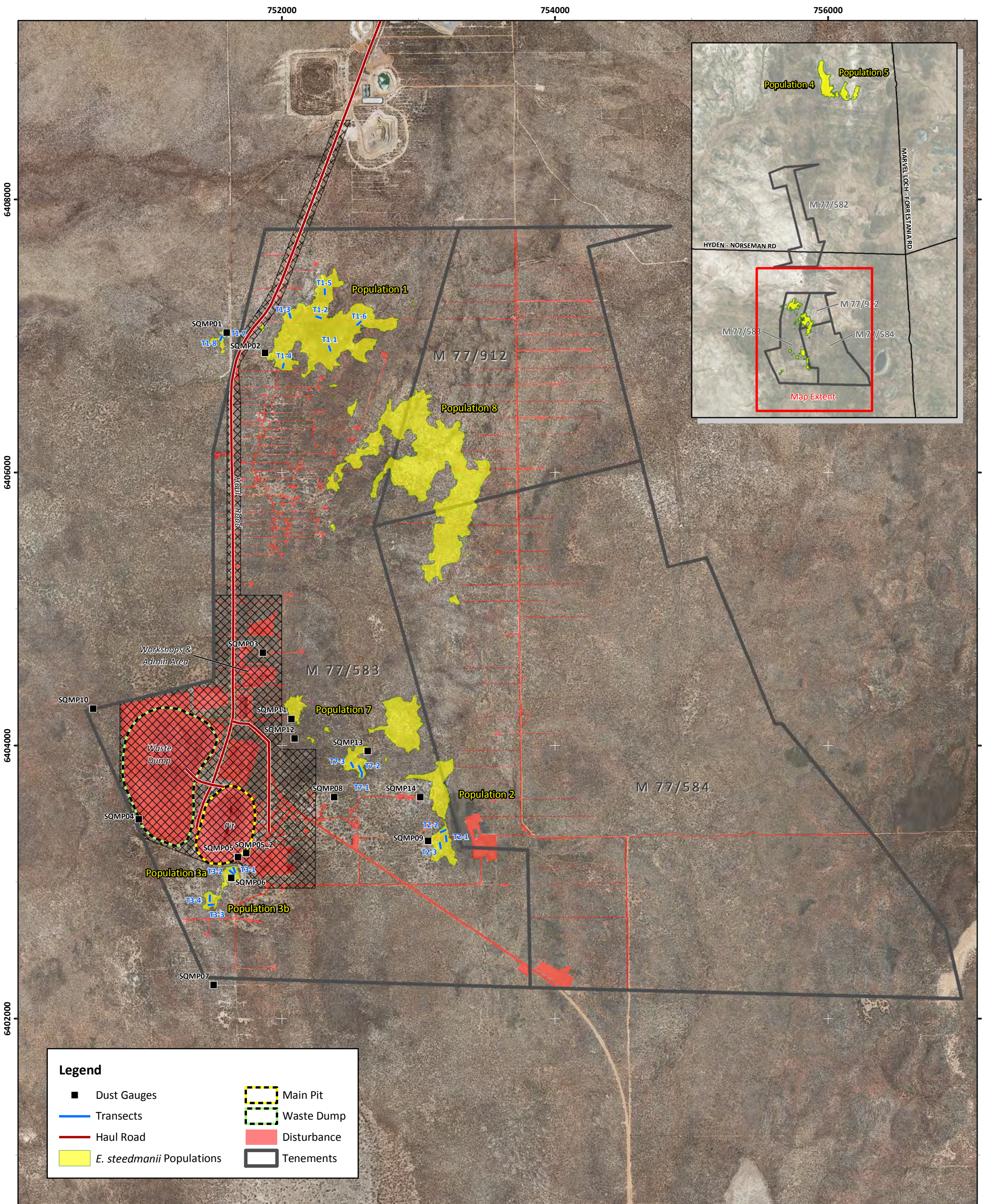
Botanical surveys conducted on site indicate that six vegetation types are present in the project area including:

1. eucalypt woodland
2. eucalypt mallee woodland
3. salmon gum woodland
4. sand plain heath
5. casuarina shrubland
6. rocky outcrop.

Eucalyptus steedmanii is present in the eucalypt woodland vegetation type. Botanica (2009) considered that the majority of the vegetation is in 'good' condition according to the Keighery (1994) condition rating scale. The condition rating 'good' is defined as: "*the vegetation structure being significantly altered, by very obvious signs of multiple disturbances, but retains basic vegetation structure or the ability to regenerate it*" (Keighery 1994).

2.2 Project Area



The project area that applies to this management plan is the area and site layout as shown in the Western Australian Government Ministerial Statement 808, Schedule 1, (Appendix D) and Figure 2.



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Figure 2: *E. steedmanii* Populations and Associated Transects & Dust Gauges



Author: R. Archibald	Date: 16-01-2014	Datum: GDA 1994 - Projection: MGA Zone 50 - Scale: 1:25,000 (A3)  
Drawn: C. Dyde	Figure Ref: 17602-14-GDR-1RevA_20140116_Fig02	

3 Species Description

Eucalyptus steedmanii is described as a small erect tree or mallee up to 8 metres (m) to 12 m high. It has a distinctive habit of producing numerous ascending branches from low on the trunk to form a very dense crown (Brown et al. 1998; Leigh et al. 1984). The smooth bark ranges from grey to bright coppery in colour. Stalked juvenile leaves are 9 centimetres (cm) long and 3 cm wide, while adult leaves are glossy olive green, up to 8 cm long and 1.5 cm wide, and are crowded with oil veins (Brown et al. 1998). Buds are yellowish- brown, held on long stalks and are square in cross-section. The buds are pendulous and appear in threes in the leaf axils. The species usually flowers in January to March and the flowers are usually cream or yellow (Brown et al. 1998). The fruits, up to 2.2 cm long and 1.7 cm in diameter, are longitudinally winged (Brown et al. 1998). A more detailed description of *E. steedmanii* can be found in Coffey (2009a) (Appendix A).



Plate 1: *Eucalyptus steedmanii* mallee form. Image from Department of Parks and Wildlife (2014).

3.1 Conservation Status

Eucalyptus steedmanii is declared as rare flora under the WC Act and listed as 'Vulnerable' under the EPBC Act.

3.2 Distribution of *Eucalyptus steedmanii*

According to Coffey (2009a), Botanica recorded eight populations of *E. steedmanii* during their 2007 flora survey (Botanica Consulting 2008). An additional population was also recorded during surveys in February 2009 (Botanica 2009). The number of plants in each population ranged from one to greater than 1,000 plants (Botanica 2008). The location of known populations in relation to the project area are shown in Figure 1. Populations of *E. steedmanii* and associated monitoring transects

and location of dust monitoring gauges within the Spotted Quoll mining tenement are shown in Figure 2.

3.3 Threatening Processes to *Eucalyptus steedmanii*

Eucalyptus steedmanii has a limited geographic distribution and no populations are currently within conservation reserves. The Commonwealth Department of Environment (DoE) has identified fire as the key threatening process to *E. steedmanii*. Fire kills adult plants but regeneration by seed has been observed following fire (Coffey 2009b). All populations were thought to be burnt in a fire in 1994, however monitoring undertaken by Botanica on behalf of WSA suggests that the populations are recovering since the fire in 1994 and in particular, the results suggest that the seed levels are increasing (Coffey 2009b).

The main potential threat to *E. steedmanii* has been identified as mining operations, firebreak maintenance and recreational activities. Populations near mining activities may be damaged through mining exploration (Department Environment Water Heritage and the Arts (DEWHA) 2008).

3.4 Potential Threats to *Eucalyptus steedmanii* at the Spotted Quoll Mine

The principal threats to *E. steedmanii* at the Spotted Quoll mine include:

- Direct loss attributable to vegetation clearing for the mining and associated infrastructure.
- Unintentional clearing of individual plants or populations.
- Indirect loss due to mining activities, in particular: dust, spillage of saline water and use of saline water for dust suppression along unsealed roads.
- Loss of plants or populations due to fire or fire management activities.

While dewatering is required at the Spotted Quoll mine site, it is considered highly unlikely that the dewatering activities would result in the death of individual plants or populations. *E. steedmanii* populations are considered highly unlikely to rely on local groundwater supplies due to the depth to groundwater (30 m below ground level) and the hypersaline characteristics of the groundwater.

4 Proposed Management Strategies

This section provides details of the management strategies that will be used to mitigate impacts on *E. steedmanii*. The primary strategy is to avoid impacts, however contingencies are also provided. Management strategies discussed in this section relate to the current operational conditions of the mine. Strategies implemented during the construction and open-pit mining operations were presented in the 2009 Conservation Management Plan (Appendix A) and subsequently reported in the WSA annual reports from 2010 to 2013.

4.1 Avoidance

The primary management strategy to prevent impacts on *E. steedmanii* is to avoid the impact. No individual plants or populations are located in proposed clearing areas. However, several plants and populations are located in close proximity to the clearing envelope. Additionally, there are plants located within 27 metres (m) of the haul road; 73 m to the south of the pit; and 60 m east of the administration area.

Prior to any clearing activities WSA will undertake targeted site surveys to accurately delineate *E. steedmanii* plants and populations in close proximity to any proposed clearing areas. As part of the targeted survey, the location of each population will be recorded using GPS as well as details relating to population size (recorded as areas occupied and numbers of individual plants). All information for the targeted survey's will be recorded and incorporated into the mine plan and used to identify individual plants or populations that may be at threat of being impacted. If there is any likelihood that *E. steedmanii* cannot be avoided, WSA will apply for approval to Department of Parks and Wildlife (DPaW) for a permit to take declared rare flora (DRF).

The mine plan has been designed to avoid local populations of *E. steedmanii* including:

- The waste rock dump has been positioned to be more than 340 m from the nearest *E. steedmanii* population.
- The alignment of the haul road and infrastructure corridor has been designed to avoid *E. steedmanii* populations with the closest point being located 27 m from the nearest population (Figure 2).
- The pit is located approximately 73 m from the nearest *E. steedmanii* population.

Additional to avoiding impacts to *E. steedmanii*, the following strategies will be implemented.

4.2 Population Mapping and Demarcation

All known locations of *E. steedmanii* populations have been accurately mapped using a GPS and will be updated and incorporated into the mine planning. Eight populations have been mapped (Figure 1) and a census of the population is updated every four years. Prior to any ground disturbing activities, all known locations of *E. steedmanii* will be identified and marked. This is conducted by:

- Delineating clearing boundaries with high visibility flagging.
- Erection of protective fencing adjacent to the works to protect populations from unintentional clearing.
- Installing signage at DRF exclusion zones to warn personnel that *E. steedmanii* is present.
- WSA environmental staff supervising all clearing activities.

4.3 On Site Awareness

Awareness, education and understanding *E. steedmanii* by personnel of the Spotted Quoll mine site is of high importance. Raising awareness of this species will assist in minimising the accidental damage or loss of the species. Prior to any ground disturbing activities:

- WSA will ensure information in regards to *E. steedmanii* is included in all environmental management training, inductions and responsibilities for staff and contractor.
- WSA personnel will provide information at staff and contractor toolbox meeting as well as regular presentations at site meetings. In particular the use of photos and details of *E. steedmanii* will be provided to assist with identification of the species in the field. Additionally, information in regards to known locations of the species, management strategies and incident reporting will be provided to all staff and contractors.
- In addition, as spillage of saline water has the potential to impact on *E. steedmanii* health, the Mine Manager must notify the Environmental Manager of any incidence of a spill within *E. steedmanni* populations.

4.4 Access Management

Vehicle access into areas with *E. steedmanii* will be restricted. Access will be via the designated haul roads only; including the infrastructure and haul road corridor between the Spotted Quoll mine and the Flying Fox mine to the north.

Access to areas containing *E. steedmanii* will be prohibited except for monitoring purposes. Signage will be installed warning personnel of the presence of DRF. In the event that access isn't required, permission will be required from the WSA Environmental Manager and access is to be undertaken under supervision of the Environmental Manager.

4.5 Dust Management

Dust may be generated into areas containing *E. steedmanii* as a result of the disturbance of fine particles derived from soil and rock, the handling of bulk construction material such as crushed hard rock aggregate, and the clearing of vegetation and disturbance of soil (Coffey 2009a). Effects are usually localised and depend on the size of the dust particles and the strength of distributing factors and usually decrease rapidly with the separation from the source (Coffey 2009a).

Dust is more likely to be a hazard close to the mine (e.g. less than 1,000 m) while further away from the mine, dispersion reduces this hazard for a given wind speed and direction (Coffey 2009a). Under adverse weather conditions dust can travel considerable distances, potentially resulting in its deposition on *E. steedmanii* populations. Extreme levels of dust deposition can stress vegetation by blocking stomata which impacts on gas exchange and reducing light availability which reduces photosynthetic ability and limits plant growth.

Climate data from Hyden (approximately 80 km east of the mine) indicated that the average wind speeds vary throughout the year from 6.2 to 10.3 km per hour in the morning to 8.1 to 10.7 km per hour in the afternoon. During summer the prevailing winds are easterlies in the morning and strong south easterlies in the afternoon. Throughout winter the morning winds are more north-westerly with lighter more directionally variable winds experienced in the afternoon (Coffey 2009a).

The mine is located in a semi-arid environment, experience dry summer months, during which time dust generation is expected to be at a peak. The greatest potential for impact will be within the immediate environs of mining activities and on the surrounding vegetation (Coffey 2009a).

Mining activities that are likely to generate dust include:

- removal of vegetation and topsoil
- light and heavy vehicle movement over unpaved surfaces
- construction of haul road and tracks
- drilling and blasting
- operations such as pit excavation and overburden and waste removal
- ore handling
- ore transport
- stock piling.

4.5.1 Reduction of Dust Impacts Due to Change In Mining Operations

A key change in the potential impacts of dust on *E. steedmanii* was made when the majority of the mining operations were changed from open pit to underground mining. Dust had a high probability of impact when the mine was in construction and open pit phases of its operation. The current phase of operation (underground) has reduced the likelihood of dust generation considerably.

4.5.2 Dust Management Strategies

Specific dust management activities will include:

- Stabilisation of topsoil stockpiles with either salvaged vegetation or stabilizing emulsion.
- Restriction of vehicle speeds in high risk dust-generating areas.
- Application of dust suppression methods along haul roads to minimize dust emissions using water carts with dribble bars during dry dusty periods (Water used for dust suppression of roads will be from dewatering operations).
- Where *E. steedmanii* populations are located adjacent to areas being watered, runoff will be prevented by constructing earth bunds where necessary.

Dust deposition gauges have been installed at *E. steedmanii* populations that are at the highest risk of impact from dust. For example, those populations that are located adjacent to the haul road and also the population south of the pit.

4.6 Fire Management

According to Coffey (2009a) the Forrestania region was last burnt in 1994. This fire contributed to pressures on seed levels of *E. steedmanii* and placed the conservation of this species at risk from further fires (Coffey 2009a).

Fires in the project area can be started from natural sources (e.g. lightning strikes) or accidental ignition from personnel or mining operations.

4.6.1 Fire Management Strategies

WSA will manage the risk of fire from the principle of avoidance and will implement the following fire management strategies:

- Construct and maintain firebreaks in the Project area in line with legislative requirements (the *Bush Fires Act 1954*).
- Fire breaks will avoid all the *E. steedmanii* populations.
- Provided appropriate on-site fire-fighting equipment including water tanker with pumps, fire extinguishers and equipment on vehicles.
- Provide adequate training for on-site staff in fire prevention and management. Firefighting staff will be informed of the presence of *E. steedmanii* populations.
- Undertake annual fuel-loading assessment in the areas surrounding the mine. The results of the assessment will be discussed with DPaW and the Department of Fire and Emergency Services (DFES) to consider the most appropriate management options.

5 Monitoring Program

Eucalyptus steedmanii populations will be monitored to enable early detection of adverse impacts as a result of mining activities. Populations 1, 2, 3 and 7 are considered potential impact areas; although, Populations 2 and 7 are not considered potential impact areas for dust deposition. Populations 4 and 5 are treated as control populations for regular monitoring. Populations 6 and 8 are only monitored during four yearly censuses and are treated as controls (Botanica 2014). The monitoring actions are outlined for each of the following three phases: prior to the commencement of any additional clearing operation, and closure. As at 2014, the mine was in the operations phase.

5.1 Review of the Monitoring Program

A comprehensive review of the existing monitoring program which was established in 2009 was conducted by Astron in 2014 and is reported in the Forresteria *Eucalyptus steedmanii* Monitoring Program Review (Appendix E). The monitoring program review identified opportunities to improve both the effectiveness and the efficiency of the monitoring program. Monitoring data to date indicates that *E. steedmanii* is generally very healthy and has not been negatively affected by construction or operations associated with the mine (Astron 2014). Given this, it was recommended that the frequency of some of the monitoring activities could reasonably be reduced. The current risk of impact is low for dust and other threatening processes, and variation in results for tree health and reproduction from one monitoring survey to the next, is minimal and not declining. However, monitoring effectiveness could be improved by incorporating additional measures during each survey: tree health ratings using a finer scale and rating abundance of fruit on each tree (Astron 2014).

The following sections outline the newly revised monitoring program incorporating the results of the monitoring program review.

5.2 Monitoring During Operations

The monitoring requirements during operations are summarised in Table 1.

Table 1: Summary of monitoring requirements during operations and closure. "Plant" refers to an *E. steedmanii* individual.

Activity	Parameters	Populations	Frequency
Census	<ul style="list-style-type: none"> Plant density Plant condition rating Reproductive status 	1 to 8 ^a	Four yearly.
<i>E. steedmanii</i> health monitoring (observation)	<ul style="list-style-type: none"> Visual observations and photographs 	1, 3A/3B and plants identified by Botanica (2009)	Quarterly.
<i>E. steedmanii</i> health monitoring (ratings)	<ul style="list-style-type: none"> Plant condition rating Presence of seed Seed development Recruitment 	1,2, 3A/3B and 7. 4, 5 and 6.	Quarterly. Annually.
Dust deposition (gauges)	<ul style="list-style-type: none"> Weight per unit area per unit time 	At-risk populations and control areas*	Quarterly.
Dust deposition (<i>E. steedmanii</i>)	<ul style="list-style-type: none"> Deposition rating 	At-risk populations and control areas*	Quarterly.

Activity	Parameters	Populations	Frequency
Fuel Load	<ul style="list-style-type: none"> Unspecified 	Areas surrounding Spotted Quoll operations.	Annual.
Miscellaneous potential threats	<ul style="list-style-type: none"> Unintentional clearing Spillage of saline water Fire and fire management Uncontrolled vehicle access 	Areas surrounding Spotted Quoll operations.	Concurrent with above monitoring activities and opportunistic surveillance at other times.

Notes:

^ Since the management plan was prepared by Coffey (2009a), Population 8 was identified and included in censuses (Botanica 2014)

*At-risk populations with respect to dust deposition are those adjacent to the haul road and those to the south of the pit; therefore, Population 1, 3a and 3b. Dust gauges and *E. steedmanii* monitoring transects at population 2 and 7 are therefore assumed at present to be controls (that is, sites where no impact of dust from operations is expected).

5.2.1 Census

A population census of all eight known *E. steedmanii* populations in the Forrestania region will be undertaken by WSA every four years until completion of the mining operation. Censuses were completed in 2009 (Botanica 2009) and 2014 (Botanica 2014).

The census will record numbers of *E. steedmanii* in each population, *E. steedmanii* health (Section 5.2.2), reproductive status (section 5.2.3) and the plants location. This action is in accordance with the Conservation Advice developed by the DEWHA (2008) for the management of *E. steedmanii*.

5.2.2 Plant Health Monitoring (Observations)

Conduct quarterly visual observations of *E. steedmanii* populations in close proximity to the haul road and operations (that is, Populations 1, 3a/3b and other plants identified by Botanica (2009)). Written and photographic records will be kept of the visual inspections of *E. steedmanii* conditions.

5.2.3 Plant Health Monitoring (Ratings)

Quarterly monitoring of *E. steedmanii* health and reproductive status along transects in populations 1, 2, 3A/3B and 7, and annual monitoring of *E. steedmanii* health in Populations 4, 5 and 6 is to be conducted by WSA.

Health for each *E. steedmanii* that intersects the transect, will be assessed using two scoring systems. The first is the same 0 to 3 system as used during the baseline period (see Section 5.1) and the second is the modified version of the Grimes (1978) system based on a 0 to 17 point scale that takes into account canopy density, dead branches and epicormic growth as component scores (Appendix E for full description).

Reproductive status for each *E. steedmanii* that intersects the transects will be recorded for presence or absence of fruit; if fruit is present, the stage of development (mature or immature) will be recorded for each plant along with a rating of abundance based on Souter et al. (2009) as follows:

- 1 = present but not readily visible (Scarce)
- 2 = clearly visible throughout the crown (Common)
- 3 = dominates the appearance of the crown (Abundant).

5.2.4 Dust Deposition (Gauges)

Dust in deposition gauges will be collected quarterly for control chart analysis. Results will be correlated with visual plant health observations and transect monitoring data. Data will be provided to DPaW annually.

5.2.5 Dust Deposition (Plants)

During quarterly monitoring of *E. steedmanii* along transects, a 1 to 5 rating for the quantity of dust deposition on each *E. steedmanii* that intersects the transect will be recorded (Table 2).

Table 2: Astron formulated dust deposition rating.

Dust deposition rating	Dust deposition descriptor	Definition
1	Negligible	No dust obviously visible on plant Virtually no cloud of dust when plant is shaken No trace of dust when rubbing plant
2	Low	Thin layer of dust apparent on leaves / stems Dust may or may not come off when plant is shaken Only very small amount of dust can be rubbed off Amount of dust too little to be noticeable between fingers
3	Moderate	Plant obviously covered in dust but leaf colour plainly visible Dust falls off in a thin cloud when plant is shaken Dust can be rubbed off plant Grit/powder noticeable between fingers, smear thin when wet
4	High	Plant covered in dust, but leaf colour is faintly visible through dust layer Dust falls off in a cloud when plant is shaken Dust can be rubbed off plant Grit/powder noticeable between fingers, smear opaque when wet
5	Extreme	Dust is caking the plant thickly, leaf/stems take on colour of dust Dust falls off in a thick cloud when plant is shaken Dust can be rubbed off leaves or stems Dust feels powdery/gritty between fingers, smear clayey when wet

5.2.6 Fuel Load

WSA is to undertake annual fuel-loading assessments in the areas surrounding the Spotted Quoll operations. WSA will also initiate consultation with DPaW and DFES to consider appropriate management options.

5.2.7 Miscellaneous Potential Threats

Whilst undertaking monitoring as outlined in Sections 5.2.1 to 5.2.6; WSA is to record the location and extent of any unintentional clearing, saline water spillage, fire or fire management activity or uncontrolled vehicle access where *E. steedmanii* is present within the Spotted Quoll tenements. Such incidences may also be noted during general surveillance by WSA environmental personnel or via reports from other WSA staff. These records will enable any impacts on *E. steedmanii* from these incidences to be assessed over time.

5.3 Closure

Monitoring will continue as outlined in Section 5.2 until completion of rehabilitation activities within the project area by WSA. Following completion of rehabilitation, monitoring of plant condition and population size will be undertaken biannually for a period of two years by WSA.

5.4 Contingency Planning

In the event that any adverse change is detected in the *E. steedmanii* condition or population size, WSA will advise DoE, DPaW and Department of Mines and Petroleum (DMP). The cause of the change will be further investigated to determine if the change is a result of the Spotted Quoll operations. If the cause of the change is attributable to WSA operations, a contingency plan will be developed outlining proposed actions to reduce, mitigate or offset impacts on *E. steedmanii* populations within the Spotted Quoll project area. The contingency plan will be submitted to DoE and DPaW for approval; WSA will continue to liaise with DPaW.

The monitoring schedule will be adapted depending on monitoring results or circumstances. Contingencies for temporarily increasing the frequency of monitoring or increasing the number of monitoring locations have also been outlined in the event that a potential threat to *E. steedmanii* health is identified (Table 3).

An acceptable limit for dust deposition has been set at three standard deviations of the mean for each gauge based on deposition records to date (values below three standard deviations but exceeding two standard deviations simply provide an alert to management). In the event that this three standard deviation limit is exceeded, dust suppression measures will be reviewed and more stringent measures implemented as appropriate. In addition, monthly monitoring of dust deposition on plants will occur at the transects in the populations near the dust gauge where any exceedance is recorded, until dust deposition readings return to below three standard deviations from the mean. If the dust levels on plants exceed predetermined limits, monthly monitoring of plant health in the affected area will be triggered (Table 3).

Table 3: Contingency monitoring schedule relevant to *E. steedmanii* threats that are directly monitored.

Threat	Trigger	Response
Dust	Exceedance of Control Limit 2 (3 standard deviations from mean) for dust deposition in gauges.	Monitor dust deposition on plants (dust deposition rating) in the population adjacent to the dust gauge on a monthly basis until dust deposition as measured in gauges fall below Control limit 2.
	For each population: if mean dust deposition rating is 3 or above, or any tree assessed during monitoring surveys is rated as 4 for dust deposition.	Undertake plant health monitoring at this population and at the nearest reference population on a monthly basis until dust deposition ratings return below the trigger.
Miscellaneous	Report of the following within an <i>E. steedmanii</i> population in the WSA tenement: <ul style="list-style-type: none"> • unintentional clearing • spillage of saline water • fire and fire management activity • uncontrolled vehicle access. 	If the affected area does not include a current monitoring transect, a new transect to be established. Undertake plant health monitoring within the affected area on a quarterly basis for 12 months.

6 Offsets

WSA has worked with DPaW and its Threatened Flora Seed Centre to sustainably harvest seed from local *E. steedmanii* populations. This offset is in accordance with the conservation advice developed by DEWHA (2008) for the management of *E. steedmanii* (Coffey 2009a). Approximately 5 kg of *E. steedmanii* seed was collected prior to commencement of ground disturbance activities at the Spotted Quoll Mine

WSA will consider opportunities for formalised agreements for the protection of *E. steedmanii* populations within its mining tenements.

7 Responsibilities and Reporting

7.1 Responsibilities

This section outlines the responsibilities for the implementation of this management plan.

7.2 WSA Registered Manager

The overall responsibility for ensuring that the site environmental management requirements are met, and that this management plan is implemented, will be with the WSA Registered Manager. The Registered Manager's responsibilities will include:

- Ensuring that all construction and operation site personnel are aware of the environmental responsibilities and obligations.
- Ensuring that all contractor staff are fully inducted and are aware of their environmental responsibilities and obligations.
- Allocating resources to ensure that all commitments are met.

7.3 WSA Environmental Manager

The site Environmental Manager is responsible for:

- Ensuring that annual and monthly monitoring requirements are undertaken in accordance with this management plan.
- Reporting the monitoring results to the Registered Manager in accordance with the management plan.
- Coordinating seed collection in consultation with DPaW.
- Ensuring that all annual reports required under State and Commonwealth approvals are prepared and submitted within the required timeframes.

7.4 WSA Mine Manager

The Mine Manager is responsible for ensuring that all staff and contractors are provided with a copy of this management plan.

7.5 Site Personnel

Site Personnel are responsible for:

- Working in accordance with this management plan.
- Reporting non-compliance to this management plan, or any other environmental incidents or emergencies impacting *E. steedmanii* to their supervisor.
- Attending inductions and environmental awareness training sessions.

7.6 Records and Reporting

All non-compliances to this management plan are to be reported to the Registered Manager within 24 hours of the breach.

Site personnel and the mine manager will be responsible for recording the details of the breach and providing the details to the Registered Manager. WSA will be responsible for notifying all relevant government departments including DMP, DPaW, EPA, DoE and Department of Environment Regulation.

An internal monitoring report will be prepared every six months and submitted to the Registered Manager.

All records of *E. steedmanii* monitoring will be summarised in the Annual Environmental Report, which will be submitted to the EPA, DMP and DoE.

8 References

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- Leigh et al. 1984 (Leigh, J., Boden, R. and Briggs, J.) Extinct and Endangered Plants of Australia. Macmillan Australia, Melbourne and Sydney.

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Appendix A: Steedman's Gum Conservation Management Plan – Spotted Quoll Mine, Shire of Kondinin (August 2009)

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**STEEDMAN'S GUM CONSERVATION
MANAGEMENT PLAN -
SPOTTED QUOLL MINE, SHIRE OF
KONDININ**

Prepared for:

Western Areas NL
11 Ventnor Avenue
WEST PERTH WA 6005

Report Date: 6 August 2009
Project Ref: EP2009/123 V1

Written/Submitted by:

Reviewed/Approved by:

PP 

Paul Zuvela
Manager (Environmental
Planning)



Martine Scheltema
Principal

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1 INTRODUCTION

1.1 Background

Western Areas NL (WSA) proposes to develop an open pit nickel mine at its Spotted Quoll deposit (M77/583) as part of its Forrestania project. Along with the Flying Fox mine (located approximately 6km north of the proposed Spotted Quoll mine) and other deposits under development, WSA aims to be producing 35,000 tonnes of nickel concentrate per annum by 2011.

The proposed Spotted Quoll mine is situated approximately 160 kilometres south of Southern Cross and 80 kilometres east of Hyden in the Shire of Kondinin (Figure 1). The mining operation will be carried out on Mining Leases 77/583 and 77/545 (Figure 2) that are 100% owned by WSA.

The proposed mining operation involves the establishment of an open pit mine. The proposed pit will be approximately 150m deep and 600m long in a north-south alignment. It will have an operational life of four years.

The works associated with the mine will comprise site preparation, operation and rehabilitation (including landform reconstruction).

Pre-mine establishment works will involve the clearing of native vegetation, topsoil stripping, removal of overburden, drainage works and the establishment of haul roads and infrastructure.

Overburden removed from the proposed open cut pit area will be used to construct infrastructure such as the run of mine pad, access roads, internal haul roads, ramps, parking bays and the water storage pond. A haul road will be constructed between the Spotted Quoll operation and the Flying Fox mine located 6km to the north.

Approximately 140ha of native vegetation will be removed during the course of the Spotted Quoll mining operation. Clearing in the proposed area of the waste rock stockpile will be undertaken as an incremental process in line with waste dump requirements, which will minimise the length of time that topsoil materials will be stored.

The nickel ore will be removed extracted via open pit mining. The operation will involve:

- Drilling and blasting;
- Excavation of wet ore;
- Haulage of ore to run of mine pad; and
- Loading of ore to road trains for transport to Cosmic Boy concentrator via Flying Fox mine.

No processing of extracted ore will be undertaken at the Spotted Quoll operation. The extracted ore will be transported by road train along a constructed haul road to the Flying Fox mine, and then via a gazetted road (already constructed) to the Cosmic Boy site for processing (Figure 2).

The extraction of the ore will require dewatering of groundwater to lower the groundwater by approximately 130m below ground surface. The mine water will be piped from the Spotted Quoll operation to a settling pond located to the north of the open cut pit and then to the abandoned Lounge Lizard and McMahon's gold pits which is located 1 to 1.5km to the south of Flying Fox mine site via an underground pipeline. The pipeline will be installed within the proposed infrastructure corridor between the Spotted Quoll operation and the Flying Fox mine.

Waste rock will be disposed of in waste rock dumps located to the northwest of the open cut pit.

On completion of mining activities the mine site will be decommissioned and rehabilitated. It is proposed that rehabilitation will be progressively undertaken during mining operations.

Vegetation and flora surveys conducted for WSA by Botanica Consulting (2008, 2009) identified the presence of Declared Rare Flora (DRF) (*Eucalyptus steedmanii*) adjacent to the proposed mine site.

Declared Rare Flora 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, and have been gazetted as such, following approval by the Minister for the Environment, after recommendation by the State's Endangered Flora Consultative Committee (DEC, 2008). DRF are protected under the Western Australian *Wildlife Conservation Act 1950* and in some instances under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The Spotted Quoll Mining Project was referred to the Department of Environment, Water, Heritage and the Arts (DEWHA) and was determined to be a controlled action due to potential effect on listed threatened species and communities.

Condition 1 of the EPBC Approval (EPBC 2008/4443) states:

In order to protect the Steedman's Gum (Eucalyptus steedmanii), the person taking the action must:

- a/ Prior to clearance of native vegetation, provide for the Minister's approval a detailed species Conservation Management Plan (the Steedman's Gum Conservation Plan) for monitoring and managing impacts on the Steedman's Gum populations within the Spotted Quoll project (as described in the EPBC referral). The Steedman's Gum Conservation Plan must include a monitoring program and detailed measures for ensuring the on-going viability of all Steedman's Gum populations within the Spotted Quoll project.*
- b/ If it is established through the monitoring program that the viability of any Steedman's Gum population within the Spotted Quoll project area is threatened, provide for the Minister's approval a Contingency plan to outline actions to reduce, mitigate, or offset impacts on Steedman's gum populations within the Spotted Gum project area.*

The approved Steedman's Gum Conservation Management Plan must be implemented.

The approved Contingency Plan (if required) must be implemented.

The Spotted Quoll Mining Project was assessed by the EPA as an Environmental Protection Statement (EPS), and whilst yet to receive Ministerial approval, the EPA has recommended the following conditions relating to the protection and management of *Eucalyptus steedmanii* (EPA, 2009):

- 6.1 The proponent shall not cause the loss of the Declared Rare Flora Eucalyptus steedmanii from the implementation of the proposal.*
- 6-2 Prior to ground disturbing activities, the proponent shall undertake baseline monitoring of the health and abundance of the Declared Rare Flora Eucalyptus steedmanii populations 2, 3a, 3b, 7 and population 1 (including individuals in close proximity to the haul road and the population fragment to the west of the haul road) identified in Figure 3, schedule 1.*
- 6-3 The proponent shall monitor impacts on the health and abundance of the Declared Rare Flora Eucalyptus steedmanii populations as identified in condition 6-2, from activities*

undertaken in implementing the proposal. This monitoring shall be carried out to the satisfaction of the Chief Executive Officer of the Department of Environment and Conservation.

- 6-4 *The proponent shall submit annually the results of monitoring required by condition 6-3 to the Chief Executive Officer of the Department of Environment and Conservation.*
- 6-5 *In the event that monitoring required by condition 6-3 indicates a decline in the health or abundance of Declared Rare Flora (DRF) *Eucalyptus steedmanii* outside the areas to be cleared:*
1. *the proponent shall report such findings to the Chief Executive Officer (CEO) of the Department of Environment and Conservation (DEC) within 21 days of the decline being identified;*
 2. *provide evidence which allows determination of the cause of the decline;*
 3. *if determined by CEO of the DEC to be a result of activities undertaken in implementing the proposal, the proponent shall submit actions to be taken to remediate the decline to the CEO; and*
 4. *the actions to remediate the decline of DRF shall be undertaken upon approval of the CEO of the DEC.*
- 6-6 *The proponent shall make the monitoring reports required by condition 6-5 publicly available in a manner approved by the Chief Executive Officer of the Department of Environment and Conservation.*

1.2 Purpose and Scope

The purpose of this Conservation Plan is to outline proposed measures to ensure the protection of *Eucalyptus steedmanii* (Steedman's Mallet) populations adjacent to the proposed Spotted Quoll mine site. The Conservation Management Plan has been developed in line with Condition 1 of the EPBC approval for the Spotted Quoll project (Appendix A) and Condition 6 of the draft Statement that a Proposal may be Implemented pursuant to the *Environmental Protection Act 1986* (Appendix B).

The plan applies to the following phases of the project:

- Pre-construction
- Construction and operation
- Post Closure.

The plan applies to activities conducted on Mining Leases 77/583 and 77/545.

1.3 Objectives

The objectives of this plan are to:

- Prevent potential adverse impacts on *Eucalyptus steedmanii* populations in, or adjacent to the proposed Spotted Quoll mine site and its associated operations; and
- Raise awareness about *Eucalyptus steedmanii*.

The above objectives are proposed to be achieved by:

- Documenting the distribution of the species in the vicinity of the proposed Spotted Quoll operations;
- Providing detailed species description and its preferred habitat;
- Identifying threatening processes to the species arising from the implementation of the Spotted Quoll operation;
- Developing strategies to reduce avoidable adverse impacts on the species;
- Identifying offsets to mitigate potential adverse impacts on the species;
- Outlining a monitoring program that aims to detect a decline in the health of local *Eucalyptus steedmanii* populations associated with the proposed mining activities; and
- Allocating responsibilities for the implementation of this Conservation Plan.

2 SITE DESCRIPTION

2.1 Climate

The climate in the general area of the Spotted Quoll Mine is semi-arid to arid and can be characterised by its relatively low annual rainfall and large temperature range.

Mean annual maximum temperature is 24.6°C and mean annual minimum 9.7°C. Daily maxima above 40°C are common from November to March. The coldest month is July and diurnal temperature variations are commonly high throughout the year (Keith Lindbeck and Associates, 2008).

The area is semi arid and the annual average rainfall at Hyden is 344.7 mm. Most of the rain falls between May and August and this amount varies greatly both seasonally and annually (Keith Lindbeck and Associates, 2008).

Climate data for Hyden (approximately 80km east of the Spotted Quoll operation) indicates that the average wind speeds vary throughout the year from 6.2 - 10.3 km/hr in the morning to 8.1 -10.7 km/hr in the afternoon. During summer the prevailing winds are easterlies in the morning and strong south easterlies in the afternoon. Throughout winter the morning winds are more north-westerly in direction, with lighter, more directionally variable winds experienced in the afternoon.

2.2 Geology and Soils

The Spotted Quoll project lies in the Forrestania Greenstone Belt (FGB), a southern extension of the Southern Cross Greenstone Belt. The greenstone belts of the Yilgarn craton are major sequences of basic to ultramafic rocks with varying levels of entrained sedimentary rocks laid down semi-contemporaneously.

The FGB is constrained by granitoid rocks that developed during the late Archaean / Proterozoic and form the western and eastern boundaries to the FGB. During the period of granite emplacement significant alteration, folding and faulting occurred within the FGB. The most significant alteration to the greenstone "stack" of mafics, ultramafics, and sediments was the formation of a major synclinal structure. This feature dominates the structural geology of the region.

The Spotted Quoll deposit is located within the traditional footwall, away from the basal ultramafic-footwall metasediment contact, which was probably the original locus for sulphide deposition from an overlying pile of komatiite flows. Subsequent metamorphism, deformation and intrusion of granitoid dykes/sills has contributed to a complex setting, with mineralisation now occupying a possible shear zone within the footwall metasediments.

Common soils are sandy duplexes (often alkaline), with ironstone gravely soils, loamy earths (often calcareous) with some loamy duplexes, sandy earths, deep sands and saline wet soils (Tille, 2006).

2.3 Vegetation and Flora

2.3.1 Vegetation Types

WSA commissioned Botanica Consulting to complete a flora and vegetation survey of the New Morning to Spotted Quoll area within Tenements M77/583 and M77/545. The flora and vegetation survey included the Spotted Quoll mine site, waste dump and pipeline/access roads.

Botanica Consulting (2009) mapped six vegetation types which are described below and shown in Figure 3. All of these vegetation types are found in the proposed project area (clearing envelope).

Eucalyptus Woodland: The dominant overstorey species in this vegetation type include *Eucalyptus flocktoniae*, *E. urna*, and *E. salubris* over an understorey of *Melaleuca adnata*, *Grevillea obliquistigma*, *Acacia eremophila*, *Eremophila densiflora*, *Melaleuca cardiophylla*. The dominant small shrubs of this vegetation type included *Microcybe multiflora*, *Dodonaea stenozyga*, *Wilsonia humilis* and *Acacia intricata*.

Eucalyptus Mallee Woodland: The dominant overstorey species in this vegetation type were *Eucalyptus eremophila* subsp. *eremophila*, *E. cylindrocarpa* and *E. leptophylla* over an understorey of *Acacia coolgardiensis*, *Melaleuca hamata*, *M. pauperiflora* subsp. *pauperiflora*, *Acacia hemiteles*, *Melaleuca cordata* and *M. cucullata*. The dominant small shrubs of this vegetation type included *Dodonaea bursariifolia*, *Phebalium tuberosum* and *Grevillea acuaria*.

Salmon Gum Woodland: The dominant overstorey species in this vegetation type was *Eucalyptus salmonophloia* over an understorey of *Melaleuca adnata*, *M. hamata*, *M. pauperiflora* subsp. *pauperiflora*, *Eremophila decipiens* subsp. *decipiens* and *Daviesia benthamii*. The dominant small shrubs of this vegetation type included *Dodonaea stenozyga*, *Phebalium tuberosum* and *Grevillea acuaria*.

Sand Plain Heath: This vegetation type was dominated by shrubs up to 2m in height. The dominant species of this vegetation type included *Allocasuarina corniculata*, *Acacia fragilis*, *Leptospermum erubescens*, *Melaleuca uncinata*, *Thyrtomene kochii*, *Banksia cirsioides*, *Leptosema daviesioides*, *Verticordia chrysanthella* and *Darwinia inconspicua*.

Allocasuarina Shrubland: This vegetation type was a shrubland dominated by *Allocasuarina campestris*, *A. acutivalvis* and *Acacia steedmanii*. Understorey species were dominated by *Melaleuca pentagona*, *M. laxiflora* and *Conospermum brownie*.

Rocky Outcrop: The dominant overstorey species in this vegetation type were *Eucalyptus calycogona* and *E. pileata*. Understorey species were dominated by *Melaleuca hamata*, *Hakea subsulcata* and *Acacia hemiteles*, *Atriplex stipitata* and *Hibbertia pungens*.

Botanica (2008) reported that the survey area does not contain any threatened ecological communities (TECs). According to DEWHA's *Protected Matters Search Tool*, the survey area has no regional significance (Botanica, 2009).

2.3.2 Vegetation Condition

The condition of vegetation in the survey area was assessed by Botanica (2009) using the condition rating scale of Keighery (1994) published in *Bush Forever* (Government of Western Australia, 2000). Keighery's condition rating scale ranges from Pristine (where vegetation exhibits no visible signs of disturbance) to Completely Degraded (where vegetation structure is no longer intact and without native plant species).

Botanica (2009) considered the majority of the vegetation to be in Good condition (Figure 4). According to the Keighery (1994) condition rating scale, Good is defined as: the vegetation structure being significantly altered, by very obvious signs of multiple disturbance, but retains basic vegetation structure or the ability to regenerate it.

Botanica's (2008) classification of the vegetation condition as Good was influenced by evidence of historic exploration lines and an existing track. Fire had burnt part of the survey area in 1994. There was no evidence of broad scale clearing for agricultural purposes, or invasive weed species.

A portion of the project area was classified as being in a Degraded condition (Figure 4). Degraded is defined as: the structure is severely disturbed, but has the ability to regenerate to a good condition with intensive management. Botanica's classification of vegetation as being in a degraded condition was largely due to disturbance resulting from drilling activities.

A small portion of the project area, largely adjacent to the haul road is in Very Good condition (Figure 4).

2.3.3 Flora

A total of 158 plant taxa represented across 62 Genera and 28 families were recorded in the survey area. No exotic species were identified during the surveys.

The dominant families represented from the survey included Myrtaceae, Proteaceae and Mimosaceae.

Dominant species in the area included:

- *Acacia steedmanii*
- *Allocasuarina campestris*, *A. acutivalvis* and *A. corniculata*
- *Eucalyptus calycogona*, *E. pileata*, *E. salmonophloia*, *E. eremophila*, *E. cylindrocarpa*, *E. leptophylla*, *E. flocktoniae*, *E. urna* and *E. salubris*

A complete list of flora recorded during the Botanica surveys (2009) is provided in Appendix C.

2.3.4 Conservation Significant Flora

The DEC Declared Rare and Priority Flora database search identified the potential for 93 DRF or Priority Flora (Appendix D) to be in, or within 10km of the survey area. Of these 93 species, 1 was DRF – presumed extinct, 6 were DRF, 24 were Priority 1 species, 18 were Priority 2 species, 31 were Priority 3 species and 13 were Priority 4 species.

One DRF and two Priority Flora were recorded by Botanica (2008, 2009) during the surveys. These were:

- *Eucalyptus steedmanii* (DRF);
- *Eremophila racemosa* (Priority 4); and
- *Microcorys sp.* Forrestania (Priority 4).

In addition to the two priority species listed above, the DEC has previously recorded one Priority 2 species (*Stylidium sejunctum*) within the survey area. This species was searched for by Botanica during the spring 2007 and autumn 2008 surveys but not recorded.

The three Priority species (including the DEC recorded *Stylidium sejunctum*) were recorded within one kilometre of the Spotted Quoll project area and pipeline corridor while the DRF species was located within the Spotted Quoll project area. The location of conservation significant flora is shown in Figure 3.

3 SPECIES PROFILE

3.1 Conservation Status

3.1.1 *Wildlife Conservation Act 1950*

The Western Australian *Wildlife Conservation Act 1950* defines rare flora as species that:

- Are likely to become extinct or are rare, or otherwise in need of special protection; or
- Are presumed to be extinct in the wild and therefore in need of special protection should they be re-discovered.

It is an offence 'to take' rare flora for any purpose and on any lands without written consent of the responsible Minister. Under the Act 'to take' is any direct or indirect action that may impact on the DRF.

Eucalyptus steedmanii is classified as a DRF. This status means that the species has been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such.

Brown *et al.* (1998) noted that this species is considered Vulnerable as there were (then) six known populations of this species on vacant Crown Land, with no known populations in conservation reserves. All populations were burnt by a fire in 1994, and are being monitored (Brown *et al.*, 1998).

Following consultation with Dr Ken Atkins (DEC), Jim's Seeds, Weeds and Trees Pty Ltd (2006) noted that it was DEC's general view that *Eucalyptus steedmanii* should remain on the DRF list until seed banks have reached sufficient levels that will support regeneration of populations. If seed levels were to increase to a sustainable level, then the DEC would consider nominating for the conservation status of the species to be reduced to a Priority level.

3.1.2 *Environment Protection and Biodiversity Conservation Act 1999*

Eucalyptus steedmanii is listed for protection under the Commonwealth EPBC Act 1999. Under this legislation, the species has been assigned a protection status of 'Vulnerable'.

3.2 Description of *Eucalyptus steedmanii*

The species was first discovered in 1928, described in 1933 and then not recorded for many years (Brown *et al.*, 1998). Despite this, it became a well-known ornamental tree, as seed was propagated from the original collections (Brown *et al.*, 1998). Until 1978, this species had not been found in the field since 1938 despite several searches for it (Leigh *et al.*, 1984).

Steedman's mallet was named after Henry Steedman, head gardener at the Zoological Gardens, Perth, who collected many botanical specimens throughout Western Australia (Leigh *et al.*, 1984).

It is a small erect tree or mallee up to 8m to 12m high (Plate 1, Plate 2), has a distinctive habit of producing numerous ascending branches from low on the trunk to form a very dense crown (Brown *et al.*, 1998; Leigh *et al.*, 1984). The smooth bark ranges from grey to bright coppery in colour. Stalked juvenile leaves are 9cm long and 3cm wide, while adult leaves are a glossy olive green, up to 8cm long and 1.5cm wide, and are crowded with oil veins (Brown *et al.*, 1998). Each inflorescence contains three flowers. The flowers are usually cream or yellow, but occasionally pink or red. The species flowers in the January to

March period (Brown *et al.*, 1998), although Leigh *et al.* (1984) reported the species flowering time as December to January.

The buds are yellowish-brown, held on long stalks and are square in cross-section (Brown *et al.*, 1998). The pendulous buds are in threes in the leaf axils (Brown *et al.*, 1998). They are an elongated diamond shape, 3.3cm long and 1.3cm wide with a pyramidal cap (Brown *et al.*, 1998). The fruits, up to 2.2cm long and 1.7cm in diameter, are longitudinally winged (Brown *et al.*, 1998).



Plate 1 Mallee form of *Eucalyptus steedmanii* Image from DEC (2008).



Plate 2 Tree Form of *Eucalyptus steedmanii* (Image by Brooker & Kleinig, ANBG Image No 17363)

3.3 Distribution and Population Size of *Eucalyptus steedmanii*

Steedman's Gum is endemic to Western Australia where it is confined to undulating country approximately 80km east of Hyden in the Forrestania to North Ironcaps areas (Brown *et al.*, 1998).

The species grows in pure stands and typically inhabits gravelly loam sites in dense woodlands (Brown *et al.*, 1998). Its habitat is primarily on very gently undulating country on low ironstone rises where it occurs in patches of low woodland at the edge of more open heath scrub (Leigh *et al.*, 1984).

There are seven known populations of this species with one population divided into two subpopulations. The locations of these populations are provided in Figure 5. Populations 1 – 6 are known to DEC and the WA Herbarium, however Population 7 was only recently discovered, and is not yet listed on the DEC's *Threatened (Declared Rare) Flora* database or the Western Australian Herbarium database. The populations, which are geographically restricted, are located up to approximately 24km between the most southern and northern populations in a north – south belt, and within a narrow east – west belt of a few kilometres. Population 6 (the most northern population) is isolated from Populations 4 and 5 which in turn is separated from Populations 1, 2 and 3A/3B. Population 7, recorded by Botanica Consulting (2009) is approximately 1000m north of population 2 and 3.5km south of Population 1. All populations are located within Eucalypt woodland. DEWHA (2008) describes the extent of the species occurrence as 83.6km².

A search of the DEC's *Threatened (Declared Rare) Flora* database (lodged 12/12/08 and received 16/12/08, Reference Number 42-1208) returned two records with population estimates (Appendix E). Populations 2 and 3A are estimated at 8,000 and 4,000 respectively. The DEC Native Vegetation Conservation Branch (Appendix F) advised WSA on the 11/12/08 that Populations 2, 3A and 3B had been

incorrectly plotted, and that this error had been corrected. Coffey Environments has assumed that the locations supplied by DEC (Reference Number 42-1208) were the amended coordinates.

The Western Australian Herbarium database was searched for records of *Eucalyptus steedmanii* (Appendix E). A number of records exist on the database. Where population estimates have been recorded in the Western Australian Herbarium database, coordinates were cross-referenced with those from the DEC database search results. The Western Australian Herbarium database search results and population numbers are presented in Appendix E and Table 1. DEC advises that the development of the Perth Herbarium database was not originally intended for electronic mapping and that the latitude and longitude coordinates for each entry are not verified prior to being entered into the database.

TABLE 1: DEC *Eucalyptus steedmanii* Population Locations

Population	Coordinates		DEC Population Size Estimate (1994)	WA Herbarium Records of Population Size Estimate and Year of Record	Comment
	Latitude	Longitude			
1	32°26'49.5"	119°41'04.3"	-	Several hundred (1978) 3 plants (1978) 3000+ (2002)	<ul style="list-style-type: none"> Population on Unallocated Crown Land Coordinates for WA Herbarium record in 1978 match closest to Population 1
2	32°28'44.6"	119°41'38.4"	8,000		<ul style="list-style-type: none"> Population on Unallocated Crown Land
3a	32°28'52.2"	119°40'39.7"	4,000		<ul style="list-style-type: none"> Population on Unallocated Crown Land
3b	32°28'52.2"	119°40'39.7"	-	30+ (1989) 1 (2006)	<ul style="list-style-type: none"> Population on Road Verge Herbarium record in 1989 and 2006 match closest to Population 3a/3b. 1989 record estimates population in excess of 100,000.
4	32°18'55.5"	119°42'05.3"	-	2,500+ (2002) 4,000+ (2002) 1,000s of plants (2003)	<ul style="list-style-type: none"> Population on Unallocated Crown Land. 2002 Herbarium record estimates in excess of 5,000 plants possibly at this location, or population 6.
5	32°20'45.5"	119°43'05.3"	-		<ul style="list-style-type: none"> Population on Unallocated Crown Land
6	32°12'55.5"	119°39'05.3"	-		<ul style="list-style-type: none"> Population on Unallocated Crown Land 2002 Herbarium record estimates in excess of 5,000 plants possibly at this location, or population 4.

Information on the known population estimates is not clear. The DEWHA (2008) estimates that there is a population of 24,500 mature plants recorded from 3 of the 6 known populations. DEC records indicate that there are six populations, of which two populations (2 and 3A) have been estimated at 8,000 and 4,000 plants respectively. The WA Herbarium records dating back from 1978 suggest the known population to

be in excess of 100,000 across the six populations (Appendix E). Botanica's population estimates included in the monitoring results (Appendix G) are based on extrapolation of transect data, suggest the total number of plants across all seven populations to be in excess of 5,400,000 plants (Table 2).

TABLE 2: Botanica Extrapolated *Eucalyptus steedmanii* Population Estimates

DEC Population Name	Extrapolated Population Estimate by Botanica – Autumn 2008	Extrapolated Population Estimate by Botanica – Spring 2008	Extrapolated Population Estimate by Botanica – Autumn 2009
1	276,489	297,300	NA
2	8,940	8,940	9387
3	4,272	4,272	1000's
4	3,854,360	3,877,440	NA
5	1,224,694	1,246,370	NA
6	NA	NA	NA
7			9387
TOTAL	5,368,755	5,434,322	

NA: Not Assessed

3.4 Distribution of *Eucalyptus steedmanii* at Spotted Quoll

Botanica's recorded eight occurrences of *Eucalyptus steedmanii* during its 2007 flora survey (Botanic Consulting, 2008). An additional population was recorded during a survey in February 2009 (Botanica, 2009). The number of plants in each population ranged from one to greater than 1,000 plants (Botanica, 2008). All populations of the species were in association with the *Eucalyptus* Woodland vegetation type.

The location of known populations in relation to the proposed mining operation are shown in Figure 3.

3.5 Threatening Processes to *Eucalyptus steedmanii*

Eucalyptus steedmanii has a limited geographic distribution. No populations are located within the Conservation Estate.

DEWHA has identified fire as the key threatening process to the species. Fire kills adult plants but regeneration by seed has been observed following fire (DEWHA, 2008). All populations were thought to be burnt in a fire in 1994. Monitoring undertaken by Botanica on behalf of WSA, suggests that the populations are recovering since the fire in 1994 and in particular, the results suggest that the seed levels are increasing (Appendix G).

The main potential threats to the species have been identified as mining operations, firebreak maintenance and recreational activities. Populations near mining activities may be damaged through mining exploration (DEWHA, 2008).

3.6 Potential Threats to *Eucalyptus steedmanii* at the Proposed Spotted Quoll Mine Site

The principal threats to the *Eucalyptus steedmanii* populations at the Spotted Quoll mine site are:

- Direct loss attributable to native vegetation clearing activities;
- Unintentional clearing of individual plants or populations;
- Indirect loss due to associated mining impacts, e.g. dust, spillage of saline water;
- Loss of plants or populations due to fire or fire management activities; and
- Impact on pollinators.

While dewatering is required at the Spotted Quoll mine site, it is considered highly unlikely that the dewatering activities would result in the death of individual plants or populations. *Eucalyptus steedmanii* populations are considered highly unlikely to rely on local groundwater supplies due to the depth to groundwater (30m below ground level) and the hypersaline characteristics of the groundwater.

4 PROPOSED MANAGEMENT STRATEGIES

4.1 Avoidance

The preferred strategy for managing impacts on DRF is avoidance. No individual plants or populations are located in the area proposed to be cleared of native vegetation (Figure 3). However, several plants and populations are located in close proximity to the proposed clearing envelope. Plants are located within 27m of the haul road, 73m to the south of the proposed pit and 60m east of the proposed administration area.

Prior to the commencement of construction activities, WSA will undertake a targeted site survey to accurately delineate the populations in close proximity to the proposed clearing areas. As part of this survey, the location of each population will be recorded using GPS as well as details relating to population size (in terms of area occupied and numbers of plants). This information will be incorporated into the mine plan and used to identify individual plants or populations that may be at threat of being impacted as a result of the construction or operational activities. Where there is uncertainty about the ability to avoid adverse impacts on the DRF species, WSA will apply to the State Minister for the Environment for approval 'to take' DRF.

The design of the mining operation has been designed to avoid local populations of *Eucalyptus steedmanii*. For example:

- The waste rock dump has been positioned to be more than 340m from the nearest *Eucalyptus steedmanii* population.
- The proposed alignment of the haul road and infrastructure corridor has been designed to avoid *Eucalyptus steedmanii* populations. The road and infrastructure corridor deviates in a northeast direction, with the closest point being located approximately 25m from the nearest population (Figure 3).
- The open cut pit is located approximately 70m from the nearest *Eucalyptus steedmanii* population.

Where the proposed operations are in close proximity to the populations, special care will be needed to avoid adverse impacts. Specific strategies are described below to address these potential adverse impacts.

4.2 Demarcation

All known locations of *Eucalyptus steedmanii* populations will be accurately mapped using a GPS, and incorporated into all mine planning.

Prior to the commencement of construction or operational activities, any known locations of *Eucalyptus steedmanii* will be identified and marked. This will be undertaken by:

- Delineating clearing boundaries with high visibility flagging;
- Erection of protective fencing to protect populations at risk of being cleared, i.e. those populations immediately adjacent to the proposed clearing area;
- Installing signage at DRF exclusion zones to warn personnel that DRF is present;
- Environmental staff supervising clearing activities.

4.3 On-site Awareness

Awareness of staff and contractors is considered an important aspect of managing the risk to *Eucalyptus steedmanii* at the Spotted Quoll mine site. Raising awareness will assist in minimising the accidental damage or loss of *Eucalyptus steedmanii* plants. Prior to the commencement of construction:

- WSA will provide information about environmental management and responsibilities (including to DRF management) in the staff and contractor site induction process.
- WSA personnel will provide information to construction staff at toolbox meetings as well as regular presentations at site meetings. In particular photos and details about *Eucalyptus steedmanii* will be provided to assist in identification of the species in the field. Information about the known locations of the species, species management and incidents will be provided to staff and contractors.

4.4 Access Management

Vehicle access into areas with *Eucalyptus steedmanii* has the potential to adversely impact on the species. To manage this risk, access will be restricted to designated haul roads including the infrastructure and haul road corridor between Spotted Quoll site and the Flying Fox mine to the north.

Access to areas containing *Eucalyptus steedmanii* will be prohibited except for monitoring purposes. Signage will be installed warning personnel of the presence of DRF. In the event that access is required, permission will be required from the Environmental Manager and access is to be undertaken with the presence of the Environmental Manager.

4.5 Dust Management

Dust is generated from mining activity as a result of the disturbance of fine particles derived from soil and rock, the handling of bulk construction materials such as crushed hard rock aggregate, and the removal of the layer of vegetation and stable soil. Consequent environmental effects are usually localised and depend on the size of the dust particles and the strength of distributing factors and usually decrease rapidly with separation from the source.

Dust is likely to be a hazard close to the mine (e.g. less than 1,000m), while further away from the mine dispersion reduces this hazard for a given wind speed and direction. However, under adverse weather conditions dust can travel considerable distances, potentially resulting in its deposition in otherwise remote locations. In the immediate vicinity of the source, dust can stress vegetation through blocking stomata (adversely affecting gas exchange) and reducing light availability (reducing photosynthetic ability and limiting plant growth).

Climate data for Hyden (approximately 80km east of the Spotted Quoll operation) indicates that the average wind speeds vary throughout the year from 6.2 - 10.3 km/hr in the morning to 8.1 -10.7 km/hr in the afternoon. During summer the prevailing winds are easterlies in the morning and strong south easterlies in the afternoon. Throughout winter the morning winds are more north-westerly in direction, with lighter, more directionally variable winds experienced in the afternoon.

Under the prevailing wind regime experienced at Hyden, the populations of *Eucalyptus steedmanii* at greatest risk of dust impacts in summer are those located to the west of the proposed haul road. In winter, the wind direction can be more variable and therefore monitoring of all populations adjacent to the haul roads and pit will be necessary.

Mining activities are likely to generate dust as a result of activities such as:

- Removal of vegetation and topsoil;
- Light and heavy vehicle movements over unpaved surfaces;
- Construction of haul roads and tracks;
- Drilling and blasting;
- Mining operations such as pit excavation and overburden and waste removal;
- Ore handling;
- Ore transport; and
- Stockpiling.

The project is located in a semi-arid environment, experiencing dry summer months, during which time dust generation is expected to be at a peak. The greatest potential for impact will be within the immediate environs of mining activities and on the surrounding vegetation. Accordingly, dust suppression measures will be necessary to mitigate any consequent adverse effects of construction or operation related dust.

Figure 3 depicts the known locations of local *Eucalyptus steedmanii* populations with respect to the proposed mining operations. Specific dust management activities will include, but not be limited to:

- Stabilisation of topsoil stockpiles with either salvaged vegetation or stabilising emulsion;
- Restriction of vehicle speeds in high risk dust-generating areas;
- Application of dust suppression methods along haul roads to minimise dust emissions using watercarts with dribble bars during dry, dusty periods. Water used for damping down of roads will be water from the dewatering operations. Dust suppression methods will need to ensure that water quality and application methods will not adversely impact native vegetation, and in particular populations of *Eucalyptus steedmanii*. Where DRF is located adjacent to areas being watered, earth bunds will be constructed to prevent runoff affecting local DRF populations. Earth bunds will be stabilised as required to prevent dust.
- Climatic conditions will be monitored and the data used to assist with planning blast events. Prevailing wind information will be utilised to, where possible, undertake blasting when wind directions are blowing away from the protected DRF areas in the immediate vicinity of the mining site.

Dust deposition gauges will be installed at each *Eucalyptus steedmanii* population that is at a greater risk of being adversely impacted (i.e. those adjacent to the haul road and the population to the south of the pit) and at control locations and monitored monthly. Indicative locations for dust monitoring locations are shown on Figure 6. The final locations of the dust deposition gauges will be identified in consultation with the DEC and results will be provided to the DEC on an annual basis.

Additional dust management procedures will be implemented as required, depending on the results of the dust deposition monitoring.

In addition, WSA will undertake weekly visual assessments of the populations located adjacent to the haul road and mining operations to detect any potential changes in plant health.

4.6 Fire Management

Coffey Environments understands that the Forrestania region was last burnt in 1994. This fire contributed to pressures on seed levels of *Eucalyptus steedmanii* and placed the conservation of this species at risk from further fires.

Fires can start from natural sources (e.g. lightning strikes) or human sources (e.g. accidental or intentional ignition). To manage the risk of fire starting from the Spotted Quoll operations, WSA will operate under the principle of fire avoidance, and it will implement (but not limited to) the following fire management strategies:

- Construct and maintain firebreaks around the Spotted Quoll operations in line with legislative requirements (i.e. the *Bush Fires Act 1954*) while avoiding DRF populations;
- Provide appropriate on-site fire-fighting equipment including water tanker with pumps, fire extinguishers on vehicles and equipment etc.;
- Provide adequate training for on-site staff in fire prevention and management. Fire fighting staff will be informed of the presence of DRF; and
- Undertake annual fuel-loading assessments in the areas surrounding the Spotted Quoll operations followed by consultation with DEC and FESA to consider appropriate management options.

4.7 Monitoring

Eucalyptus steedmanii populations will be monitored to enable early detection of adverse impacts as a result of construction and mining activities. The proposed monitoring actions have been outlined for each of the three phases, these being:

- Prior to commencement of construction and operation;
- During construction and operation; and
- Post closure.

4.7.1 Prior to Commencement of Construction and Operation

Before commencement of construction and operation at Spotted Quoll, WSA will:

- Undertake a targeted site survey prior to the commencement of construction activities in and adjacent to the proposed clearing area to accurately delineate DRF populations and to ascertain accurately the number of plants in each population located adjacent to WSA's operations.
- Undertake a population census of all seven known *Eucalyptus steedmanii* populations in the Forrestania Region every four years until completion of the mining operation. The census should record numbers of plants in each population, plant health, reproductive status and location. This action is in accordance with the Conservation Advice developed by DEHWA (2008) for the management of *Eucalyptus steedmanii*.
- Establish permanent 100m transects for plant health monitoring. Refer to Figure 6 for indicative locations of transects. These locations incorporate control transects to enable comparison of data. The final locations will be determined in consultation with DEC.
- Undertake baseline monitoring of plant health and reproductive status of *Eucalyptus steedmanii* populations on transects. Plant condition for each individual that intersects the transect will be assessed using a rating method that assigns a score based on species health/vigour (e.g. 0 = dead, 1 = poor health (i.e. extensive crown decline), 2 = moderate health (i.e. some evidence of crown decline) and 3 = very healthy (i.e. no evidence of crown decline)), as well as noting information relating to the stage of seed development. Results from the baseline monitoring will be provided to DEC.

- Commence monthly baseline dust deposition monitoring at control sites and at each *Eucalyptus steedmanii* population at greatest risk of being adversely impacted by dust (i.e. those adjacent to the haul road and the population to the south of the pit). Indicative locations for dust monitoring locations are shown on Figure 6. The final locations of the dust deposition gauges will be identified in consultation with the DEC and results will be provided to the DEC on an annual basis.

4.7.2 During Construction and Operation

During construction and operation phases, WSA will:

- Undertake weekly visual observations of *Eucalyptus steedmanii* populations in close proximity to the haul road and operations (i.e. Populations 1, 3A/3B and other plants identified by Botanica, 2009). Written and photographic records will be kept of the visual inspections of plant conditions.
- Undertake monthly transect monitoring of Populations 1, 2 3A/3B and 7, and annual transect monitoring in Populations 4, 5 and 6. Transect monitoring will address plant health and reproductive status of *Eucalyptus steedmanii* populations. Plant condition for each individual that intersects the transect will be assessed using a rating method that assigns a score based on species health/vigour (e.g. 0 = dead, 1 = poor health (i.e. extensive crown decline), 2 = moderate health (i.e. some evidence of crown decline) and 3 = very healthy (i.e. no evidence of crown decline)), as well as noting information relating to the stage of seed development.
- Undertake monthly collection and analysis of dust deposition gauges. Results will be correlated with visual plant health observations and monthly transect monitoring results.
- After 12 months of monitoring dust deposition and DRF plant health, in consultation with the DEC, assess the feasibility of developing appropriate operational dust deposition targets.
- In the event that dust levels exceed acceptable limits, dust suppression measures will be immediately reviewed and more stringent measures implemented as appropriate. Remediation actions will be undertaken on the affected plants on consultation with the DEC.
- Undertake annual fuel-loading assessments in the areas surrounding the Spotted Quoll operations followed by consultation with DEC and FESA to consider appropriate management options.
- Undertake a population census of all seven known *Eucalyptus steedmanii* populations in the Forrestania Region every four years until completion of the mining operation. The census will record numbers of plants in each population, plant health, reproductive status and location. This action is in accordance with the Conservation Advice developed by DEHWA (2008) for the management of *Eucalyptus steedmanii*.

4.7.3 Post-Closure

Monitoring will continue as outlined in section 4.7.2 until completion of rehabilitation activities on site by WSA. Following completion of rehabilitation, monitoring of plant condition and population size will be undertaken biannually for a period of two years by WSA.

4.8 Contingency Planning

In the event that any adverse change is detected in the plant condition or population size, WSA will advise the DEHWA, DEC and Department of Mines and Petroleum (DMP). The cause of the change will be further investigated to determine if the change is a result of the Spotted Quoll operations. If the cause of

the change is attributable to WSA operations, a Contingency Plan will be developed outlining proposed actions to reduce, mitigate or offset impacts on *Eucalyptus steedmanii* populations within the Spotted Quoll project area. The Contingency Plan will be submitted to DEWHA and DEC for approval.

4.9 Offsets

4.9.1 Seed Collection

WSA is currently working with the DEC and the Threatened Flora Seed Centre to sustainably harvest seed from local *Eucalyptus steedmanii* populations. This proposed offset is in accordance with the Conservation Advice developed by DEHWA (2008) for the management of *Eucalyptus steedmanii*.

WSA is being guided by the DEC with respect to:

- Optimal timing for collection of *Eucalyptus steedmanii* seed;
- Preferred techniques for collecting seed; and
- Required documentation.

The Threatened Flora Seed Centre is undertaking the cleaning, drying, packaging, storage and viability testing of collected seed.

To date the following seed has been collected by WSA and provided to the Threatened Flora Seed Centre:

TABLE 3: *Eucalyptus steedmanii* Seed Collection Summary

DEC Population Name	Date Collected	Number of trees collected from	Seed Weight collected (kg)
1	31 Mar 2009	50-60	1.29
2	31 Mar 2009	30-40	1.55
3	31 Mar 2009	30-40	0.59
4	31 Mar 2009	>100	0.62
5	31 Mar 2009	>100	0.75
6	31 Mar 2009	No plants located	0
New population – Jan 2009	N/C	NC	-
NC: Not Collected			
TOTAL			4.80

4.9.2 Formalised Agreement

WSA will consider opportunities for entering into a formalised agreement for the protection of the DRF populations within its mining tenement.

This proposed offset is in accordance with the Conservation Advice developed by DEHWA (2008) for the management of *Eucalyptus steedmanii*.

4.10 Reporting

All non-compliances with this Conservation Plan are to be reported to the Registered Manager within 24 hours of the breach.

Site Personnel and Mine Manager will be responsible for recording the details of the breach and providing the details to the Registered Manager. WSA will be responsible for notifying the DEWHA, DEC and DMP.

An internal monitoring report will be prepared every six months and submitted to the Registered Manager.

All records of *Eucalyptus steedmanii* monitoring kept in accordance with this plan will be summarised in the Annual Environmental Report, which will be submitted to the DEWHA, DEC and DMP.

5 RESPONSIBILITIES

5.1 Registered Manager

Overall responsibility for ensuring that the site environmental management requirements are met during the life of the project will rest with the Registered Manager. This responsibility will include:

- Ensuring that all construction and operational site personnel are aware of their environmental responsibilities and obligations;
- Ensuring that all contractor staff are fully inducted and are aware of their environmental responsibilities and obligations; and
- Allocating resources to ensure that commitments can be met.

5.2 Environmental Manager

The Site Environmental Manager is responsible for:

- Ensuring that annual and monthly monitoring requirements for monitoring *Eucalyptus steedmanii* populations are undertaken in accordance with this Conservation Plan.
- Reporting the monitoring results to the Registered Manager in accordance with this Conservation Plan.
- Coordinating seed collection in consultation with the DEC.
- Ensuring annual reports required under State and Commonwealth approvals are prepared and submitted.

5.3 Mine Manager

The Mine Manager is responsible for ensuring that all staff and contractors are provided a copy of this Conservation Plan.

5.4 Site Personnel

Site Personnel are responsible for:

- Working in accordance with this Conservation Plan;
- Reporting non-compliance with this Conservation Plan, environmental incidents or emergencies to their Supervisor; and
- Attending inductions and environmental awareness training sessions.

6 CONCLUSIONS

Eucalyptus steedmanii is classified as a DRF and is afforded protection under the *Environmental Protection Act 1986* and the *Environment Protection and Biodiversity Conservation Act 1999* (Cth).

The species is restricted to seven known populations within the Forrestania area, where it inhabits gravelly loam in dense low woodlands. The total population is not accurately known.

WSA will implement this Conservation Management Plan to minimise the potential risk to *Eucalyptus steedmanii* resulting from the proposed Spotted Quoll Mining Project operations. Key elements of this Conservation Management Plan relate to:

- Avoidance of populations, including the establishment of exclusion zones;
- Field demarcation and signage to protect known populations;
- Supervision of native vegetation clearing activities;
- Raising awareness of staff through induction processes and on-going training;
- DRF Seed collection undertaken in consultation with the DEC;
- Managing dust emissions generated during the mining and transportation activities;
- Implementing fire management techniques to reduce the potential for anthropogenic sources of fire and to maximise opportunities for control of fire;
- Undertaking DRF monitoring and dust monitoring to detect changes in population size and plant condition.

The approach outlined in this Conservation Management Plan, if followed by WSA, will significantly reduce the risk of potential damage to *Eucalyptus steedmanii* and is in accordance with the Conservation Advice provided DEWHA for *Eucalyptus steedmanii* (DEWHA, 2008).

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**Appendix B: Australian Government (DEWHA) Approval EPBC Ref:
2008/4443**

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Australian Government

Department of the Environment, Water, Heritage and the Arts

Approval

Spotted Quoll Mining Project **EPBC Ref 2008/4443**

This decision is made under sections 130(1) and 133 of the *Environment Protection and Biodiversity Conservation Act 1999*.

Proposed action

Person to whom the approval is granted

Operations Director
Western Areas N.L.
Suite 3, Level 1
11 Ventnor Avenue
WEST PERTH WA 6005

proposed action

To develop and operate the Spotted Quoll nickel sulphide open cut mine, underground mine and associated infrastructure in the Shire of Kondinin, Western Australia, and as described in the referral received under the EPBC Act on 8 September 2008.

Approval

Controlling Provision	Decision
Listed threatened species and communities (sections 18 & 18A)	Approved

conditions of approval This approval is subject to the conditions specified below

expiry date of approval This approval has effect until 3 August 2014

Decision-maker

name and position

Fiona Beynon
A/g Assistant Secretary
Environment Assessment Branch

signature

date of decision

30 / 7 / 09

Conditions attached to the approval

1. In order to protect the Steedman's Gum (*Eucalyptus steedmanii*), the person taking the action must:
 - a) Prior to the clearance of native vegetation, provide for the Minister's approval a detailed Species Conservation Management Plan (the Steedman's Gum Conservation Plan) for monitoring and managing impacts on the Steedman's Gum populations within the Spotted Quoll project (as described in the EPBC referral). The Steedman's Gum Conservation Plan must include a monitoring program and detail measures for ensuring the on-going viability of all Steedman's Gum populations within the Spotted Quoll project.
 - b) If it is established through the monitoring program that the viability of any Steedman's Gum population within the Spotted Quoll project area is threatened, provide for the Minister's approval a Contingency Plan to outline actions to reduce, mitigate or offset impacts on Steedman's Gum populations within the Spotted Quoll project area.

The approved Steedman's Gum Conservation Management Plan must be implemented.

The approved Contingency Plan (if required) must be implemented.

2. In order to protect the Malleefowl (*Leipoa ocellata*), the person taking the action must:
 - a) Prior to the clearing of native vegetation, provide for the Minister's approval a detailed Species Conservation Management Plan (the Malleefowl Conservation Plan) which incorporates a targeted survey for the mitigation of actions proposed and monitoring of the Malleefowl;
 - b) Provide information to the Department on the location/s of sightings of Malleefowl and actions undertaken with respect to the approved Malleefowl Conservation Plan; and
 - c) Undertake surveys in accordance with the approved Malleefowl Conservation Plan. Results or reports of all surveys for the Malleefowl are to be provided to the Department within a month of their finalisation.

The approved Malleefowl Conservation Management Plan must be implemented.

3. In order to protect the Chuditch (*Dasyuris geoffroi*), the person taking the action must:
 - a) Prior to the clearing of native vegetation, provide for the Minister's approval a detailed Species Conservation Management Plan (the Chuditch Conservation Plan) covering: the targeted survey for, mitigation of actions proposed and monitoring of the species;
 - b) Provide information to the Department on the location/s of sightings of Chuditch and actions undertaken with respect to the approved Chuditch Conservation Management Plan; and
 - c) Undertake surveys in accordance with the approved Chuditch Conservation Management Plan. Results or reports of all surveys for the Chuditch are to be provided to the Department within a month of their finalisation.

The approved Chuditch Conservation Management Plan must be implemented.

4. Within 14 days of commencement of the action, the person taking the action must advise the Department of the actual date of commencement.

5. Within three months of every 12 month anniversary of the commencement of the action, the person taking the action must submit to the Department an annual report addressing compliance with the conditions of this approval. The annual reports must list each approval condition and the actions taken to address each approval condition. Annual reports must be provided until the Minister is satisfied that the proponent has complied with all conditions of the approval and the Department has advised the person taking the action, in writing, that all the approval conditions have been complied with.
6. Upon the direction of the Minister, the person taking the action must ensure that an independent audit of compliance with the conditions of approval is conducted and a report submitted to the Minister. The independent auditor must be approved by the Minister prior to the commencement of the audit. Audit criteria must be agreed to by the Minister and the audit report must address the criteria to the satisfaction of the Minister.
7. If the person taking the action wishes to carry out any activity otherwise than in accordance with the plans referred to in conditions 1, 2 and 3, the person taking the action must submit for the Minister's approval a revised version of any such Plan. If the Minister approves such a revised plan, that plan must be implemented in place of the plan originally approved.
8. If the Minister believes that is necessary or desirable for the better protection of threatened species and ecological community to do so, the Minister may request that the person taking the action to make specified revisions to the plans approved pursuant to conditions 1, 2 and 3, and to submit the revised plan for the Minister's approval. The person taking the action must comply with any such request. If the Minister approves a revised plan pursuant to this condition, the person taking the action must implement that plan instead of the plan as originally approved.
9. If, at any time after 5 years from the date of this approval, the Minister notifies the person taking the action in writing is not satisfied that there has been substantial commencement of the action, the action must not thereafter be commenced without the written agreement of the Minister.
10. The person taking the action must maintain accurate records substantiating all activities associated with or relevant to the above conditions of approval, and make them available upon request to the Department. Such records may be subject to audit by the Department, and used to verify compliance with the conditions of approval. Summaries of audits will be posted on the Departments website. The results of audits may also be publicised through the general media.

Definitions:

1. Department. The Australian Government Department responsible for the *Environment Protection and Biodiversity Conservation Act 1999*.
2. Commencement of action. Ground disturbing activities including vegetation removal.
3. Clearance of native vegetation. The cutting down, felling, thinning, logging, removing, killing, destroying, poisoning, ringbarking, uprooting or burning of native vegetation.
4. Minister. The Minister responsible for the *Environment Protection and Biodiversity Conservation Act 1999*.

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**Appendix C: *Eucalyptus steedmanii* Management Plan – Spotted Quoll
Mine, Shire of Kondinin (June 2009)**

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**EUCALYPTUS STEEDMANII
MANAGEMENT PLAN -
SPOTTED QUOLL MINE, SHIRE OF
KONDININ**

Prepared for:

Western Areas NL
11 Ventnor Avenue
WEST PERTH WA 6005

Report Date: 10 June 2009
Project Ref: EP2008/165 V2

Written/Submitted by:



Paul Zuvela
Manager (Environmental
Planning)

Reviewed/Approved by:



Martine Scheltema
Principal

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- Appendix D: DEC Letter of Advice Regarding *Eucalyptus steedmanii* Locations
- Appendix E: Botanica *Eucalyptus steedmanii* Seed Levels Monitoring Results

1 INTRODUCTION

1.1 Background

Western Areas NL (WSA) proposes to develop an open pit nickel mine at its Spotted Quoll deposit (M77/583) as part of its Forrestania project. Along with the Flying Fox mine (located approximately 6km north of the proposed Spotted Quoll mine) and other deposits under development, WSA aims to be producing 35,000 tonnes of nickel concentrate per annum by 2011.

The proposed Spotted Quoll mine is situated approximately 160 kilometres south of Southern Cross and 80 kilometres east of Hyden in the Shire of Kondinin (Figure 1). The mining operation will be carried out on Mining Leases 77/583 and 77/545 (Figure 2) that are 100% owned by WSA.

The proposed mining operation involves the establishment of an open pit mine. The proposed pit will be approximately 150m deep and 600m long in a north-south alignment. It will have an operational life of four years.

The works associated with the mine will comprise site preparation, operation and rehabilitation (including landform reconstruction).

Pre-mine establishment works will involve the clearing of native vegetation, topsoil stripping, removal of overburden, drainage works and the establishment of haul roads and infrastructure.

Overburden removed from the proposed open cut pit area will be used to construct infrastructure such as the run of mine pad, access roads, internal haul roads, ramps, parking bays and the water storage pond. A haul road will be constructed between the Spotted Quoll operation and the Flying Fox mine located 6km to the north.

Approximately 140ha of native vegetation will be removed during the course of the Spotted Quoll mining operation. Clearing in the proposed area of the waste rock stockpile will be undertaken as an incremental process in line with waste dump requirements, which will minimise the length of time that topsoil materials will be stored.

The nickel ore will be removed extracted via open pit mining. The operation will involve:

- Drilling and blasting;
- Excavation of wet ore;
- Haulage of ore to run of mine pad; and
- Loading of ore to road trains for transport to Cosmic Boy concentrator via Flying Fox mine.

No processing of extracted ore will be undertaken at the Spotted Quoll operation. The extracted ore will be transported by road train along a constructed haul road to the Flying Fox mine, and then via a gazetted road (already constructed) to the Cosmic Boy site for processing (Figure 2).

The extraction of the ore will require dewatering of groundwater to lower the groundwater by approximately 130m below ground surface. The mine water will be piped from the Spotted Quoll operation to a settling pond located to the north of the open cut pit and then to the abandoned Lounge Lizard and McMahon's gold pits which is located 1 to 1.5km to the south of Flying Fox mine site via an underground pipeline. The pipeline will be installed within the proposed infrastructure corridor between the Spotted Quoll operation and the Flying Fox mine.

Waste rock will be disposed of in waste rock dumps located to the northwest of the open cut pit.

On completion of mining activities the mine site will be decommissioned and rehabilitated. It is proposed that rehabilitation will be progressively undertaken during mining operations.

Vegetation and flora surveys conducted for WSA by Botanica Consulting (2008 & 2009) identified the presence of Declared Rare Flora (DRF) (*Eucalyptus steedmanii*) adjacent to the proposed mine site.

DRF 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, and have been gazetted as such, following approval by the Minister for the Environment, after recommendation by the State's Endangered Flora Consultative Committee (DEC, 2008). DRF are protected under the Western Australian *Wildlife Conservation Act 1950* and in some instances under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

1.2 Purpose and Scope

The purpose of this Management Plan is to outline proposed measures to ensure the protection of *Eucalyptus steedmanii* (Steedman's Mallet) populations adjacent to the proposed Spotted Quoll mine site.

The plan applies to the following phases of the project:

- Pre-construction
- Construction and operation
- Post Closure.

The plan applies to activities conducted on Mining Leases 77/583 and 77/545.

1.3 Objectives

The objectives of this plan are to:

- Prevent potential adverse impacts on *Eucalyptus steedmanii* populations in, or adjacent to the proposed Spotted Quoll mine site and its associated operations; and
- Raise awareness about *Eucalyptus steedmanii*.

The above objectives are proposed to be achieved by:

- Documenting the distribution of the species in the vicinity of the proposed Spotted Quoll operations;
- Providing detailed species description and its preferred habitat;
- Identifying threatening processes to the species arising from the implementation of the Spotted Quoll operation;
- Developing strategies to reduce avoidable adverse impacts on the species;
- Identifying offsets to mitigate potential adverse impacts on the species;
- Outlining a monitoring program that aims to detect a decline in the health of local *Eucalyptus steedmanii* populations associated with the proposed mining activities; and
- Allocating responsibilities for the implementation of this Management Plan.

2 SITE DESCRIPTION

2.1 Climate

The climate in the general area of the Spotted Quoll Mine is semi-arid to arid and can be characterised by its relatively low annual rainfall and large temperature range.

Mean annual maximum temperature is 24.6°C and mean annual minimum 9.7°C. Daily maxima above 40°C are common from November to March. The coldest month is July and diurnal temperature variations are commonly high throughout the year (Keith Lindbeck and Associates, 2008).

The area is semi arid and the annual average rainfall at Hyden is 344.7 mm. Most of the rain falls between May and August and this amount varies greatly both seasonally and annually (Keith Lindbeck and Associates, 2008).

Climate data for Hyden (approximately 80km east of the Spotted Quoll operation) indicates that the average wind speeds vary throughout the year from 6.2 - 10.3 km/hr in the morning to 8.1 -10.7 km/hr in the afternoon. During summer the prevailing winds are easterlies in the morning and strong south easterlies in the afternoon. Throughout winter the morning winds are more north-westerly in direction, with lighter, more directionally variable winds experienced in the afternoon.

2.2 Geology and Soils

The Spotted Quoll project lies in the Forrestania Greenstone Belt (FGB), a southern extension of the Southern Cross Greenstone Belt. The greenstone belts of the Yilgarn craton are major sequences of basic to ultramafic rocks with varying levels of entrained sedimentary rocks laid down semi-contemporaneously.

The FGB is constrained by granitoid rocks that developed during the late Archaean / Proterozoic and form the western and eastern boundaries to the FGB. During the period of granite emplacement significant alteration, folding and faulting occurred within the FGB. The most significant alteration to the greenstone "stack" of mafics, ultramafics, and sediments was the formation of a major synclinal structure. This feature dominates the structural geology of the region.

The Spotted Quoll deposit is located within the traditional footwall, away from the basal ultramafic-footwall metasediment contact, which was probably the original locus for sulphide deposition from an overlying pile of komatiite flows. Subsequent metamorphism, deformation and intrusion of granitoid dykes/sills has contributed to a complex setting, with mineralisation now occupying a possible shear zone within the footwall metasediments.

Common soils are sandy duplexes (often alkaline), with ironstone gravelly soils, loamy earths (often calcareous) with some loamy duplexes, sandy earths, deep sands and saline wet soils (Tille, 2006).

2.3 Vegetation and Flora

2.3.1 Vegetation Types

WSA commissioned Botanica Consulting to complete a flora and vegetation survey of the New Morning to Spotted Quoll area within Tenements M77/583 and M77/545. The flora and vegetation survey included the Spotted Quoll mine site, waste dump and pipeline/access roads.

Botanica Consulting (2009) mapped six vegetation types which are described below and shown in Figure 3. All of these vegetation types are found in the proposed project area (clearing envelope).

***Eucalyptus* Woodland:** The dominant overstorey species in this vegetation type include *Eucalyptus flocktoniae*, *E. urna*, and *E. salubris* over an understorey of *Melaleuca adnata*, *Grevillea obliquistigma*, *Acacia eremophila*, *Eremophila densiflora*, *Melaleuca cardiophylla*. The dominant small shrubs of this vegetation type included *Microcybe multiflora*, *Dodonaea stenozyga*, *Wilsonia humilis* and *Acacia intricate*.

***Eucalyptus* Mallee Woodland:** The dominant overstorey species in this vegetation type were *Eucalyptus eremophila* subsp. *eremophila*, *E. cylindrocarpa* and *E. leptophylla* over an understorey of *Acacia coolgardiensis*, *Melaleuca hamata*, *M. pauperiflora* subsp. *pauperiflora*, *Acacia hemiteles*, *Melaleuca cordata* and *M. cucullata*. The dominant small shrubs of this vegetation type included *Dodonaea bursariifolia*, *Phebalium tuberosum* and *Grevillea acuaria*.

Salmon Gum Woodland: The dominant overstorey species in this vegetation type was *Eucalyptus salmonophloia* over an understory of *Melaleuca adnata*, *M. hamata*, *M. pauperiflora* subsp. *pauperiflora*, *Eremophila decipiens* subsp. *decipiens* and *Daviesia benthamii*. The dominant small shrubs of this vegetation type included *Dodonaea stenozyga*, *Phebalium tuberosum* and *Grevillea acuaria*.

Sand Plain Heath: This vegetation type was dominated by shrubs up to 2m in height. The dominant species of this vegetation type included *Allocasuarina corniculata*, *Acacia fragilis*, *Leptospermum erubescens*, *Melaleuca uncinata*, *Thyrtomene kochii*, *Banksia cirsioides*, *Leptosema daviesioides*, *Verticordia chrysanthella* and *Darwinia inconspicua*.

***Allocasuarina* Shrubland:** This vegetation type was a shrubland dominated by *Allocasuarina campestris*, *A. acutivalvis* and *Acacia steedmanii*. Understorey species were dominated by *Melaleuca pentagona*, *M. laxiflora* and *Conospermum brownie*.

Rocky Outcrop: The dominant overstorey species in this vegetation type were *Eucalyptus calycogona* and *E. pileata*. Understorey species were dominated by *Melaleuca hamata*, *Hakea subsulcata* and *Acacia hemiteles*, *Atriplex stipitata* and *Hibbertia pungens*.

Botanica (2008) reported that the survey area does not contain any threatened ecological communities (TECs). According to the Department of the Environment, Water, Heritage and the Arts' (DEWHA) *Protected Matters Search Tool*, the survey area has no regional significance (Botanica, 2009).

2.3.2 Vegetation Condition

The condition of vegetation in the survey area was assessed by Botanica (2009) using the condition rating scale of Keighery (1994) published in *Bush Forever* (Government of Western Australia, 2000). Keighery's condition rating scale ranges from Pristine (where vegetation exhibits no visible signs of disturbance) to Completely Degraded (where vegetation structure is no longer intact and without native plant species).

Botanica (2009) considered the majority of the vegetation to be in Good condition (Figure 4). According to the Keighery (1994) condition rating scale, Good is defined as: the vegetation structure being significantly altered, by very obvious signs of multiple disturbance, but retains basic vegetation structure or the ability to regenerate it.

Botanica's (2008) classification of the vegetation condition as Good was influenced by evidence of historic exploration lines and an existing track. Fire had burnt part of the survey area in 1994. There was no evidence of broad scale clearing for agricultural purposes, or invasive weed species.

A portion of the project area was classified as being in a Degraded condition. Degraded is defined as: the structure is severely disturbed, but has the ability to regenerate to a good condition with intensive management. Botanica's classification of vegetation as being in a degraded condition was largely due to disturbance resulting from drilling activities.

A small portion of the project area, largely adjacent to the haul road is in Very Good condition (Figure 4).

2.3.3 Flora

A total of 158 plant taxa represented across 62 Genera and 28 families were recorded in the survey area. No exotic species were identified during the surveys.

The dominant families represented from the survey included Myrtaceae, Proteaceae and Mimosaceae.

Dominant species in the area included:

- *Acacia steedmanii*
- *Allocasuarina campestris*, *A. acutivalvis* and *A. corniculata*
- *Eucalyptus calycogona*, *E. pileata*, *E. salmonophloia*, *E. eremophila*, *E. cylindrocarpa*, *E. leptophylla*, *E. flocktoniae*, *E. urna* and *E. salubris*

A complete list of flora recorded during the Botanica surveys (2009) is provided in Appendix A.

2.3.4 Conservation Significant Flora

The DEC Declared Rare and Priority Flora database search identified the potential for 93 DRF or Priority Flora (Appendix B) to be in, or within 10km of the survey area. Of these 93 species, 1 was DRF – presumed extinct, 6 were DRF, 24 were Priority 1 species, 18 were Priority 2 species, 31 were Priority 3 species and 13 were Priority 4 species.

One DRF and two Priority Flora were recorded by Botanica (2008 & 2009) during the surveys. These were:

- *Eucalyptus steedmanii* (DRF);
- *Eremophila racemosa* (Priority 4); and
- *Microcorys sp.* Forresteria (Priority 4).

In addition to the above two priority species, the DEC has previously recorded one Priority 2 species (*Stylidium sejunctum*) within the survey area. This species was searched for by Botanica during the spring 2007 and autumn 2008 surveys but not recorded.

The three Priority species (including the DEC recorded *Stylidium sejunctum*) were recorded within one kilometre of the Spotted Quoll project area and pipeline corridor. The DRF species was located within the Spotted Quoll project area. The location of conservation significant flora is shown in Figure 3.

3 SPECIES PROFILE

3.1 Conservation Status

3.1.1 *Wildlife Conservation Act 1950*

The Western Australian *Wildlife Conservation Act 1950* defines rare flora as species that:

- Are likely to become extinct or are rare, or otherwise in need of special protection; or
- Are presumed to be extinct in the wild and therefore in need of special protection should they be re-discovered.

It is an offence 'to take' rare flora for any purpose and on any lands without written consent of the responsible Minister. Under the Act 'to take' is any direct or indirect action that may impact on the DRF.

Eucalyptus steedmanii is classified as a DRF. This status means that the species has been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such.

Brown *et al.* (1998) noted that this species is considered Vulnerable as there were (then) six known populations of this species on vacant Crown Land, with no known populations in conservation reserves. All populations were burnt by a fire in 1994, and are being monitored (Brown *et al.*, 1998).

Following consultation with Dr Ken Atkins (DEC), Jim's Seeds, Weeds and Trees Pty Ltd (2006) noted that it was DEC's general view that *Eucalyptus steedmanii* should remain on the DRF list until seed banks have reached sufficient levels that will support regeneration of populations. If seed levels were to increase to a sustainable level, then the DEC would consider nominating for the conservation status of the species to be reduced to a Priority level.

3.1.2 *Environment Protection and Biodiversity Conservation Act 1999*

Eucalyptus steedmanii is listed for protection under the Commonwealth *Environment Protection and Biodiversity Conservation (EPBC) Act 1999*. Under this legislation, the species has been assigned a protection status of 'Vulnerable'.

3.2 Description of *Eucalyptus steedmanii*

The species was first discovered in 1928, described in 1933 and then not recorded for many years (Brown *et al.*, 1998). Despite this, it became a well-known ornamental tree, as seed was propagated from the original collections (Brown *et al.*, 1998). Until 1978, this species had not been found in the field since 1938 despite several searches for it (Leigh *et al.*, 1984).

Steedman's mallet was named after Henry Steedman, head gardener at the Zoological Gardens, Perth, who collected many botanical specimens throughout Western Australia (Leigh *et al.*, 1984).

It is a small erect tree or mallee up to 8m to 12m high (Plate 1, Plate 2), has a distinctive habit of producing numerous ascending branches from low on the trunk to form a very dense crown (Brown *et al.*, 1998; Leigh *et al.*, 1984). The smooth bark ranges from grey to bright coppery in colour. Stalked juvenile leaves are 9cm long and 3cm wide, while adult leaves are a glossy olive green, up to 8cm long and 1.5cm wide, and are crowded with oil veins (Brown *et al.*, 1998). Each inflorescence contains three flowers. The

flowers are usually cream or yellow, but occasionally pink or red. The species flowers in the January to March period (Brown *et al.*, 1998), although Leigh *et al.* (1984) reported the species flowering time as December to January.

The buds are yellowish-brown, held on long stalks and are square in cross-section (Brown *et al.*, 1998). The pendulous buds are in threes in the leaf axils (Brown *et al.*, 1998). They are an elongated diamond shape, 3.3cm long and 1.3cm wide with a pyramidal cap (Brown *et al.*, 1998). The fruits, up to 2.2cm long and 1.7cm in diameter, are longitudinally winged (Brown *et al.*, 1998).



Plate 1 Mallee form of *Eucalyptus steedmanii* Image from DEC (2008).



Plate 2 Tree Form of *Eucalyptus steedmanii* (Image by Brooker & Kleinig, ANBG Image No 17363)

3.3 Distribution and Population Size of *Eucalyptus steedmanii*

Steedman's Gum is endemic to Western Australia where it is confined to undulating country approximately 80km east of Hyden in the Forrestania to North Ironcaps areas (Brown *et al.*, 1998).

The species grows in pure stands and typically inhabits gravelly loam sites in dense woodlands (Brown *et al.*, 1998). Its habitat is primarily on very gently undulating country on low ironstone rises where it occurs in patches of low woodland at the edge of more open heath scrub (Leigh *et al.*, 1984).

There are seven known populations of this species with one population divided into two subpopulations. The locations of these populations are provided in Figure 5. Populations 1 – 6 are known to DEC and the WA Herbarium, however Population 7 was only recently discovered, and is not yet listed on the DEC's *Threatened (Declared Rare) Flora* database or the Western Australian Herbarium database. The populations, which are geographically restricted, are located up to approximately 24km between the most southern and northern populations in a north – south belt, and within a narrow east – west belt of a few kilometres. Population 6 (the most northern population) is isolated from Populations 4 and 5 which in turn is separated from Populations 1, 2 and 3A/3B. Population 7, recorded by Botanica Consulting (2009) is approximately 1000m north of population 2 and 3.5km south of Population 1. All populations are located within Eucalypt woodland. The (Cth) Department of the Environment (DEWHA, 2008) describes the extent of the species occurrence as 83.6km².

A search of the DEC's *Threatened (Declared Rare) Flora* database (lodged 12/12/08 and received 16/12/08, Reference Number 42-1208) returned two records with population estimates (refer to Appendix C for search results). Populations 2 and 3A are estimated at 8,000 and 4,000 respectively. The DEC Native Vegetation Conservation Branch (Appendix D) advised WSA on the 11/12/08 that Populations 2,

3A and 3B had been incorrectly plotted, and that this error had been corrected. Coffey Environments has assumed that the locations supplied by DEC (Reference Number 42-1208) were the amended coordinates.

The Western Australian Herbarium database was searched for records of *Eucalyptus steedmanii* (refer to Appendix C for search results). A number of records exist on the database. Where population estimates have been recorded in the Western Australian Herbarium database, coordinates were cross-referenced with those from the DEC database search results. The Western Australian Herbarium database search results and population numbers are presented in Appendix C and Table 1. DEC advises that the development of the Perth Herbarium database was not originally intended for electronic mapping and that the latitude and longitude coordinates for each entry are not verified prior to being entered into the database.

TABLE 1: DEC *Eucalyptus steedmanii* Population Locations

Population	Coordinates		DEC Population Size Estimate (1994)	WA Herbarium Records of Population Size Estimate and Year of Record	Comment
	Latitude	Longitude			
1	32°26'49.5"	119°41'04.3"	-	Several hundred (1978) 3 plants (1978) 3000+ (2002)	<ul style="list-style-type: none"> Population on Unallocated Crown Land Coordinates for WA Herbarium record in 1978 match closest to Population 1
2	32°28'44.6"	119°41'38.4"	8,000		<ul style="list-style-type: none"> Population on Unallocated Crown Land
3a	32°28'52.2"	119°40'39.7"	4,000		<ul style="list-style-type: none"> Population on Unallocated Crown Land
3b	32°28'52.2"	119°40'39.7"	-	30+ (1989) 1 (2006)	<ul style="list-style-type: none"> Population on Road Verge Herbarium record in 1989 and 2006 match closest to Population 3a/3b. 1989 record estimates population in excess of 100,000.
4	32°18'55.5"	119°42'05.3"	-	2,500+ (2002) 4,000+ (2002) 1,000s of plants (2003)	<ul style="list-style-type: none"> Population on Unallocated Crown Land. 2002 Herbarium record estimates in excess of 5,000 plants possibly at this location, or population 6.
5	32°20'45.5"	119°43'05.3"	-		<ul style="list-style-type: none"> Population on Unallocated Crown Land
6	32°12'55.5"	119°39'05.3"	-		<ul style="list-style-type: none"> Population on Unallocated Crown Land 2002 Herbarium record estimates in excess of 5,000 plants possibly at this location, or population 4.

Information on the known population estimates is not clear. The (Cth) Department of the Environment (DEWHA, 2008) estimates that there is a population of 24,500 mature plants recorded from 3 of the 6

known populations. DEC records indicate that there are six populations, of which two populations (2 and 3A) have been estimated at 8,000 and 4,000 plants respectively. The WA Herbarium records dating back from 1978 suggest the known population to be in excess of 100,000 across the six populations (Appendix C). Botanica's population estimates included in the monitoring results (Appendix E) are based on extrapolation of transect data, suggest the total number of plants across all seven populations to be in excess of 5,400,000 plants (Table 2).

TABLE 2: Botanica Extrapolated *Eucalyptus steedmanii* Population Estimates

DEC Population Name	Extrapolated Population Estimate by Botanica – Autumn 2008	Extrapolated Population Estimate by Botanica – Spring 2008	Extrapolated Population Estimate by Botanica – Autumn 2009
1	276,489	297,300	NA
2	8,940	8,940	9387
3	4,272	4,272	1000's
4	3,854,360	3,877,440	NA
5	1,224,694	1,246,370	NA
6	NA	NA	NA
7			9387
TOTAL	5,368,755	5,434,322	

NA: Not Assessed

3.4 Distribution of *Eucalyptus steedmanii* at Spotted Quoll

Botanica's recorded eight occurrences of *Eucalyptus steedmanii* during its 2007 flora survey (Botanica Consulting, 2008). An additional population was recorded during a survey in February 2009 (Botanica, 2009). The number of plants in each population ranged from one to more than a 1,000 plants (Botanica, 2008). All populations of the species were in association with the *Eucalyptus* Woodland vegetation type.

The location of known populations in relation to the proposed mining operation are shown in Figure 3.

3.5 Threatening Processes to *Eucalyptus steedmanii*

Eucalyptus steedmanii has a limited geographic distribution. No populations are located within the Conservation Estate.

The (Cth) Department of Environment, Water, Heritage and the Arts has identified fire as the key threatening process to the species. Fire kills adult plants but regeneration by seed has been observed following fire (DEWHA, 2008). All populations were thought to be burnt in a fire in 1994. Monitoring undertaken by Botanica on behalf of WSA, suggests that the populations are recovering since the fire in 1994 and in particular, the results suggest that the seed levels are increasing (Appendix E).

The main potential threat to the species have been identified as mining operations, firebreak maintenance and recreational activities. Populations near mining activities may be damaged through mining exploration (DEWHA, 2008).

3.6 Potential Threats to *Eucalyptus steedmanii* at the Proposed Spotted Quoll Mine Site

The principal threats to the *Eucalyptus steedmanii* populations at the Spotted Quoll mine site are:

- Direct loss attributable to native vegetation clearing activities;
- Unintentional clearing of individual plants or populations;
- Indirect loss due to associated mining impacts, e.g. dust, spillage of saline water;
- Loss of plants or populations due to fire or fire management activities; and
- Impact on pollinators.

While dewatering is required at the Spotted Quoll mine site, it is considered highly unlikely that the dewatering activities would result in the death of individual plants or populations. *Eucalyptus steedmanii* populations are considered highly unlikely to rely on local groundwater supplies due to the depth to groundwater (30m below ground level) and the hypersaline characteristics of the groundwater.

4 PROPOSED MANAGEMENT STRATEGIES

4.1 Avoidance

The preferred strategy for managing impacts on DRF is avoidance. No individual plants or populations are located in the area proposed to be cleared of native vegetation (Figure 3). However, several plants and populations are located in close proximity to the proposed clearing envelope. Plants are located within 27m of the haul road, 73m to the south of the proposed pit and 60m east of the proposed administration area.

Prior to the commencement of construction activities, WSA will undertake a targeted site survey to accurately delineate the populations in close proximity to the proposed clearing areas. As part of this survey, the location of each population will be recorded using GPS as well as details relating to population size (in terms of area occupied and numbers of plants). This information will be incorporated into the mine plan and used to identify individual plants or populations that may be at threat of being impacted as a result of the construction or operational activities. Where there is uncertainty about the ability to avoid adverse impacts on the DRF species, WSA will apply to the Minister for the Environment for approval 'to take' DRF.

The design of the mining operation has been designed to avoid local populations of *Eucalyptus steedmanii*. For example:

- The waste rock dump has been positioned to be more than 340m from the nearest *Eucalyptus steedmanii* population.
- The proposed alignment of the haul road and infrastructure corridor has been designed to avoid *Eucalyptus steedmanii* populations. The road and infrastructure corridor deviates in a northeast direction, with the closest point being located approximately 25m from the nearest population (Figure 3).
- The open cut pit is located approximately 70m from the nearest *Eucalyptus steedmanii* population.

Where the proposed operations are in close proximity to the populations, special care will be needed to avoid adverse impacts. Specific strategies are described below to address these potential adverse impacts.

4.2 Demarcation

All known locations of *Eucalyptus steedmanii* populations will be accurately mapped using a GPS, and incorporated into all mine planning.

Prior to the commencement of construction or operational activities, any known locations of *Eucalyptus steedmanii* will be identified and marked. This will be undertaken by:

- Delineating clearing boundaries with high visibility flagging;
- Erection of protective fencing to protect populations at risk of being cleared, i.e. those populations immediately adjacent to the proposed clearing area;
- Installing signage at DRF exclusion zones to warn personnel that DRF is present;
- Environmental staff supervising clearing activities.

4.3 On-site Awareness

Awareness of staff and contractors is considered an important aspect of managing the risk to *Eucalyptus steedmanii* at Spotted Quoll minesite. Raising awareness will assist in minimising the accidental damage or loss of *Eucalyptus steedmanii* plants. Prior to the commencement of construction:

- WSA will provide information about environmental management and responsibilities (including to DRF management) in the staff and contractor site induction process.
- WSA personnel will provide information to construction staff at toolbox meetings as well as regular presentations at site meetings. In particular photos and details about *Eucalyptus steedmanii* will be provided to assist in identification of the species in the field. Information about the known locations of the species, species management and incidents will be provided to staff and contractors.

4.4 Access Management

Vehicle access into areas with *Eucalyptus steedmanii* has the potential to adversely impact on the species. To manage this risk, access will be restricted to designated haul roads including the infrastructure and haul road corridor between Spotted Quoll site and the Flying Fox mine to the north.

Access to areas containing *Eucalyptus steedmanii* will be prohibited except for monitoring purposes. Signage will be installed warning personnel of the presence of DRF. In the event that access is required, permission will be required from the Environmental Manager and access is to be undertaken with the presence of the Environmental Manager.

4.5 Dust Management

Dust is generated from mining activity as a result of the disturbance of fine particles derived from soil and rock, the handling of bulk construction materials such as crushed hard rock aggregate, and the removal of the layer of vegetation and stable soil. Consequent environmental effects are usually localised and depend on the size of the dust particles and the strength of distributing factors and usually decrease rapidly with separation from the source.

Dust is likely to be a hazard close to the mine (e.g. less than 1,000m), while further away from the mine dispersion reduces this hazard for a given wind speed and direction. However, under adverse weather conditions dust can travel considerable distances, potentially resulting in its deposition in otherwise remote locations. In the immediate vicinity of the source, dust can stress vegetation through blocking stomata (adversely affecting gas exchange) and reducing light availability (reducing photosynthetic ability and limiting plant growth).

Climate data for Hyden (approximately 80km east of the Spotted Quoll operation) indicates that the average wind speeds vary throughout the year from 6.2 - 10.3 km/hr in the morning to 8.1 -10.7 km/hr in the afternoon. During summer the prevailing winds are easterlies in the morning and strong south easterlies in the afternoon. Throughout winter the morning winds are more north-westerly in direction, with lighter, more directionally variable winds experienced in the afternoon.

Under the prevailing wind regime experienced at Hyden, the populations of *Eucalyptus steedmanii* at greatest risk of dust impacts in summer are those located to the west of the proposed haul road. In winter, the wind direction can be more variable and therefore monitoring of all populations adjacent to the haul roads and pit will be necessary.

Mining activities are likely to generate dust as a result of activities such as:

- Removal of vegetation and topsoil;
- Light and heavy vehicle movements over unpaved surfaces;
- Construction of haul roads and tracks;
- Drilling and blasting;
- Mining operations such as pit excavation and overburden and waste removal;
- Ore handling;
- Ore transport; and
- Stockpiling.

The project is located in a semi-arid environment, experiencing dry summer months, during which time dust generation is expected to be at a peak. The greatest potential for impact will be within the immediate environs of mining activities and on the surrounding vegetation. Accordingly, dust suppression measures will be necessary to mitigate any consequent adverse effects of construction or operation related dust.

Figure 3 depicts the known locations of local *Eucalyptus steedmanii* populations with respect to the proposed mining operations. Specific dust management activities will include, but not be limited to:

- Stabilisation of topsoil stockpiles with either salvaged vegetation or stabilising emulsion;
- Restriction of vehicle speeds in high risk dust-generating areas;
- Application of dust suppression methods along haul roads to minimise dust emissions using watercarts with dribble bars during dry, dusty periods. Water used for damping down of roads will be water from the dewatering operations. Dust suppression methods will need to ensure that water quality and application methods will not adversely impact native vegetation, and in particular populations of *Eucalyptus steedmanii*. Where DRF is located adjacent to areas being watered, earth bunds will be constructed to prevent runoff affecting local DRF populations. Earth bunds will be stabilised as required to prevent dust.
- Climatic conditions will be monitored and the data used to assist with planning blast events. Prevailing wind information will be utilised to, where possible, undertake blasting when wind directions are blowing away from the protected DRF areas in the immediate vicinity of the mining site.

Dust deposition gauges will be installed at each *Eucalyptus steedmanii* population that is at a greater risk of being adversely impacted (i.e. those adjacent to the haul road and the population to the south of the pit) and at control locations and monitored monthly. Indicative locations for dust monitoring locations are shown on Figure 6. The final locations of the dust deposition gauges will be identified in consultation with the DEC and results will be provided to the DEC on an annual basis.

Additional dust management procedures will be implemented as required, depending on the results of the dust deposition monitoring.

In addition, WSA will undertake weekly visual assessments of the populations located adjacent to the haul road and mining operations to detect any potential changes in plant health.

4.6 Fire Management

Coffey Environments understands that the Forrestania region was last burnt in 1994. This fire contributed to pressures on seed levels of *Eucalyptus steedmanii* and placed the conservation of this species at risk from further fires.

Fires can start from natural sources (e.g. lightning strikes) or human sources (e.g. accidental or intentional ignition). To manage the risk of fire starting from the Spotted Quoll operations, WSA will operate under the principle of fire avoidance, and it will implement (but not limited to) the following fire management strategies:

- Construct and maintain firebreaks around the Spotted Quoll operations in line with legislative requirements (i.e. the *Bush Fires Act 1954*) while avoiding DRF populations;
- Provide appropriate on-site fire-fighting equipment including water tanker with pumps, fire extinguishers on vehicles and equipment etc.;
- Provide adequate training for on-site staff in fire prevention and management. Fire fighting staff will be informed of the presence of DRF; and
- Undertake annual fuel-loading assessments in the areas surrounding the Spotted Quoll operations followed by consultation with DEC and FESA to consider appropriate management options.

4.7 Monitoring

Eucalyptus steedmanii populations will be monitored to enable early detection of adverse impacts as a result of construction and mining activities. The proposed monitoring actions have been outlined for each of the three phases, these being:

- Prior to commencement of construction and operation;
- During construction and operation; and
- Post closure.

4.7.1 Prior to Commencement of Construction and Operation

Before commencement of construction and operation at Spotted Quoll, WSA will:

- Undertake a targeted site survey prior to the commencement of construction activities in and adjacent to the proposed clearing area to accurately delineate DRF populations and to ascertain accurately the number of plants in each population located adjacent to WSA's operations.
- Undertake a population census of all seven known *Eucalyptus steedmanii* populations in the Forrestania Region every four years until completion of the mining operation. The census should record numbers of plants in each population, plant health, reproductive status and location. This action is in accordance with the Conservation Advice developed by DEHWA (2008) for the management of *Eucalyptus steedmanii*.
- Establish permanent 100m transects for plant health monitoring. Refer to Figure 6 for indicative locations of transects. These locations incorporate control transects to enable comparison of data. The final locations will be determined in consultation with DEC.

- Undertake baseline monitoring of plant health and reproductive status of *Eucalyptus steedmanii* populations on transects. Plant condition for each individual that intersects the transect will be assessed using a rating method that assigns a score based on species health/vigour (e.g. 0 = dead, 1 = poor health (i.e. extensive crown decline), 2 = moderate health (i.e. some evidence of crown decline) and 3 = very healthy (i.e. no evidence of crown decline)), as well as noting information relating to the stage of seed development. Results from the baseline monitoring will be provided to DEC.
- Commence monthly baseline dust deposition monitoring at control sites and at each *Eucalyptus steedmanii* population at greatest risk of being adversely impacted by dust (i.e. those adjacent to the haul road and the population to the south of the pit). Indicative locations for dust monitoring locations are shown on Figure 6. The final locations of the dust deposition gauges will be identified in consultation with the DEC and results will be provided to the DEC on an annual basis.

4.7.2 During Construction and Operation

During construction and operation phases, WSA will:

- Undertake weekly visual observations of *Eucalyptus steedmanii* populations in close proximity to the haul road and operations (i.e. Populations 1, 3A/3B and other plants identified by Botanica, 2009). Written and photographic records will be kept of the visual inspections of plant conditions.
- Undertake monthly transect monitoring of Populations 1, 2 3A/3B and 7, and annual transect monitoring in Populations 4, 5 and 6. Transect monitoring will address plant health, recruitment and reproductive status of *Eucalyptus steedmanii* populations. Plant condition for each individual that intersects the transect will be assessed using a rating method that assigns a score based on species health/vigour (e.g. 0 = dead, 1 = poor health (i.e. extensive crown decline), 2 = moderate health (i.e. some evidence of crown decline) and 3 = very healthy (i.e. no evidence of crown decline)), as well as noting information relating to the stage of seed development.
- Undertake monthly collection and analysis of dust deposition gauges. Results will be correlated with visual plant health observations and monthly transect monitoring results.
- After 12 months of monitoring dust deposition and DRF plant health, in consultation with the DEC, assess the feasibility of developing appropriate operational dust deposition targets.
- In the event that dust levels exceed acceptable limits, dust suppression measures will be immediately reviewed and more stringent measures implemented as appropriate. Remediation actions will be undertaken on the affected plants on consultation with the DEC.
- Undertake annual fuel-loading assessments in the areas surrounding the Spotted Quoll operations followed by consultation with DEC and FESA to consider appropriate management options.
- Undertake a population census of all seven known *Eucalyptus steedmanii* populations in the Forrestania Region every four years until completion of the mining operation. The census should record numbers of plants in each population, plant health, reproductive status and location. This action is in accordance with the Conservation Advice developed by DEHWA (2008) for the management of *Eucalyptus steedmanii*.

4.7.3 Post-Closure

Monitoring will continue as outlined in section 4.7.2 until completion of rehabilitation activities on site by WSA. Following completion of rehabilitation, monitoring of plant condition and population size will be undertaken biannually for a period of two years by WSA.

4.8 Contingency Planning

In the event that any adverse change is detected in the plant condition or population size, the Registered Manager will advise the DEC and Department of Mines and Petroleum (DMP). The cause of the change will be further investigated to determine if the change is a result of the Spotted Quoll operations. If the cause of the change is attributable to WSA operations, mining operations will be modified to ensure further adverse impacts are avoided. WSA will continue to liaise with DEC to determine appropriate remedial actions.

4.9 Offsets

4.9.1 Seed Collection

WSA is currently working with the DEC and the Threatened Flora Seed Centre to sustainably harvest seed from local *Eucalyptus steedmanii* populations. This proposed offset is in accordance with the Conservation Advice developed by DEHWA (2008) for the management of *Eucalyptus steedmanii*. WSA is being guided by the DEC with respect to:

- Optimal timing for collection of *Eucalyptus steedmanii* seed;
- Preferred techniques for collecting seed; and
- Required documentation.

The Threatened Flora Seed Centre is undertaking the cleaning, drying, packaging, storage and viability testing of collected seed.

To date the following seed has been collected by WSA and provided to the Threatened Flora Seed Centre:

TABLE 3: *Eucalyptus steedmanii* Seed Collection Summary

DEC Population Name	Date Collected	Number of trees collected from	Seed Weight collected (kg)
1	31 Mar 2009	50-60	1.29
2	31 Mar 2009	30-40	1.55
3	31 Mar 2009	30-40	0.59
4	31 Mar 2009	>100	0.62
5	31 Mar 2009	>100	0.75
6	31 Mar 2009	No plants located	0
New population –	N/C	NC	-

Jan 2009			
NC: Not Collected		TOTAL	4.80

4.9.2 Formalised Agreement

WSA will consider opportunities for entering into a formalised agreement for the protection of the DRF populations within its mining tenement.

This proposed offset is in accordance with the Conservation Advice developed by DEHWA (2008) for the management of *Eucalyptus steedmanii*.

4.10 Reporting

All non-compliances with this Management Plan are to be reported to the Registered Manager within 24 hours of the breach.

Site Personnel and Mine Manager will be responsible for recording the details of the breach and providing the details to the Registered Manager. WSA will be responsible for notifying the DEC and DMP.

An internal monitoring report will be prepared every six months and submitted to the Registered Manager.

All records of *Eucalyptus steedmanii* monitoring kept in accordance with this plan will be summarised in the Annual Environmental Report, which will be submitted to the DMP and DEC.

5 RESPONSIBILITIES

5.1 Registered Manager

Overall responsibility for ensuring that the site environmental management requirements are met during the life of the project will rest with the Registered Manager. This responsibility will include:

- Ensuring that all construction and operational site personnel are aware of their environmental responsibilities and obligations;
- Ensuring that all contractor staff are fully inducted and are aware of their environmental responsibilities and obligations; and
- Allocating resources to ensure that commitments can be met.

5.2 Environmental Manager

The Site Environmental Manager is responsible for:

- Ensuring that annual and monthly monitoring requirements for monitoring *Eucalyptus steedmanii* populations are undertaken in accordance with this Management Plan.
- Reporting the monitoring results to the Registered Manager in accordance with this Management Plan.
- Coordinating seed collection in consultation with the DEC.

5.3 Mine Manager

The Mine Manager is responsible for ensuring that all staff and contractors are provided a copy of this procedure.

5.4 Site Personnel

Site Personnel are responsible for:

- Working in accordance with this Management Plan;
- Reporting non-compliance with this Management Plan, environmental incidents or emergencies to their Supervisor; and
- Attending inductions and environmental awareness training sessions.

6 CONCLUSIONS

Eucalyptus steedmanii is classified as a DRF and is afforded protection under the *Environmental Protection Act 1986* and the *Environment Protection and Biodiversity Conservation Act 1999* (Cth).

The species is restricted to seven known populations within the Forrestania area, where it inhabits gravelly loam in dense low woodlands. The total population is not accurately known.

WSA will implement this management plan to minimise the potential risk to *Eucalyptus steedmanii* resulting from the proposed Spotted Quoll operations. Key elements of this management plan relate to:

- Avoidance of populations, including the establishment of exclusion zones;
- Field demarcation and signage to protect known populations;
- Supervision of native vegetation clearing activities;
- Raising awareness of staff through induction processes and on-going training;
- DRF Seed collection undertaken in consultation with the DEC;
- Managing dust emissions generated during the mining and transportation activities;
- Implementing fire management techniques to reduce the potential for anthropogenic sources of fire and to maximise opportunities for control of fire;
- Undertaking DRF monitoring and dust monitoring to detect changes in population size and plant condition.

The approach outlined in this management plan, if followed by WSA, will significantly reduce the risk of potential damage to *Eucalyptus steedmanii* and is in accordance with the Conservation Advice provided by the (Cth) Department of the Environment for *Eucalyptus steedmanii* (DEWHA, 2008).

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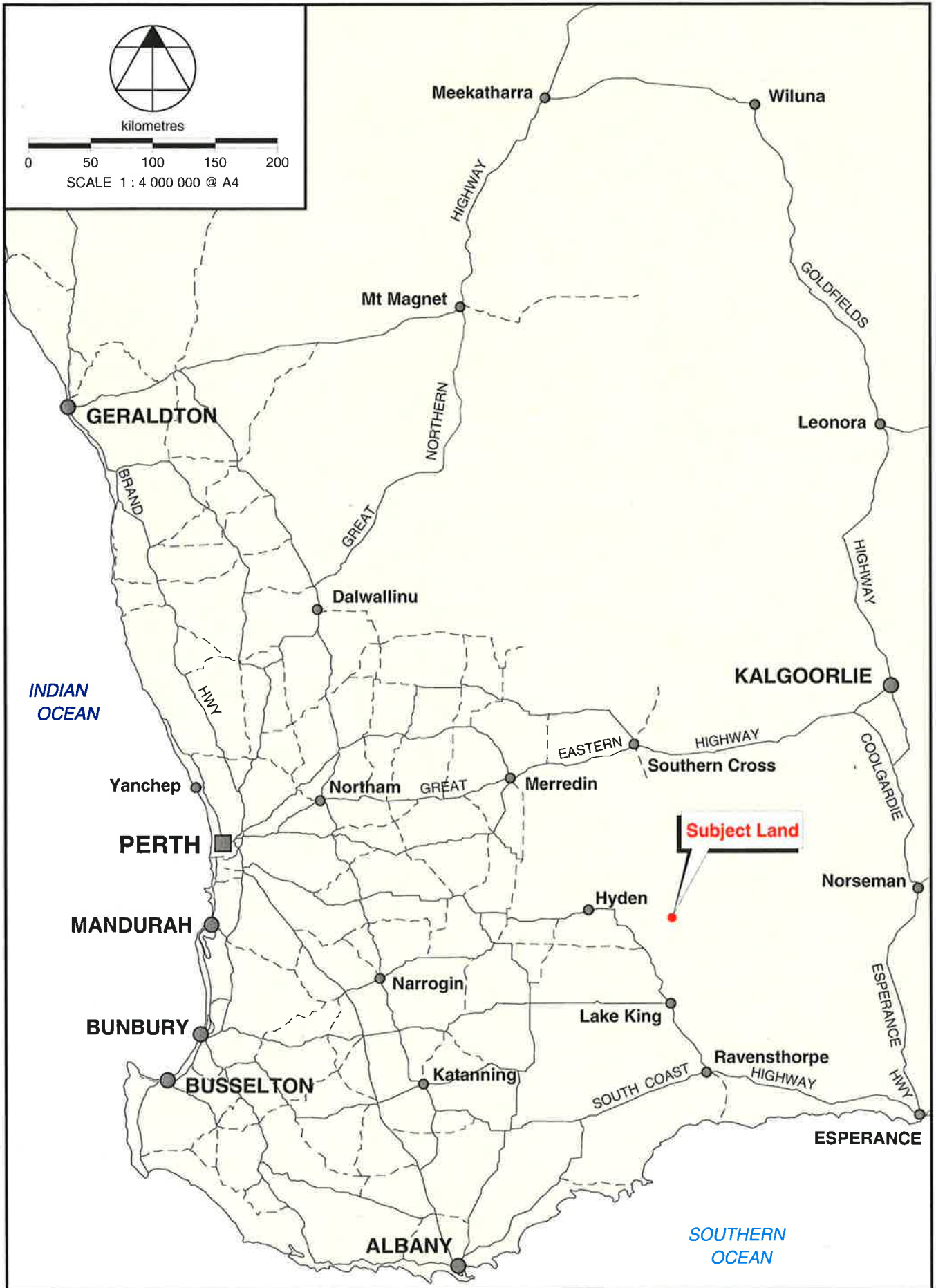
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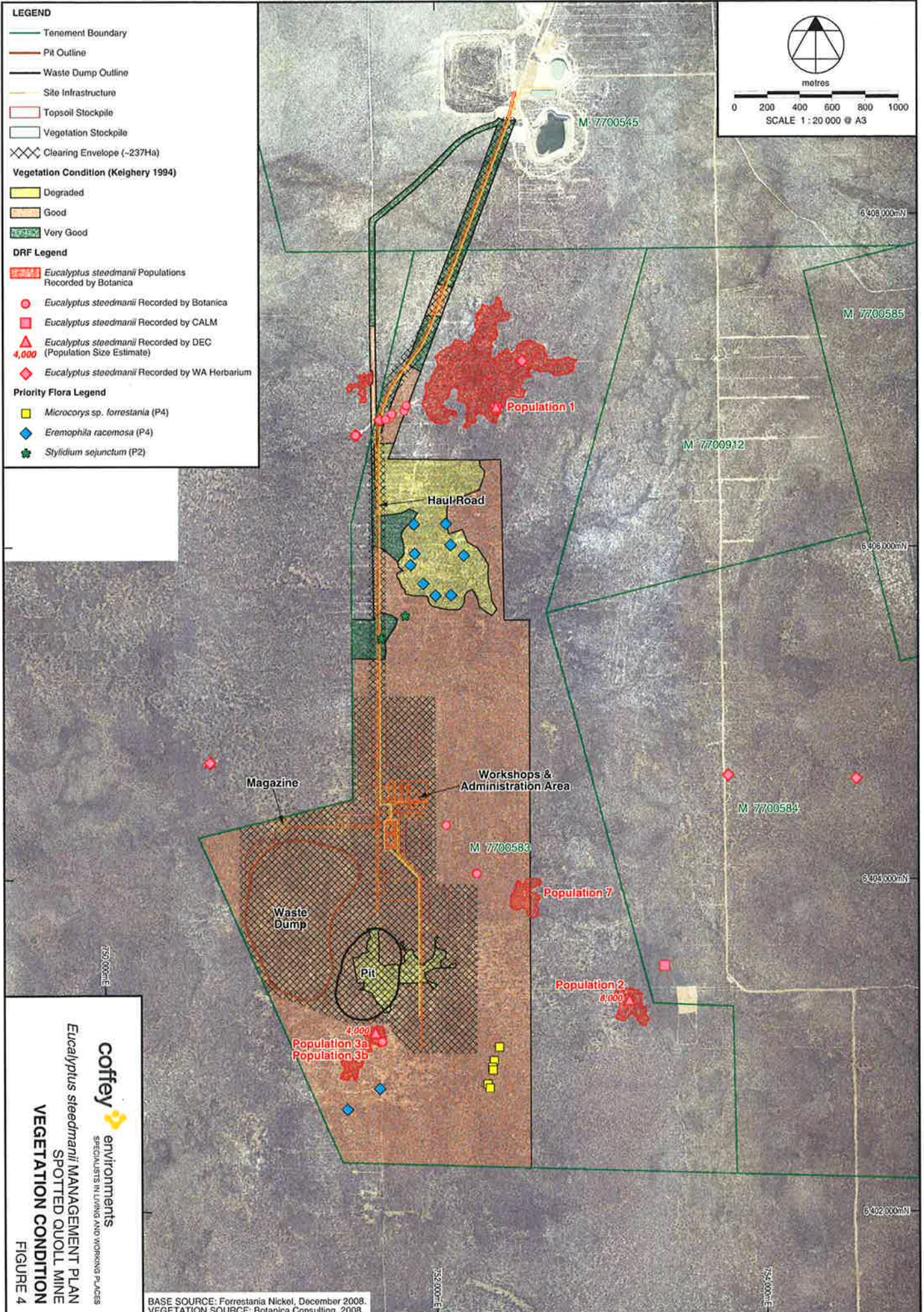
Figures

**Eucalyptus steedmanii Management Plan
Spotted Quoll Mine**



Eucalyptus steedmanii MANAGEMENT PLAN
 SPOTTED QUOLL MINE
REGIONAL LOCATION

FIGURE 1



coffey environments
SPECIALISTS IN LIVING AND WORKING PLACES

Eucalyptus steedmanii MANAGEMENT PLAN
SPOTTED QUOLL MINE
VEGETATION CONDITION
FIGURE 4

BASE SOURCE: Forrestania Nickel, December 2008.
VEGETATION SOURCE: Botanica Consulting, 2008.

LEGEND

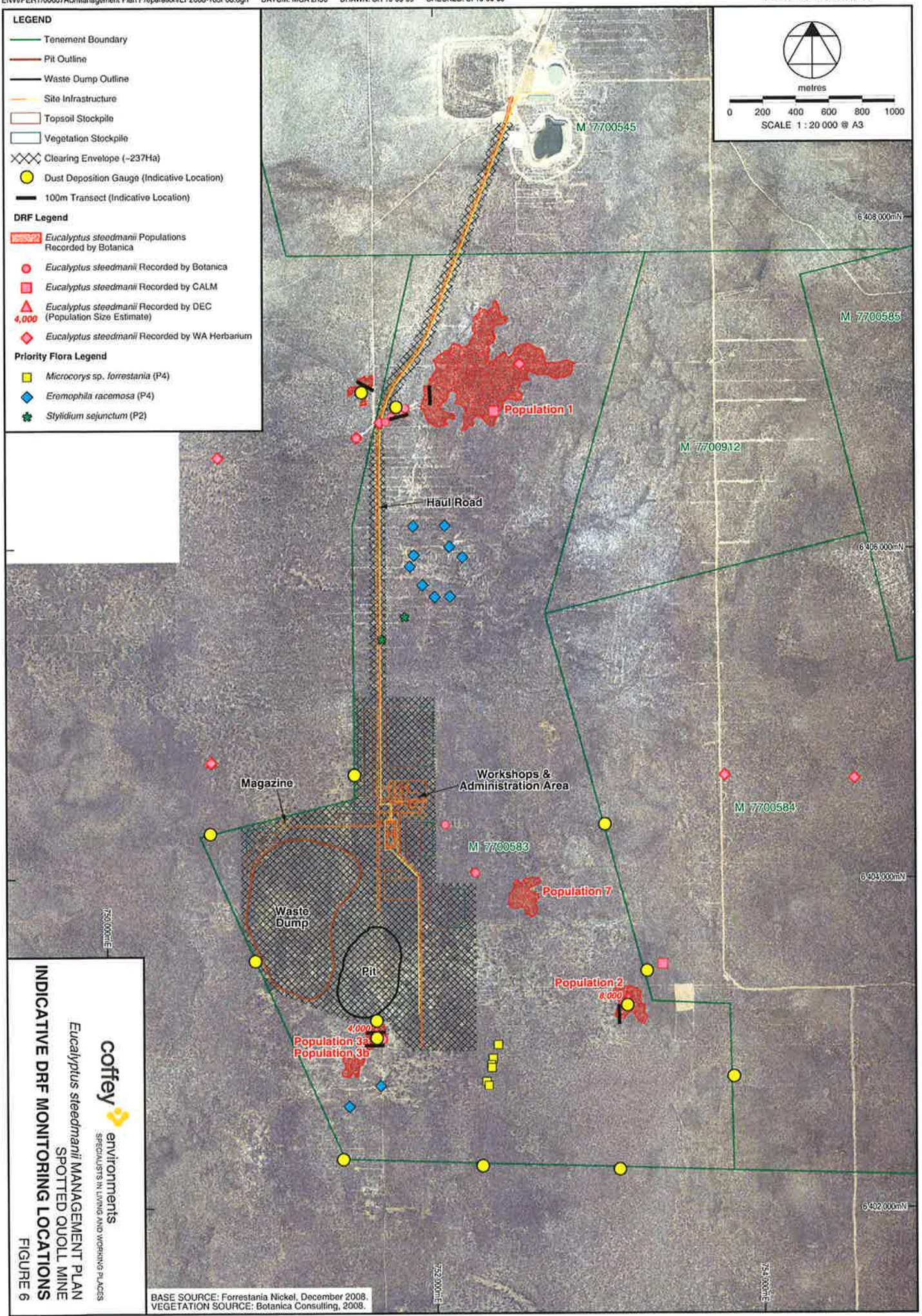
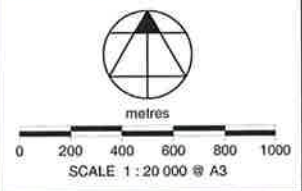
- Tenement Boundary
- Pit Outline
- Waste Dump Outline
- Site Infrastructure
- Topsoil Stockpile
- Vegetation Stockpile
- Clearing Envelope (-237Ha)
- Dust Deposition Gauge (Indicative Location)
- 100m Transect (Indicative Location)

DRF Legend

- Eucalyptus steedmanii* Populations Recorded by Botanica
- Eucalyptus steedmanii* Recorded by Botanica
- Eucalyptus steedmanii* Recorded by CALM
- Eucalyptus steedmanii* Recorded by DEC (Population Size Estimate)
- Eucalyptus steedmanii* Recorded by WA Herbarium

Priority Flora Legend

- Microcorys sp. lorrestania* (P4)
- Eremophila racemosa* (P4)
- Styliidium sejunctum* (P2)



coffey
environments
 SPECIALISTS IN LIVING AND WORKING PLACES
Eucalyptus steedmanii MANAGEMENT PLAN
 SPOTTED QUOLL MINE
INDICATIVE DRF MONITORING LOCATIONS
FIGURE 6

BASE SOURCE: Forrester Nickel, December 2008.
 VEGETATION SOURCE: Botanica Consulting, 2008.

LEGEND

- Tenement Boundary
- Pit Outline
- Waste Dump Outline
- Site Infrastructure
- Topsoil Stockpile
- Vegetation Stockpile
- Clearing Envelope (~237Ha)

Vegetation Legend

- Salmon Gum Woodland
- Rocky Outcrop
- Eucalyptus Mallee Woodland
- Sandplain Heath
- Allocasuarina Woodland
- Eucalyptus Woodland

DRF Legend

- Eucalyptus steedmanii Populations Recorded by Botanica
- Eucalyptus steedmanii Recorded by Botanica
- Eucalyptus steedmanii Recorded by CALM
- Eucalyptus steedmanii Recorded by DEC (Population Size Estimate)
- Eucalyptus steedmanii Recorded by WA Herbarium

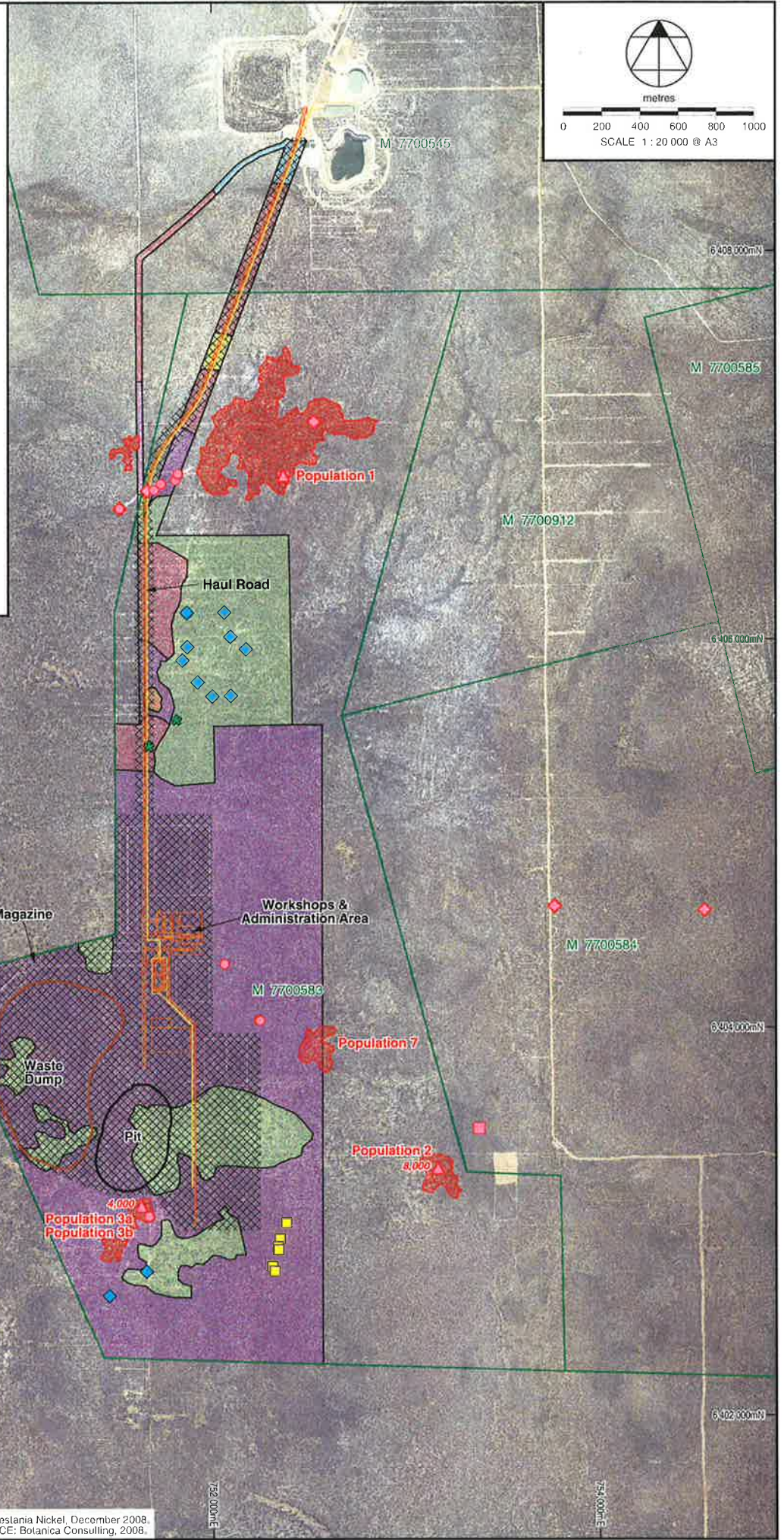
Priority Flora Legend

- Microcorys sp. forrestania (P4)
- Eremophila racemosa (P4)
- Styliidium sejunctum (P2)

metres

0 200 400 600 800 1000

SCALE 1 : 20 000 @ A3



coffey environments
SPECIALISTS IN LIVING AND WORKING PLACES

Eucalyptus steedmanii MANAGEMENT PLAN
SPOTTED QUOLL MINE
LOCATION OF
CONSERVATION SIGNIFICANT FLORA
FIGURE 3

BASE SOURCE: Forresterland Nickel, December 2008.
VEGETATION SOURCE: Botanica Consulting, 2008.

Appendix A Botanica (2009) Flora List

**Eucalyptus steedmanii Management Plan
Spotted Quoll Mine**

Species list of the survey area

Family	Genus	Species	Eucalyptus woodland	Eucalyptus mallee woodland	Eucalyptus salmonophloia woodland	Sandplain heath	Rocky outcrop	Allocasuarina thicket
Anthericaceae	<i>Thysanotus</i>	<i>sparteus</i>	*					
Asphodelaceae	<i>Bulbine</i>	<i>semibarbata</i>			*			
Asteraceae	<i>Angianthus</i>	<i>tomentosus</i>	*				*	
Asteraceae	<i>Calotis</i>	<i>hispidula</i>	*					
Asteraceae	<i>Gnephosis</i>	<i>tenuissima</i>	*					
Asteraceae	<i>Olearia</i>	<i>muelleri</i>	*	*				*
Asteraceae	<i>Olearia</i>	<i>pimeleoides</i>	*					
Caesalpiniaceae	<i>Senna</i>	<i>artemisioides</i> subsp. <i>filifolia</i>	*				*	
Casuarinaceae	<i>Allocasuarina</i>	<i>acutivalvis</i> subsp. <i>acutivalvis</i>	*	*			*	*
Casuarinaceae	<i>Allocasuarina</i>	<i>campestris</i>	*	*			*	*
Casuarinaceae	<i>Allocasuarina</i>	<i>corniculata</i>	*	*		*	*	*
Casuarinaceae	<i>Allocasuarina</i>	<i>helmsii</i>	*	*			*	*
Casuarinaceae	<i>Allocasuarina</i>	<i>microstachya</i>	*			*		
Chenopodiaceae	<i>Atriplex</i>	<i>stipitata</i>	*		*		*	
Chenopodiaceae	<i>Atriplex</i>	<i>vesicaria</i>	*		*			
Chenopodiaceae	<i>Maireana</i>	<i>georgei</i>	*		*			
Chenopodiaceae	<i>Maireana</i>	<i>oppositifolia</i>	*					
Chenopodiaceae	<i>Sclerolaena</i>	<i>diacantha</i>	*		*			
Chenopodiaceae	<i>Sclerolaena</i>	<i>uniflora</i>	*	*	*			
Convolvulaceae	<i>Wilsonia</i>	<i>humilis</i>	*	*	*			
Cupressaceae	<i>Callitris</i>	<i>preissii</i>	*	*	*			
Cyperaceae	<i>Gahnia</i>	<i>ancistrophylla</i>	*		*		*	
Cyperaceae	<i>Lepidosperma</i>	<i>brunonianum</i>	*	*	*		*	*
Cyperaceae	<i>Lepidosperma</i>	<i>drummondii</i>	*	*	*		*	*
Dilleniaceae	<i>Hibbertia</i>	<i>pungens</i>	*	*	*		*	*
Epacridaceae	<i>Astroloma</i>	<i>serratifolium</i>	*	*	*		*	*
Epacridaceae	<i>Leucopogon</i>	<i>cuneifolius</i>	*	*	*		*	*
Epacridaceae	<i>Lysinema</i>	<i>ciliatum</i> forma Lake King (J.S. Beard 3698)				*		*
Euphorbiaceae	<i>Bertya</i>	? <i>dimirostegia</i>			*	*		
Goodeniaceae	<i>Cooperhookia</i>	<i>strophiolata</i>	*	*	*		*	*
Goodeniaceae	<i>Dampiera</i>	<i>angulata</i> subsp. <i>angulata</i>	*	*	*		*	*
Goodeniaceae	<i>Goodenia</i>	<i>pinifolia</i>	*	*	*		*	*
Goodeniaceae	<i>Goodenia</i>	<i>viscida</i>	*	*	*		*	*
Haloragaceae	<i>Glischrocaryon</i>	<i>roei</i>	*	*	*		*	*
Lamiaceae	<i>Microcorys</i>	<i>obovata</i>	*	*	*		*	*
Lamiaceae	<i>Microcorys</i>	sp. <i>Forrestiana</i> (P.A.)	*	*	*		*	*
Lamiaceae	<i>Westringia</i>	<i>cephalantha</i> var. Lake King	*	*	*	*	*	*

Family	Genus	Species	Eucalyptus woodland	Eucalyptus mallee woodland	Eucalyptus salmonophloia woodland	Sandplain heath	Rocky outcrop	Allocasuarina thicket
Lamiaceae	<i>Westringia</i>	<i>rigida</i>	*		*			
Lauraceae	<i>Cassipoua</i>	<i>melantha</i>	*	*	*	*		
Mimosaceae	<i>Acacia</i>	<i>acuminata</i>	*	*				*
Mimosaceae	<i>Acacia</i>	<i>campoclada</i>	*					
Mimosaceae	<i>Acacia</i>	<i>coolgardiensis</i>		*	*	*		*
Mimosaceae	<i>Acacia</i>	<i>deficiens</i>	*	*				
Mimosaceae	<i>Acacia</i>	<i>densiflora</i>	*	*				
Mimosaceae	<i>Acacia</i>	<i>enervia subsp. enervia</i>	*					
Mimosaceae	<i>Acacia</i>	<i>eremophila var. eremophila</i>	*		*			
Mimosaceae	<i>Acacia</i>	<i>erinacea</i>	*	*	*	*		*
Mimosaceae	<i>Acacia</i>	<i>fragilis</i>	*	*	*	*		*
Mimosaceae	<i>Acacia</i>	<i>hemiteles</i>	*	*	*	*	*	*
Mimosaceae	<i>Acacia</i>	<i>hystrix subsp. hystrix</i>	*	*	*	*		
Mimosaceae	<i>Acacia</i>	<i>intricata</i>	*	*	*	*	*	*
Mimosaceae	<i>Acacia</i>	<i>longispinea</i>	*	*	*	*		
Mimosaceae	<i>Acacia</i>	<i>merrallii</i>	*	*	*	*		*
Mimosaceae	<i>Acacia</i>	<i>poliochroa</i>	*	*	*	*		
Mimosaceae	<i>Acacia</i>	<i>sphaelata subsp. sphaelata</i>	*	*	*	*	*	*
Mimosaceae	<i>Acacia</i>	<i>steedmanii subsp. borealis</i>	*	*	*	*	*	*
Mimosaceae	<i>Acacia</i>	<i>uncinella</i>	*	*	*	*		
Mimosaceae	<i>Acacia</i>	<i>viscifolia</i>	*	*	*	*		
Myoporaceae	<i>Eremophila</i>	<i>decipiens subsp. decipiens</i>	*		*			
Myoporaceae	<i>Eremophila</i>	<i>densifolia subsp. capitata</i>	*	*	*	*		
Myoporaceae	<i>Eremophila</i>	<i>drummondii</i>	*	*	*	*		
Myoporaceae	<i>Eremophila</i>	<i>maculata subsp. brevifolia</i>	*					
Myoporaceae	<i>Eremophila</i>	<i>recemosa P4</i>	*		*			
Myrtaceae	<i>Baeckea</i>	<i>crispiflora subsp. Kulin (R. Hnatiuk 780026)</i>		*		*		*
Myrtaceae	<i>Beaufortia</i>	<i>interstans</i>				*		
Myrtaceae	<i>Beaufortia</i>	<i>schaueri</i>				*		
Myrtaceae	<i>Calytrix</i>	<i>breviflora</i>				*		
Myrtaceae	<i>Darwinia</i>	<i>inconspicua N.G. Marchant & Keighery ms</i>		*		*		*
Myrtaceae	<i>Eucalyptus</i>	<i>annulata</i>	*		*			
Myrtaceae	<i>Eucalyptus</i>	<i>calycogona</i>					*	
Myrtaceae	<i>Eucalyptus</i>	<i>cylindrocarpa</i>	*	*				
Myrtaceae	<i>Eucalyptus</i>	<i>eremophila subsp. eremophila</i>	*	*	*	*		*
Myrtaceae	<i>Eucalyptus</i>	<i>flocktoniae Maiden subsp. flocktoniae</i>	*	*	*			
Myrtaceae	<i>Eucalyptus</i>	<i>gracilis</i>	*					

Family	Genus	Species	Eucalyptus woodland	Eucalyptus mallee woodland	Eucalyptus salmonophloia woodland	Sandplain heath	Rocky outcrop	Allocasuarina thicket
Myrtaceae	<i>Eucalyptus</i>	<i>kondininensis</i>	*	*				
Myrtaceae	<i>Eucalyptus</i>	<i>leptophylla</i>		*		*		
Myrtaceae	<i>Eucalyptus</i>	<i>melanoxylon</i>	*					
Myrtaceae	<i>Eucalyptus</i>	<i>pileata</i>		*			*	*
Myrtaceae	<i>Eucalyptus</i>	<i>platycorys</i>				*		
Myrtaceae	<i>Eucalyptus</i>	<i>polita</i>	*	*	*			
Myrtaceae	<i>Eucalyptus</i>	<i>salmonophloia</i>	*	*	*			
Myrtaceae	<i>Eucalyptus</i>	<i>salubris</i>	*	*	*			
Myrtaceae	<i>Eucalyptus</i>	<i>sporadica</i>	*					*
Myrtaceae	<i>Eucalyptus</i>	<i>steedmanii (DRF)</i>	*					
Myrtaceae	<i>Eucalyptus</i>	<i>urna</i>	*	*				
Myrtaceae	<i>Leptospermum</i>	<i>erubescens</i>		*	*	*		*
Myrtaceae	<i>Melaleuca</i>	<i>adnata</i>	*	*	*	*		*
Myrtaceae	<i>Melaleuca</i>	<i>cordata</i>		*		*		*
Myrtaceae	<i>Melaleuca</i>	<i>cucullata</i>	*	*				
Myrtaceae	<i>Melaleuca</i>	<i>eleuterostachya</i>	*	*				
Myrtaceae	<i>Melaleuca</i>	<i>elliptica</i>	*	*	*			
Myrtaceae	<i>Melaleuca</i>	<i>hamata</i>	*	*	*	*	*	*
Myrtaceae	<i>Melaleuca</i>	<i>laxiflora</i>		*	*			*
Myrtaceae	<i>Melaleuca</i>	<i>pauperiflora subsp. fastigiata</i>	*	*	*			
Myrtaceae	<i>Melaleuca</i>	<i>pauperiflora subsp. pauperiflora</i>	*	*	*			
Myrtaceae	<i>Melaleuca</i>	<i>pentagona</i>	*	*		*		*
Myrtaceae	<i>Melaleuca</i>	<i>pungens var. pungens</i>		*		*		
Myrtaceae	<i>Melaleuca</i>	<i>sapientes</i>		*		*		
Myrtaceae	<i>Melaleuca</i>	<i>sparsiflora</i>	*					
Myrtaceae	<i>Melaleuca</i>	<i>teuthidooides</i>	*		*	*		
Myrtaceae	<i>Melaleuca</i>	<i>thyoides</i>	*			*		
Myrtaceae	<i>Melaleuca</i>	<i>uncinata</i>	*	*		*		*
Myrtaceae	<i>Thryptomene</i>	<i>kochii</i>		*		*		
Myrtaceae	<i>Verticordia</i>	<i>chrysantha</i>				*		
Myrtaceae	<i>Verticordia</i>	<i>plumosa var. incrassata</i>				*		
Myrtaceae	<i>Verticordia</i>	<i>roei</i>				*		
Papilionaceae	<i>Daviesia</i>	<i>benthamii subsp. acanthoclona</i>	*	*	*	*		
Papilionaceae	<i>Daviesia</i>	<i>benthamii subsp. benthamii</i>	*	*	*	*		
Papilionaceae	<i>Daviesia</i>	<i>lancifolia</i>		*		*		
Papilionaceae	<i>Daviesia</i>	<i>nematophylla</i>	*	*		*		*
Papilionaceae	<i>Gastrolobium</i>	<i>spinosum</i>				*		*
Papilionaceae	<i>Gompholobium</i>	<i>gompholobioides</i>	*		*	*		*
Papilionaceae	<i>Leptosema</i>	<i>daviesioides</i>				*		*

Family	Genus	Species	Eucalyptus woodland	Eucalyptus mallee woodland	Eucalyptus salmophloia woodland	Sandplain heath	Rocky outcrop	Allocasuarina thicket
Papilionaceae	<i>Templetonia</i>	<i>egena</i>		*				*
Phormiaceae	<i>Dianella</i>	<i>revoluta</i> var. <i>revoluta</i>	*					
Proteaceae	<i>Banksia</i>	<i>circioides</i>				*		
Proteaceae	<i>Banksia</i>	<i>elderiana</i>				*		*
Proteaceae	<i>Banksia</i>	<i>erythrocephala</i> var. <i>erythrocephala</i>				*		
Proteaceae	<i>Conospermum</i>	<i>brownii</i>				*		*
Proteaceae	<i>Grevillea</i>	<i>acuaria</i>	*					*
Proteaceae	<i>Grevillea</i>	<i>cagiana</i>	*			*		
Proteaceae	<i>Grevillea</i>	<i>eriotachya</i>		*		*		*
Proteaceae	<i>Grevillea</i>	<i>huegellii</i>	*			*		
Proteaceae	<i>Grevillea</i>	<i>obliquistigma</i> subsp. <i>obliquistigma</i>	*			*		
Proteaceae	<i>Grevillea</i>	<i>oligantha</i>	*					
Proteaceae	<i>Grevillea</i>	<i>oncogyne</i>		*		*		*
Proteaceae	<i>Grevillea</i>	<i>pterosperma</i>		*		*		*
Proteaceae	<i>Grevillea</i>	<i>shuttleworthiana</i> subsp. <i>obovata</i>				*		
Proteaceae	<i>Hakea</i>	<i>commutata</i>	*					
Proteaceae	<i>Hakea</i>	<i>corymbosa</i>				*		*
Proteaceae	<i>Hakea</i>	<i>erecta</i>				*		*
Proteaceae	<i>Hakea</i>	<i>multilineata</i>		*		*		*
Proteaceae	<i>Hakea</i>	<i>newbeyana</i>		*				
Proteaceae	<i>Hakea</i>	<i>platysperma</i>				*		
Proteaceae	<i>Hakea</i>	<i>scoparia</i> subsp. <i>scoparia</i>		*				*
Proteaceae	<i>Hakea</i>	<i>subulcata</i>					*	*
Proteaceae	<i>Isopogon</i>	<i>scabriusculus</i> subsp. <i>pubifloris</i>				*		*
Proteaceae	<i>Persoonia</i>	<i>coriacea</i>				*		*
Proteaceae	<i>Persoonia</i>	<i>helix</i>				*		*
Proteaceae	<i>Petrophile</i>	<i>divaricata</i>				*		
Proteaceae	<i>Petrophile</i>	<i>squamata</i>				*		
Proteaceae	<i>Synaphea</i>	<i>interioris</i>				*		
Rhamnaceae	<i>Cryptandra</i>	<i>minutifolia</i> subsp. <i>brevistyla</i>	*			*		
Rhamnaceae	<i>Cryptandra</i>	<i>nutans</i>				*		
Rutaceae	<i>Drummondita</i>	<i>hassellii</i>				*		*
Rutaceae	<i>Microcybe</i>	<i>multiflora</i> subsp. <i>multiflora</i>	*					
Rutaceae	<i>Phebalium</i>	<i>ambiguum</i>				*		
Rutaceae	<i>Phebalium</i>	<i>tuberosum</i>	*			*		
Rutaceae	<i>Philothea</i>	<i>rhomboidea</i>	*			*		*
Santalaceae	<i>Exocarpos</i>	<i>aphyllus</i>	*			*		
Santalaceae	<i>Exocarpos</i>	<i>sparteus</i>	*			*		*
Santalaceae	<i>Santalum</i>	<i>acuminatum</i>	*			*		*

Family	Genus	Species	Eucalyptus woodland	Eucalyptus mallee woodland	<i>Eucalyptus salomonophloia</i> woodland	Sandplain heath	Rocky outcrop	Allocasuarina thicket
Sapindaceae	<i>Dodonaea</i>	<i>bursariifolia</i>		*				
Sapindaceae	<i>Dodonaea</i>	<i>microzyga</i> var. <i>acrolobata</i>	*	*	*			
Sapindaceae	<i>Dodonaea</i>	<i>stenozyga</i>	*	*	*			
Sapindaceae	<i>Dodonaea</i>	<i>viscosa</i> subsp. <i>angustissima</i>	*					
Thymelaeaceae	<i>Pimelea</i>	<i>aeruginosa</i>		*		*		
Violaceae	<i>Hybanthus</i>	<i>floribundus</i> subsp. <i>curvifolius</i>					*	

Appendix B
DEC Declared Rare and Priority Flora
Database Search Results

**Eucalyptus steedmanii Management Plan
Spotted Quoll Mine**

Total No. of Records = 7

Species Name	Cons. Code	Status	Pop ID	No. Plants	Latitude	Longitude	Purpose	Vest
Eucalyptus steedmanii	R		1		32^26'49.5"	119^41'04.3"	Un-allocated Crown land	NON
			2	8000	32^28'44.6"	119^41'38.4"	Un-allocated Crown land	NON
			3A	4000	32^28'52.2"	119^40'39.7"	Un-allocated Crown land	NON
			3B		32^28'52.2"	119^40'39.7"	Road Verge	SHI
			4		32^18'55.5"	119^42'05.3"	Un-allocated Crown land	NON
			5		32^20'45.5"	119^43'05.3"	Un-allocated Crown land	NON
			6		32^12'55.5"	119^39'05.3"	Un-allocated Crown land	NON

Appendix C
DEC and WA Herbarium Database Search
Results for *Eucalyptus steedmanii*

**Eucalyptus steedmanii Management Plan
Spotted Quoll Mine**

February 12, 2009

WAHERB SPECIMEN DATABASE
GENERAL ENQUIRY

Eucalyptus steedmanii
C.A.Gardner (Myrtaceae)
CONSERVATION STATUS:R
Coll.: R.D. Royce s.n. Date: 07 1944 (PERTH
01506560)
LOCALITY Cultivated: Observatory Grounds, Perth
WA
LAT Deg Min Sec LONG Deg Min
Sec
From seed ex Type Locality.
Previous det.: *Eucalyptus steedmanii* C. Gardner

Eucalyptus steedmanii
C.A.Gardner (Myrtaceae)
CONSERVATION STATUS:R
Coll.: Teakle L.J. s.n. Date: 11 1929 (PERTH 1050788
)
LOCALITY Near Forrestania WA
LAT 32 Deg 34 Min Sec S LONG 119 Deg 51
Min Sec E
Bushy tree, 25 ft.
Previous det.: *Eucalyptus steedmanii* C. Gardner

Eucalyptus steedmanii
C.A.Gardner (Myrtaceae)
CONSERVATION STATUS:R
Coll.: M.I.H. Brooker 6731 Date: 30 12 1979 (PERTH
1051237)
LOCALITY 8.3 km S of Hyden - Norseman road SW of
crossroads [ca 80 km ESE of Hyden] WA
LAT 32 Deg 28 Min Sec S LONG 119 Deg 40
Min Sec E
Tree 6 m tall branching at 0.3 m into several stems, bark.
Previous det.: *Eucalyptus steedmanii* C. Gardner

Eucalyptus steedmanii
C.A.Gardner (Myrtaceae)
CONSERVATION STATUS:R
Coll.: C.F. Davies s.n. Date: 09 1966 (PERTH
1506110)
LOCALITY Ravensthorpe septen trionalem versus [N of
Ravensthorpe] WA
LAT 33 Deg 34 Min 47.000 Sec S LONG 120 Deg 2
Min 36.000 Sec E
Frutex 2 m alt.
Previous det.: *Eucalyptus steedmanii* C. Gardner

Eucalyptus steedmanii
C.A.Gardner (Myrtaceae)
CONSERVATION STATUS:R
Coll.: T. Tapper s.n. Date: 08 06 1978 (PERTH 1051202
)
LOCALITY At an old campsite 6-7 km SW of Lake
Cronin, which is 80 km E of Hyden;
5 km SW of Hyden-Norseman/Southern Cross-Lake King
crossroads WA
LAT 32 Deg 27 Min Sec S LONG 119 Deg 43
Min Sec E
Tree to 4 m in young stand. Odd trees to 8 m.
Previous det.: *Eucalyptus steedmanii* C. Gardner

Eucalyptus steedmanii
C.A.Gardner (Myrtaceae)
CONSERVATION STATUS:R
Coll.: L.D. Pryor & J.D. Briggs 96 Date: 13 09 1978 (PERTH
1043676)
LOCALITY Ca 80 km E of Hyden [For exact location see
Perth Herbarium]. WA
LAT 32 Deg 25 Min Sec S LONG 119 Deg 40
Min Sec E
Young tree 4 m high, d.b.h. 3 cm, with a smooth grey
stem. On an ironstone rise.

In a small (ca 1 ha.), pure stand of *E. steedmanii*. *E.*
Gardneri and *E. cylindrocarpa* nearby.
The stand appeared to be mainly regeneration following
fire within the last 10 years.
Previous det.: *Eucalyptus steedmanii* C. Gardner

Eucalyptus steedmanii
C.A.Gardner (Myrtaceae)
CONSERVATION STATUS:R
Coll.: L.D. Pryor & J.D. Briggs 96 Date: 13 09 1978 (PERTH
1043684)
LOCALITY Ca 80 km E of Hyden [For exact location see
Perth Herbarium] WA
LAT 32 Deg 25 Min Sec S LONG 119 Deg 40
Min Sec E
Young tree 4 m high, d.b.h. 3 cm, with a smooth grey
stem. On an ironstone rise.
In a small (ca 1 ha.), pure stand of *E. steedmanii*. *E.*
Gardneri and *E. cylindrocarpa* nearby.
The stand appeared to be mainly regeneration following
fire within the last 10 years.
Previous det.: *Eucalyptus steedmanii* C. Gardner

Eucalyptus steedmanii
C.A.Gardner (Myrtaceae)
CONSERVATION STATUS:R
Coll.: S.D. Hopper 1071 Date: 16 08 1978 (PERTH
1051326)
LOCALITY 74 km E of Hyden, 36 km NNE of Holt Rock
WA
LAT 32 Deg 27 Min Sec S LONG 119 Deg 40
Min Sec E
Poles and mallees to 5 m tall (averaging 3 m). W side
of ridge top. Red brown gravelly loam.
Growing in Open *Eucalyptus salmonophloia* woodland
over *E. salubris*, *E. steedmanii* mallee over *Callitris*
morrisoni?, *Acacia* sp.,
Santalum sp, and *Melaleuca* sp. shrub.
Several hundred plants seen.
Previous det.: *Eucalyptus steedmanii* C. Gardner

Eucalyptus steedmanii
C.A.Gardner (Myrtaceae)
CONSERVATION STATUS:R
Coll.: S.D. Hopper 1073 Date: 17 08 1978 (PERTH
1051318)
LOCALITY 76 km E of Hyden, 36 km NNE of Holt Rock
WA
LAT 32 Deg 26 Min Sec S LONG 119 Deg 40
Min Sec E
Trees 5-8 m tall which branch into several mallee-like
stems within 1 m above
ground level to form a 'V'-shaped canopy; leaves grey-
green and mostly held
erect, bark smooth, varying from grey to a rich red-brown.
Pale red-brown loam.
Growing in open woodland of *Eucalyptus salmonophloia*
and *E. steedmanii* over open mallee of *E. eremophila* over
low scrub.
Previous det.: *Eucalyptus steedmanii* C. Gardner

Eucalyptus steedmanii
C.A.Gardner (Myrtaceae)
CONSERVATION STATUS:R
Coll.: M.I.H. Brooker 6301 Date: 11 08 1979 (PERTH
1051229)
LOCALITY 7.2 km S of Hyden-Norseman road on road 6
km W of crossroads. [Ca 77 km E of Hyden] WA
LAT 32 Deg 25 Min Sec S LONG 119 Deg 40
Min Sec E
Tree 5 m tall, branching from near base, bark smooth light
pink and grey satiny, leaves grey-green, glossy.
Growing on low sandy rise with quartz rubble. With *E.*
salubris, *E. eremophila*, *E. flocktoniae*, *E. salmonophloia**
Previous det.: *Eucalyptus steedmanii* C. Gardner

February 12, 2009

Eucalyptus steedmanii
C.A.Gardner (Myrtaceae)
CONSERVATION STATUS:R
Coll.: C.F. Davies s.n. Date: 09 1966 (PERTH 1506129)
LOCALITY Ravensthorpe meridionalem versus [S of Ravensthorpe] WA
LAT 33 Deg 34 Min 47.000 Sec S LONG 120 Deg 2 Min 36.000 Sec E
Frutex erectus, 2 m alt.
Previous det.: *Eucalyptus steedmanii* C. Gardner

Eucalyptus steedmanii
C.A.Gardner (Myrtaceae)
CONSERVATION STATUS:R
Coll.: T. Tapper s.n. Date: 08 06 1978 (PERTH 1051210)
LOCALITY At an old campsite 6-7 km SW of Lake Cronin, which is 80 km E of Hyden; 5 km SW of Hyden-Norseman/Southern Cross-Lake King crossroads WA
LAT 32 Deg 27 Min Sec S LONG 119 Deg 43 Min Sec E
Tree to 4 m in young stand. Odd trees to 8 m.
Previous det.: *Eucalyptus steedmanii* C. Gardner

Eucalyptus steedmanii
C.A.Gardner (Myrtaceae)
CONSERVATION STATUS:R
Coll.: K.R. Newbey 6179 Date: 03 10 1979 (PERTH 1050796)
LOCALITY 10 km SW of Lake Cronin, ca 75 km E of Hyden WA
LAT 32 Deg 28 Min Sec S LONG 119 Deg 42 Min 30.000 Sec E
Upright-spreading, moderately-dense, woody tree 3-5 x 0.8-1.5 m.
Well-drained clayey sand. Moderately exposed, gentle undulating plain. Almost pure stand of *Eucalyptus steedmanii* Low Forest B.
Previous det.: *Eucalyptus steedmanii* C. Gardner

Eucalyptus steedmanii
C.A.Gardner (Myrtaceae)
CONSERVATION STATUS:R
Coll.: S.D. Hopper 1073 Date: 17 08 1978 (PERTH 1051245)
LOCALITY 76 km E of Hyden, 36 km NNE of Holt Rock WA
LAT 32 Deg 26 Min Sec S LONG 119 Deg 40 Min Sec E
Trees 5-8 m tall which branch into several mallee-like stems within 1 m above ground level to form a 'V'-shaped canopy; leaves grey-green and mostly held erect, bark smooth, varying from grey to a rich red-brown. Pale red-brown loam.
Growing in open woodland of *Eucalyptus salmonophloia* and *E. steedmanii* over open mallee of *E. eremophila* over low scrub.
Previous det.: *Eucalyptus steedmanii* C. Gardner

Eucalyptus steedmanii
C.A.Gardner (Myrtaceae)
CONSERVATION STATUS:R
Coll.: S.D. Hopper 1057 Date: 16 08 1978 (PERTH 1051288)
LOCALITY 73 km E of Hyden, 37 km NNE of Holt Rock WA
LAT 32 Deg 26 Min Sec S LONG 119 Deg 39 Min Sec E
Regenerating as poles up to 4 m high. Most plants have fruit, a few of the larger ones have buds.

Growing in lateritic loam, rich red-brown loam and ironstone gravel on ridge tops.
Growing sympatrically with *Eucalyptus salubris* in mallee vegetation over shrub.
Abundance: Several hundred plants located.
Previous det.: *Eucalyptus steedmanii* C. Gardner

Eucalyptus steedmanii
C.A.Gardner (Myrtaceae)
CONSERVATION STATUS:R
Coll.: D.F. Blaxell 1732 Date: 13 09 1978 (PERTH 1051334)
LOCALITY 80 km E of Hyden on track to Norseman WA
LAT 32 Deg 15 Min Sec S LONG 119 Deg 30 Min Sec E
Small tree 5 m. Bark smooth, shining, grey-green. Leaves with a grey cast. On low hills in gravelly loam over ironstone.
In woodland of this sp., *Eucalyptus salubris*, *E. flocktoniae*, *E. gardneri*, *Callitris* etc.
Spirit Collection Number: 1854 - buds - photo (NSW).
Previous det.: *Eucalyptus steedmanii* C. Gardner
Frequency:locally common.

Eucalyptus steedmanii
C.A.Gardner (Myrtaceae)
CONSERVATION STATUS:R
Coll.: K. Kershaw & L. Kerrigan KK 2359 Date: 28 02 2002 (PERTH 06397352)
LOCALITY Head 3.9 km W along gridline located 9.4 km N along Southern Cross-Forrestania Road from intersection with Hyden-Norseman Road WA
LAT 32 Deg 19 Min 45.300 Sec S LONG 119 Deg 42 Min 20.300 Sec E
Mallet 4.5 m high. Ironstone/quartz. Red/brown clay and gravel.
Mallee Woodland. *Eucalyptus* sp. mallet x 2, *Exocarpus* sp., *Acacia* sp., *Phelabium* sp., *Dodonaea* sp.

Eucalyptus steedmanii
C.A.Gardner (Myrtaceae)
CONSERVATION STATUS:R
Coll.: K. Kershaw & L. Kerrigan KK 2360 Date: 28 02 2002 (PERTH 06397360)
LOCALITY 350 m N along gridline located 4.2 km W along gridline located 9.4 km N along Southern Cross-Forrestania Road from intersection with Hyden-Norseman Road WA
LAT 32 Deg 19 Min 35.800 Sec S LONG 119 Deg 42 Min 9.200 Sec E
Small tree. Mallet-fire regeneration 2 m high. Quartz. Red/brown clay.
Mallet Woodland. *Olearia muellerii*, *Acacia* sp., *Melaleuca* sp., *Eucalyptus* sp x 2
Frequency:abundant. 4000+ plants.

Eucalyptus steedmanii
C.A.Gardner (Myrtaceae)
CONSERVATION STATUS:R
Coll.: S. van Leeuwen s.n. Date: 04 1989 (PERTH 06121772)
LOCALITY Gridline N of Forrestania mining camp, SSW of Lake Cronin WA
LAT 32 Deg 30 Min Sec S LONG 119 Deg 45 Min Sec E
Mallet to 5 m with smooth coppery bark. On greenstone/red loam on gradual SW facing slope.
Previous det.: *Eucalyptus steedmanii* C.A.Gardner
Frequency:in dense population of over 100,000 plants.

Eucalyptus steedmanii
C.A.Gardner (Myrtaceae)
CONSERVATION STATUS:R

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Coll.: A.P. Brown 378 Date: 03 09 1986 (PERTH 06008186)
LOCALITY Low hill c. 7.25 km S of the Hyden - Norseman road on track which also heads N of the road to North Iron Cap WA
LAT 32 Deg 28 Min Sec S LONG 119 Deg 39 Min Sec E
In bud and fruit, no flowers. Low quartzite hill. Shrubland of Melaleuca, Callitris canescens, Allocasuarina and Santalum with emergent Eucalyptus steedmanii.
Previous det.: Eucalyptus steedmanii C.A.Gardner
Frequency:30+ plants.

Eucalyptus steedmanii
C.A.Gardner (Myrtaceae)
CONSERVATION STATUS:R
Coll.: M.E. French 1499 Date: 01 03 2003 (PERTH 06405940)
LOCALITY NE of North Ironcap, W of Forrestania - Southern Cross Road WA
LAT 32 Deg 19 Min 39.500 Sec S LONG 119 Deg 43 Min 25.300 Sec E
Mallet, 6 m high. Smooth grey bark. Slight quartz rise with some ironstone.
Eucalyptus pilcata, E. salubris, E. urna, E. salmonophloia.

Eucalyptus steedmanii
C.A.Gardner (Myrtaceae)
CONSERVATION STATUS:R
Coll.: M. French 1505 Date: 16 04 2003 (PERTH 06419089)
LOCALITY Holland Track, SW of Wattle Rocks and SW of Mount Holland WA
LAT 32 Deg 16 Min 52.500 Sec S LONG 119 Deg 34 Min 57.300 Sec E
Mallet. Height: 3 m. Smooth tan bark, glossy olive-green leaves. Slight slope of white clay-loam.
Eucalyptus urna, E. salmonophloia, E. livioia.
Common North and South of Wattle Rocks.
Frequency:sparse clumps.

Eucalyptus steedmanii
C.A.Gardner (Myrtaceae)
CONSERVATION STATUS:R
Coll.: M. French 1507 Date: 16 04 2003 (PERTH 06419097)
LOCALITY SE of Wattle Rocks on Holland Track, SW of Mount Holland WA
LAT 32 Deg 15 Min 53.500 Sec S LONG 119 Deg 35 Min 14.300 Sec E
Mallet. Height: 3 m. Smooth tan bark, glossy olive-green leaves. White clay loams, high in landscape.
Eucalyptus livida, E. densa subsp. densa, E. flocktoniae subsp. flocktoniae.
Frequency:common.

Eucalyptus steedmanii
C.A.Gardner (Myrtaceae)
CONSERVATION STATUS:R
Coll.: E. Reid s.n. Date: 18 03 2006 (PERTH 07280165)
LOCALITY 75 km E of Hyden, 3.6 km S of Hyden Norseman Road, 7.8 km W of Forrestania South - Hyden Norseman crossroads WA
LAT 32 Deg 26 Min 55.400 Sec S LONG 119 Deg 40 Min 32.000 Sec E
Man made dame edge. Moist white/grey sand over laterite.
Eucalyptus salmonophloia, Hakea multilineata, Acacia hemiteles, Melaleuca elliptica.
Condition of Population: only three trees in area.
Frequency:3 mature plants.

Eucalyptus steedmanii
C.A.Gardner (Myrtaceae)
CONSERVATION STATUS:R

Coll.: E. Reid s.n. Date: 18 03 2006 (PERTH 07280173)
LOCALITY 75 km E of Hyden, 3.6 km S of Hyden Norseman Road, 7.8 km W of Forrestania South - Hyden Norseman crossroads WA
LAT 32 Deg 26 Min 52.300 Sec S LONG 119 Deg 40 Min 37.400 Sec E
Man made dam edge. Moist white/grey sand over laterite. Melaleuca adnata, M. elliptica, Eucalyptus polita.
Frequency:1 mature plant.

Eucalyptus steedmanii
C.A.Gardner (Myrtaceae)
CONSERVATION STATUS:R TYPE
STATUS: HOL
Coll.: H. Steedman s.n. Date: 02 1928 (PERTH 1005960)
LOCALITY Forrestania. WA
LAT 32 Deg 34 Min Sec S LONG 119 Deg 51 Min Sec E
Previous det.: Eucalyptus steedmanii C. Gardner

Eucalyptus steedmanii
C.A.Gardner (Myrtaceae)
CONSERVATION STATUS:R TYPE
STATUS: ISO
Coll.: H. Steedman s.n. Date: 02 1928 (PERTH 1005979)
LOCALITY Forrestania. WA
LAT 32 Deg 34 Min Sec S LONG 119 Deg 51 Min Sec E

Eucalyptus steedmanii
C.A.Gardner (Myrtaceae)
CONSERVATION STATUS:R
Coll.: L.D. Pryor & J.D. Briggs 96 Date: 13 09 1978 (PERTH 1044095)
LOCALITY Ca 80 km E of Hyden [For exact location see Perth Herbarium] WA
LAT 32 Deg 25 Min Sec S LONG 119 Deg 40 Min Sec E
Young tree 4 m high, d.b.h. 3 cm, with a smooth grey stem. On an ironstone rise.
In a small (ca 1 ha.), pure stand of E. steedmanii. E. Gardneri and E. cylindrocarpa nearby.
The stand appeared to be mainly regeneration following fire within the last 10 years.
Previous det.: Eucalyptus steedmanii C. Gardner

Eucalyptus steedmanii
C.A.Gardner (Myrtaceae)
CONSERVATION STATUS:R
Coll.: S.D. Hopper 1057 Date: 16 08 1978 (PERTH 01051296)
LOCALITY 73 km E of Hyden, 37 km NNE of Holt Rock WA
LAT 32 Deg 26 Min Sec S LONG 119 Deg 39 Min Sec E
Regenerating as poles up to 4 m high, most plants have fruit, a few of the larger ones have buds.
Growing in lateritic loam, rich red-brown loam and ironstone gravel on ridge tops.
Growing sympatrically with Eucalyptus salubris in mallee vegetation over shrub.
Previous det.: Eucalyptus steedmanii C. Gardner
Frequency:several hundred plants located.

Eucalyptus steedmanii
C.A.Gardner (Myrtaceae)
CONSERVATION STATUS:R
Coll.: J.A. Cochrane & A. Crawford JAC 4630 Date: 12 05 2003 (PERTH 07224710)
LOCALITY 9.4 km N of Forrestania crossroad and 3.9 km W - on N side of grid line (S side burnt) WA

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LAT 32 Deg 19 Min 45.900 Sec S LONG 119 Deg 42 Min 24.300 Sec E

Tall mallee with smooth red copper bark. Glossy grey-green leaves. Regeneration to 5 m tall. Flattish/rise in landscape. Red clay. Laterite. Woodland. *Exocarpus spartus*, *Acacia sp.*, *Phebalium sp.*, *Eucalyptus spp.*

Majority of plants on S side of grid line have not flowered and produced fruit since last fire. Frequency: 1000's of plants.

Eucalyptus steedmanii

C.A.Gardner (Myrtaceae)

CONSERVATION STATUS:R

Coll.: K. Kershaw & L. Kerrigan KK 2361 Date: 28 02 2002 (PERTH 06397344)

LOCALITY 250 m S along gridline located 3 km W along gridline located 9.4 km N along Southern Cross-Forrestania Road from intersection with Hyden-Norseman Road WA

LAT 32 Deg 19 Min 53.100 Sec S LONG 119 Deg 42 Min 52.200 Sec E

Small tree 2.5 m high. Fire regeneration/Mallet species.

Ironstone/quartz. Red/brown clay.

Eucalyptus sp mallee x 3, *Acacia sp.*, *Melaleuca sp.*,

Olearia muelleri, *Exocarpus sp.*

Eucalyptus steedmanii

C.A.Gardner (Myrtaceae)

CONSERVATION STATUS:R

Coll.: K. Kershaw & L. Kerrigan KK 2358 Date: 28 02 2002 (PERTH 06397301)

LOCALITY Head 2.4 km W along gridline located 9.4 km N along Southern Cross-Forrestania Road from the intersection of Hyden-Norseman Road WA

LAT 32 Deg 19 Min 43.900 Sec S LONG 119 Deg 43 Min 16.900 Sec E

Small tree. Mallee 3 m high. Upslope. Ironstone and quartz. Red/brown clayey sand.

Mallee Woodland. *Olearia muelleri*, *Acacia sp.*, *Melaleuca sp. x 2*, *Dodonaea sp.*, *Eucalyptus sp. x 2* (mallee).

Frequency: abundant. 2500+ plants.

Eucalyptus steedmanii

C.A.Gardner (Myrtaceae)

CONSERVATION STATUS:R

Coll.: K. Kershaw & L. Kerrigan KK 2362 Date: 28 02 2002 (PERTH 06397336)

LOCALITY 400 m E along gridline located 5.6 km S along gridline located 7.4 km

W along Hyden-Norseman Road from Southern Cross-Forrestania Road intersection WA

LAT 32 Deg 26 Min 40.100 Sec S LONG 119 Deg 41 Min 10.100 Sec E

Small tree. Mallee 2.5 m. Ironstone/quartz.

Red/brown clayey sand.

Mallee Woodland. *Olearia muelleri*, *Acacia sp.*, *Exocarpus sp.*, *Melaleuca sp.*, *Eucalyptus sp. mallee x 2*.

Frequency: abundant. 3000+ plants.

Eucalyptus steedmanii

C.A.Gardner (Myrtaceae)

CONSERVATION STATUS:R

Coll.: K. Kershaw & L. Kerrigan KK 2353 Date: 27 02 2002 (PERTH 06397328)

LOCALITY 23.5 km NE along Holland Track from Hyden-Norseman Road or 1 km NE of Wattle Rocks WA

LAT 32 Deg 15 Min 24.400 Sec S LONG 119 Deg 35 Min 49.700 Sec E

Small tree. Mallee 1.5 m. Upslope granite.

Red/brown sandy clay.

Mallee Woodland. *Olearia muelleri*, *Daviesia benthamii*, *Melaleuca lateriflora*,

Acacia hemiteles, *Microcorys sp.*, *Melaleuca sp.*, *Eucalyptus sp.*

Frequency: abundant, 5000+ plants.

Eucalyptus steedmanii

C.A.Gardner (Myrtaceae)

CONSERVATION STATUS:R

Coll.: K.R. Newbey 8331 Date: 21 07 1981 (PERTH 1050818)

LOCALITY 10.6 km SW of Lake Cronin, ca 75 km E of Hyden (Hyden 1:250,000 sheet) WA

LAT 32 Deg 28 Min Sec S LONG 119 Deg 42 Min Sec E

Upright-spreading, moderately-dense, woody tree 2.2-2.6 m x 0.8-1.0 m. Leaves dull medium green.

Well-drained, stony loamy sand. Moderately exposed, gentle undulating plain. In *E. eremophila* Open Shrub Mallee (Muir, 1977).

Previous det.: *Eucalyptus steedmanii* C. Gardner

Frequency: rare.

Appendix D
DEC Letter of Advice Regarding
Eucalyptus steedmanii Locations

**Eucalyptus steedmanii Management Plan
Spotted Quoll Mine**



Department of
Environment and Conservation

17 DEC 2008
BY: _____

Your ref:
Our ref:
Enquiries:
Phone: Caron Macneall
Fax: 9219 8778
Email: 9219 8701
caron.macneall@dec.wa.gov.au

Mr P Knapton
Western Areas NL
Suite 3, Level 1
11 Ventnor Avenue
WEST PERTH WA 6005

Dear Mr Knapton

INQUIRY INTO LOCATION OF ENVIRONMENTALLY SENSITIVE AREA ON MINING TENEMENT M77/583

Thank you for your inquiry into the accuracy of Environmentally Sensitive Areas (ESAs) on mining tenement M77/583 received 10 November 2008.

I have been advised by the Species and Communities Branch at the Department of Environment and Conservation (DEC) that the ESA's under question were incorrectly plotted based on inaccurate records of populations of *Eucalyptus steedmanii*.

From the information you have submitted our records have been updated with the new *E. steedmanii* population coordinates supplied by Botanica consulting. The ESA's should now be aligned with the new populations of *E. steedmanii*.

The areas previously associated with *E. steedmanii* populations 2, 3A and 3B are no longer considered as ESA's and therefore exemptions under *Regulation 5 of the Environmental Protection (Clearing of Native Vegetation) Regulations 2004* apply.

If you have any further queries regarding the location of the ESA's on mining tenement M77/583, please do not hesitate to contact Caron Macneall at the Department's Native Vegetation Conservation Branch on 9219 8744.

Yours sincerely

Kelly Faulkner
MANAGER
NATIVE VEGETATION CONSERVATION BRANCH

11 December 2008

DIRECTOR GENERAL AND ENVIRONMENTAL SERVICES DIVISIONS: The Atrium, 168 St Georges Terrace, Perth, Western Australia
Phone: (08) 6364 6500 Fax: (08) 6364 6520 TTY: 1880 555 630

PARKS AND CONSERVATION SERVICES DIVISIONS: Executive: Corner of Australia II Drive and Hackett Drive, Crawley, Western Australia
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POSTAL ADDRESS FOR ALL DIVISIONS: Locked Bag 104, Bentley Delivery Centre, Western Australia 6983
www.dec.wa.gov.au

Appendix E
Botanica *Eucalyptus steedmanii* Seed
Levels Monitoring Results

**Eucalyptus steedmanii Management Plan
Spotted Quoll Mine**

Population 1

Way Point: 071/ pic 79
Way Point: 070/ pic 80

Distance (m)	# of DRF trees with Fruit/ vegetation	Distance covered (m)
0		
2.7	other veg	2.7
3.6	X 1 no fruit	0.9
8.3	other veg	4.7
9.8	X 3 no fruit	1.5
10.2	other veg	0.4
10.6	X 1 no fruit, X 1 mature fruit	0.4
14.3	other veg	3.7
15.2	X 1 no fruit	0.9
21	other veg	5.8
23	X 3 mature fruit, X 1 no fruit	2
25.2	other veg	2.2
25.6	X 1 no fruit	0.4
27	other veg	1.4
28.1	X 1 mature fruit, X 1 no fruit	1.1
28.9	other veg	0.8
29.3	X 1 no fruit, X 1 mature fruit	0.4
30.6	other veg	1.3
30.9	X 1 no fruit	0.3
32.8	other veg	1.9
33.7	X 1 no fruit	0.9
35	other veg	1.3
35.5	X 2 no fruit	0.5
36.7	other veg	1.2
37.2	X 1 mature fruit	0.5
37.9	other veg	0.7
38.4	X 1 immature fruit	0.5
40.8	other veg	2.4
42.2	X 1 mature fruit, X 1 no fruit	1.4
46.4	other veg	4.2
47.3	X 1 mature fruit, X 1 no fruit	0.9
48.6	other veg	1.3
49.2	X 1 mature fruit	0.6
50	other veg	0.8

	no fruit	immature fruit	mature fruit	total
number	16	1	10	27
%	59.26%	3.70%	37.04%	100.00%

Cover	other veg	Euc steedmanii	total
Total distance covered (m)	36.8	13.2	50
(% of distance)	73.60%	26.40%	100.00%

Plants per 100 square metres	estimated area of population (ha)	extrapolated population numbers
100	29.73	297300

Way point: 072/ pic 83
Way point: 073/ pic 84

Population 2

Distance (m)	# of DRF trees with Fruit/ vegetation	Distance covered (m)
0		
10	X 5 mature fruit	10
10.6	other veg	0.6
11.4	X 1 mature fruit	0.8
14	other veg	2.6
17.4	X 3 mature fruit	3.4
20.4	other veg	3
21.5	X 3 mature fruit	1.1
22.4	other veg	0.9
25.8	X 2 mature fruit	3.4
27.8	other veg	2
29.9	X 3 mature fruit	2.1
35	other veg	5.1
38.2	X 2 mature fruit	3.2
47.1	other veg	8.9
47.7	X 2 mature fruit	0.6
50	other veg	2.3

	no fruit	immature fruit	mature fruit	total
number	0	0	21	21
%	0.00%	0.00%	100.00%	100.00%

Cover	Euc		total
	other veg	steedmanii	
Total distance covered (m)	25.4	24.6	50
(% of distance)	50.80%	49.20%	100.00%

Plants per 100 square metres	estimated area of population numbers
30	2.96
	extrapolated population numbers
	8940

Population 3

Way point: 068/ pic 81
Way point: 069/ pic 82

Distance (m)	# of DRF trees with Fruit/ vegetation	Distance covered (m)
0		
1.7	other veg	1.7
2.3	X 1 no fruit	0.6
3.8	other veg	1.5
4.2	X 1 no fruit	0.4
4.8	other veg	0.6
5.6	X 1 mature fruit, X 1 no fruit	0.8
7.9	other veg	2.3
8.2	X 1 no fruit	0.3
8.9	other veg	0.7
9.6	X 1 no fruit	0.7
16.4	other veg	6.8
17.2	X 1 mature fruit	0.8
38.2	other veg	21
39.2	X 1 mature fruit	1
41.9	other veg	2.7
43.1	X 1 no fruit	1.2
45.6	other veg	2.5
45.8	X 1 no fruit	0.2
47.1	other veg	1.3
48.1	X 2 no fruit	1
48.7	other veg	0.6
50	X 1 immature fruit, X 3 mature fruit	1.3

Maturity Count number	no fruit	immature fruit	mature fruit	total
	9	1	6	16
%	56.25%	6.25%	37.50%	100.00%

Cover	other veg	Euc steedmanii	total
Total distance covered (m)	41.7	8.3	50
(% of distance)	83.40%	16.60%	100.00%

Plants per 100 square metres	estimated area of population	extrapolated population numbers
16	2.67	4272

Population 4

Way point: 076/ pic 77
Way point: 077/ pic 78

Distance (m)	# of DRF trees with Fruit/ vegetation	Distance covered (m)
0		
2.8	other veg	2.8
3.9	X 1 mature fruit, X 3 no fruit	1.1
4.6	other veg	0.7
5.8	X 4 no fruit	1.2
6.2	other veg	0.4
6.4	X 1 no fruit	0.2
6.6	other veg	0.2
9.3	X 8 no fruit, X 3 immature fruit	2.7
9.6	other veg	0.3
10.8	X 1 mature fruit, X 3 no fruit	1.2
15.5	other veg	4.7
17.2	X 2 mature fruit, X 1 no fruit	1.7
21.4	other veg	4.2
22.5	X 2 mature fruit	1.1
25.2	other veg	2.7
25.7	X 1 mature fruit	0.5
26.3	other veg	0.6
27	X 1 mature fruit	0.7
28.8	other veg	1.8
29.8	X 3 mature fruit	1
32	other veg	2.2
36.9	X 18 mature fruit	4.9
39.8	other veg	2.9
40.2	X 1 no fruit	0.4
40.5	other veg	0.3
42	X 2 mature fruit	1.5
43	other veg	1
43.3	X 1 mature fruit	0.3
43.5	other veg	0.2
44.6	X 4 mature fruit	1.1
45.1	other veg	0.5
47	X 8 mature fruit	1.9
47.6	other veg	0.6
48.5	X 1 immature, X 2 no fruit	0.9
49.4	X 1 immature fruit, X 1 no fruit, X 1 mature fruit	0.9
50	other veg	0.6

	no fruit	immature fruit	mature fruit	total
number	24	5	45	74
%	32.43%	6.76%	60.81%	100.00%

Cover	other veg	Euc steedmanii	total
Total distance covered (m)	26.7	23.3	50
(% of distance)	53.40%	46.60%	100.00%

Plants per 100 square metres	estimated area of population	extrapolated population numbers
336	115.4	3877440

Population 5

Way point: 075/ pic 76
Way point: 074/ pic 75

Distance (m)	# of DRF trees with Fruit/ vegetation	Distance covered (m)
0		
0.9	other veg	0.9
1.4	X 2 E. <i>steedmanii</i> no fruit	0.5
4.6	other veg	3.2
4.8	X 1 E. <i>steedmanii</i> no fruit	0.2
7.7	other veg	2.9
8	X 1 mature fruit-seed	0.3
11.4	other veg	3.4
12.1	X 2 E. <i>steedmanii</i> immature fruit, X 1 no fruit	0.7
13.9	other veg	1.8
14.7	X 3 E. <i>steedmanii</i> no fruit, 1 immature fruit	0.8
16.1	other veg	1.4
16.7	X 1 no fruit	0.6
17.9	other veg	1.2
18.2	X 1 no fruit	0.3
19.1	other veg	0.9
19.4	X 1 no fruit	0.3
20.2	other veg	0.8
20.7	X 2 no fruit	0.5
21.6	other veg	0.9
21.9	X 1 no fruit	0.3
23	other veg	1.1
23.5	X 1 no fruit	0.5
24.5	other veg	1
24.9	X 1 no fruit	0.4
25.8	other veg	0.9
27.8	X 5 no fruit	2
31.1	other veg	3.3
31.3	X 1 no fruit	0.2
35.8	other veg	4.5
36.7	X 2 immature fruit, X 1 no fruit	0.9
37.6	other veg	0.9
39.3	X 6 mature fruit	1.7
40.1	other veg	0.8
40.5	X 1 mature fruit	0.4
40.8	other veg	0.3
44	X 13 mature fruit	3.2
44.5	other veg	0.5
45.2	X 4 mature fruit	0.7
47.1	other veg	1.9
48.4	X 4 mature fruit	1.3
50	other veg	1.6

	no fruit	immature fruit	mature fruit	total
number	22	5	29	56
%	39.29%	8.93%	51.79%	100.00%

Cover	other veg	Euc <i>steedmanii</i>	total
Total distance covered (m)	34.2	15.8	50
(% of distance)	68.40%	31.60%	100.00%

Plants per 100 square metres	estimated area of population (ha)	extrapolated population numbers
230	54.19	1246370

Eucalyptus steedmanii monitoring data for Population 2, February 2009

Transect Distance (m)	# of DRF trees with Fruit/ vegetation	Distance covered (m)
0		
10	X 5 mature fruit	10
10.6	other veg	0.6
11.4	X 1 mature fruit	0.8
14	other veg	2.6
17.4	X 3 mature fruit	3.4
20.4	other veg	3
21.5	X 3 mature fruit	1.1
22.4	other veg	0.9
25.8	X 2 mature fruit	3.4
27.8	other veg	2
29.9	X 3 mature fruit	2.1
35	other veg	5.1
38.2	X 2 mature fruit	3.2
47.1	other veg	8.9
47.7	X 2 mature fruit	0.6
50	other veg	2.3

	no fruit	immature fruit	mature fruit	total
number	0	0	21	21
%	0.00%	0.00%	100.00%	100.00%

Cover	other veg	Euc steedmanii	total
Total distance covered (m)	25.4	24.6	50
(% of distance)	50.80%	49.20%	100.00%

	Plants per 100 square metres	estimated area of population (ha)	extrapolated population numbers*
plot 1	30	2.98	8940
plot 2	33	2.98	9834
average	31.5	2.98	9387

*plants per metre square x estimated area of population

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**Appendix D: Statement that a proposal may be implemented
(pursuant to the provisions of the *Environmental Protection Act 1986*)
Statement No: 808**

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Published on 17 September

Statement No. 808

**STATEMENT THAT A PROPOSAL MAY BE IMPLEMENTED
(PURSUANT TO THE PROVISIONS OF THE
ENVIRONMENTAL PROTECTION ACT 1986)**

**SPOTTED QUOLL OPEN PIT NICKEL MINE
SHIRE OF KONDININ**

Proposal: The proposal is to develop and operate an open pit nickel mine and associated infrastructure on Mining Lease 77/00583 and haulage road on Mining Lease 77/00545 within the Shire of Kondinin.

The proposal is further documented in schedule 1 of this statement.

Proponent: Western Areas NL

Proponent Address: Suite 3, Level 1, 11, Ventnor Avenue,
WEST PERTH WA 6005

Assessment Number: 1795

Report of the Environmental Protection Authority: Report 1334

The proposal referred to in the above report of the Environmental Protection Authority may be implemented. The implementation of that proposal is subject to the following conditions and procedures:

1 Proposal Implementation

1-1 The proponent shall implement the proposal as documented and described in schedule 1 of this statement subject to the conditions and procedures of this statement.

2 Proponent Nomination and Contact Details

2-1 The proponent for the time being nominated by the Minister for Environment under sections 38(6) or 38(7) of the *Environmental Protection Act 1986* is responsible for the implementation of the proposal.

2-2 The proponent shall notify the Chief Executive Officer of the Department of Environment and Conservation of any change of the name and address of the proponent for the serving of notices or other correspondence within 30 days of such change.

3 Time Limit of Authorisation

3-1 The authorisation to implement the proposal provided for in this statement shall lapse and be void five years after the date of this statement if the proposal to which this statement relates is not substantially commenced.

3-2 The proponent shall provide the Chief Executive Officer of the Department of Environment and Conservation with written evidence which demonstrates that the proposal has substantially commenced on or before the expiration of five years from the date of this statement.

4 Compliance Reporting

4-1 The proponent shall prepare and maintain a compliance assessment plan to the satisfaction of the Chief Executive Officer of the Department of Environment and Conservation.

4-2 The proponent shall submit to the Chief Executive Officer of the Department of Environment and Conservation, the compliance assessment plan required by condition 4-1 at least 6 months prior to the first compliance report required by condition 4-6. The compliance assessment plan shall indicate:

1. the frequency of compliance reporting;
2. the approach and timing of compliance assessments;
3. the retention of compliance assessments;
4. reporting of potential non-compliances and corrective actions taken;
5. the table of contents of compliance reports; and
6. public availability of compliance reports.

4-3 The proponent shall assess compliance with conditions in accordance with the compliance assessment plan required by condition 4-1.

4-4 The proponent shall retain reports of all compliance assessments described in the compliance assessment plan required by condition 4-1 and shall make those reports available when requested by the Chief Executive Officer of the Department of Environment and Conservation.

- 4-5 The proponent shall advise the Chief Executive Officer of the Department of Environment and Conservation of any potential non-compliance within two business days of that non-compliance being known.
- 4-6 The proponent shall submit a compliance assessment report annually from the date of issue of this Implementation Statement addressing the previous twelve month period or other period as agreed by the Chief Executive Officer of the Department of Environment and Conservation. The compliance assessment report shall:
1. be endorsed by the proponent's Managing Director or a person, approved in writing by the Department of Environment and Conservation, delegated to sign on the Managing Director's behalf;
 2. include a statement as to whether the proponent has complied with the conditions;
 3. identify all potential non-compliances and describe corrective and preventative actions taken;
 4. be made publicly available in accordance with the approved compliance assessment plan; and
 5. indicate any proposed changes to the compliance assessment plan required by condition 4-1.

5 Performance Review and Reporting

- 5-1 The proponent shall submit to the Chief Executive Officer of the Department of Environment and Conservation, a Performance Review Report at the conclusion of the first year after the start of implementation and then annually, which addresses:
1. the major environmental risks and impacts; the performance objectives, standards and criteria related to these; the success of risk reduction/impact mitigation measures and results of monitoring related to management of the major risks and impacts;
 2. the level of progress in the achievement of sound environmental performance, including industry benchmarking, and the use of best available technology where practicable; and
 3. improvements gained in environmental management which could be applied to this and other similar projects.

6 Flora and Vegetation

- 6-1 The proponent shall not cause the loss of the Declared Rare Flora *Eucalyptus steedmanii* from the implementation of the proposal.
- 6-2 Prior to ground disturbing activities, the proponent shall undertake baseline monitoring of the health and abundance of the Declared Rare Flora *Eucalyptus*

steedmanii populations 2, 3a, 3b, 7 and population 1 (including individuals in close proximity to the haul road and the population fragment to the west of the haul road) identified in Figure 3, schedule 1.

- 6-3 The proponent shall monitor impacts on the health and abundance of the Declared Rare Flora *Eucalyptus steedmanii* populations as identified in condition 6-2, from activities undertaken in implementing the proposal. This monitoring shall be carried out to the satisfaction of the Chief Executive Officer of the Department of Environment and Conservation.
- 6-4 The proponent shall submit annually the results of monitoring required by condition 6-3 to the Chief Executive Officer of the Department of Environment and Conservation.
- 6-5 In the event that monitoring required by condition 6-3 indicates a decline in the health or abundance of Declared Rare Flora *Eucalyptus steedmanii* outside the areas to be cleared:
1. the proponent shall report such findings to the Chief Executive Officer of the Department of Environment and Conservation within 21 days of the decline being identified;
 2. provide evidence which allows determination of the cause of the decline;
 3. if determined by Chief Executive Officer of the Department of Environment and Conservation to be a result of activities undertaken in implementing the proposal, the proponent shall submit actions to be taken to remediate the decline to the Chief Executive Officer; and
 4. the actions to remediate the decline of Declared Rare Flora shall be undertaken upon approval of the Chief Executive Officer of the Department of Environment and Conservation.
- 6-6 The proponent shall make the monitoring reports required by condition 6-5 publicly available in a manner approved by the Chief Executive Officer of the Department of Environment and Conservation.

7 Fauna

- 7-1 The proponent shall implement measures identified in Chapter 6.3 of the *Environmental Protection Statement for the Proposed Spotted Quoll Mine*, prepared by Coffey Environments Pty Ltd, Perth, Western Australia (July 2009) to prevent adverse impacts to Malleefowl along the haul road.

8 Mine Closure and Rehabilitation

- 8-1 Prior to the commencement of ground-disturbing activities, the proponent shall conduct surveys of the proposal area to collect baseline information on the following:
1. pre-mining soil profiles;

2. groundwater levels;
3. surface water flows;
4. vegetation complexes;
5. landscape and landforms; and
6. material characterisation.

8-2 The proponent shall submit a Rehabilitation and Mine Closure Plan acceptable to the Chief Executive Officer of the Department of Environment and Conservation and the Director General of the Department of Mines and Petroleum with the advice of other agencies as appropriate within 12 months of the commencement of ground disturbing activities.

The Rehabilitation and Mine Closure Plan shall provide for specific outcomes for:

1. landform design and material characterisation;
2. rehabilitation completion criteria consistent with Environmental Protection Authority Guidance Statement No. 6* to provide a self-sustaining, functional ecosystem comprising, native vegetation of local provenance species;
3. progressive rehabilitation timelines and monitoring against key performance indicators;
4. annual reporting procedures; and
5. procedures to review and revise the Rehabilitation and Mine Closure Plan.

* - *Guidance for the Assessment of Environmental Factors: Rehabilitation of Terrestrial Ecosystems: No 6*, Environmental Protection Authority, 2006

8-3 The proponent shall ensure that after mine closure, the final pit void:

1. does not cause significant groundwater contamination outside of the final pit void;
2. is not accessible by terrestrial native fauna if water remains in the final pit void; and
3. is not accessible by any native fauna which may subsequently be harmed or fauna which may harm surrounding native vegetation.

Procedures

1. The Minister for Environment will determine any dispute between the proponent and the Environmental Protection Authority or the Department of Environment and Conservation over the fulfilment of the requirements of the conditions.

2. The proponent is required to apply for a Works Approval and Licence for this project under the provisions of Part V of the Environmental Protection Act 1986.
3. Where a condition lists advisory bodies, it is expected that the proponent will obtain the advice of those listed as part of its compliance reporting to the Department of Environment and Conservation.

Donna Faragher JP MLC
MINISTER FOR ENVIRONMENT; YOUTH

Schedule 1

Spotted Quoll Open Pit Nickel Mine (Assessment No. 1795)

The proposal is to:

- develop and operate an open pit nickel mine and associated infrastructure on Mining Lease 77/00583 and haulage road on Mining Lease 77/00545 within the Shire of Kondinin; and
- construct mining infrastructure at Spotted Quoll.

The location of the various project components is shown in Figure 1.

The main characteristics of the proposal are summarised in Table 1 below. A detailed description of the proposal is provided in Section 2 of the project referral document, *Environmental Protection Statement for the Proposed Spotted Quoll Mine*, prepared by Coffey Environments Pty Ltd, Perth, Western Australia (June 2009).

Table 1: Summary of key proposal characteristics for Spotted Quoll Open Pit Nickel Mine

Element	Description
General	
Project area	237 hectares
Area of vegetation disturbance	No more than 140 hectares
Total area of rehabilitation	A minimum of 120 hectares
Mining Operation	
Operating life	33 months (including 2-3 months pre-strip) (approximately)
Size of Orebody	Open Cut - 386,000 tonnes at 5.1% nickel (approximately)
Number of mine pits	One
Depth to groundwater	30 to 40 metres from ground level (approximately)
Total Mine Depth	150 metres from ground level (approximately)
Material movements:	
• Total waste	6.83 million tonnes per annum (approximately)
• Ore	200,000 tonnes per annum (approximately)
Dewatering rate	Years 1-2 year: up to 4.7 Gigalitres per year Year 3: 1.5 - 3.2 Gigalitres per year

Figures

Figure 1. Project location.

Figure 2. Project area and site layout.

Figure 3. *Eucalyptus steedmanii* within and adjacent to the Spotted Quoll project area.



Figure 1: Project location

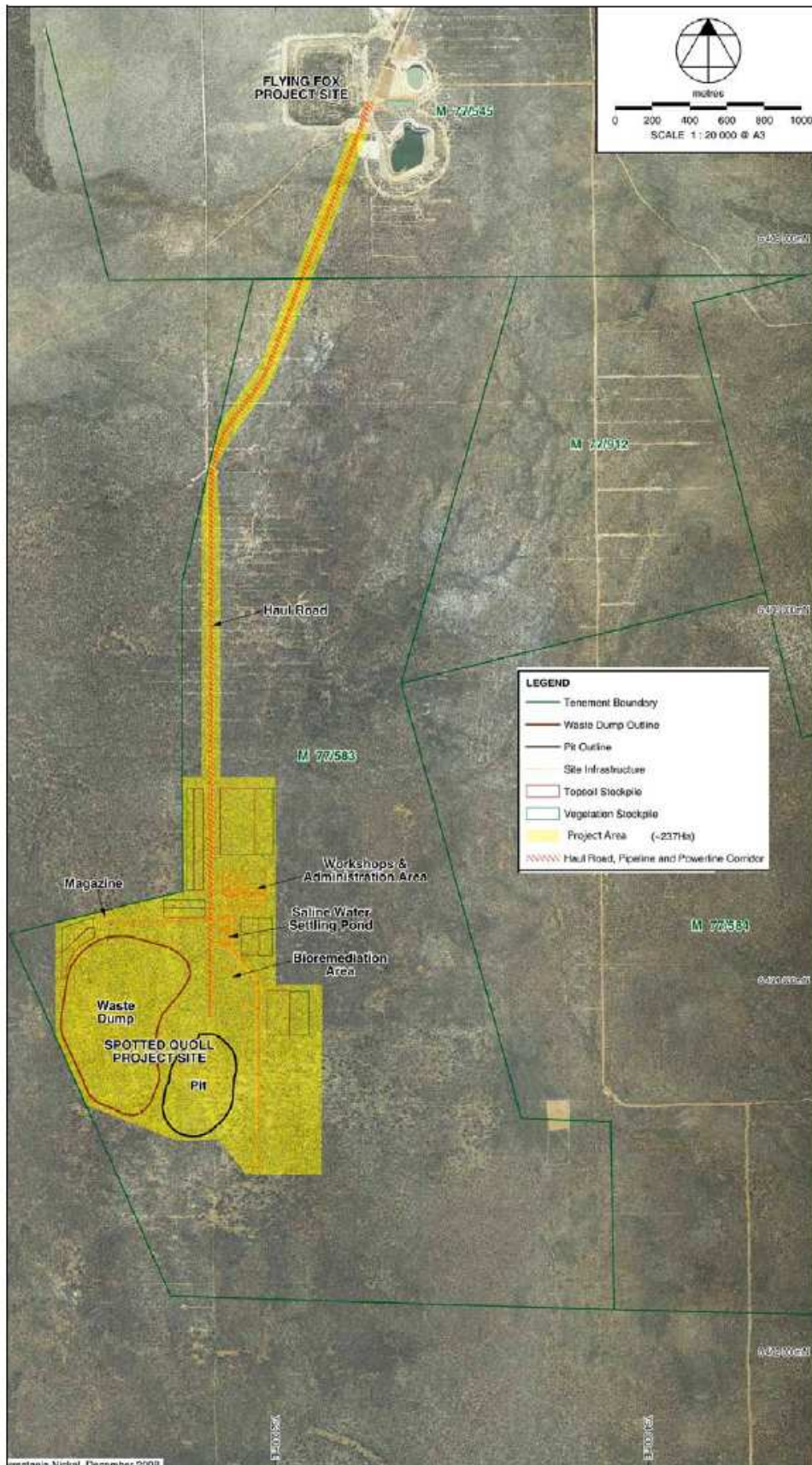


Figure 2: Project area and site layout

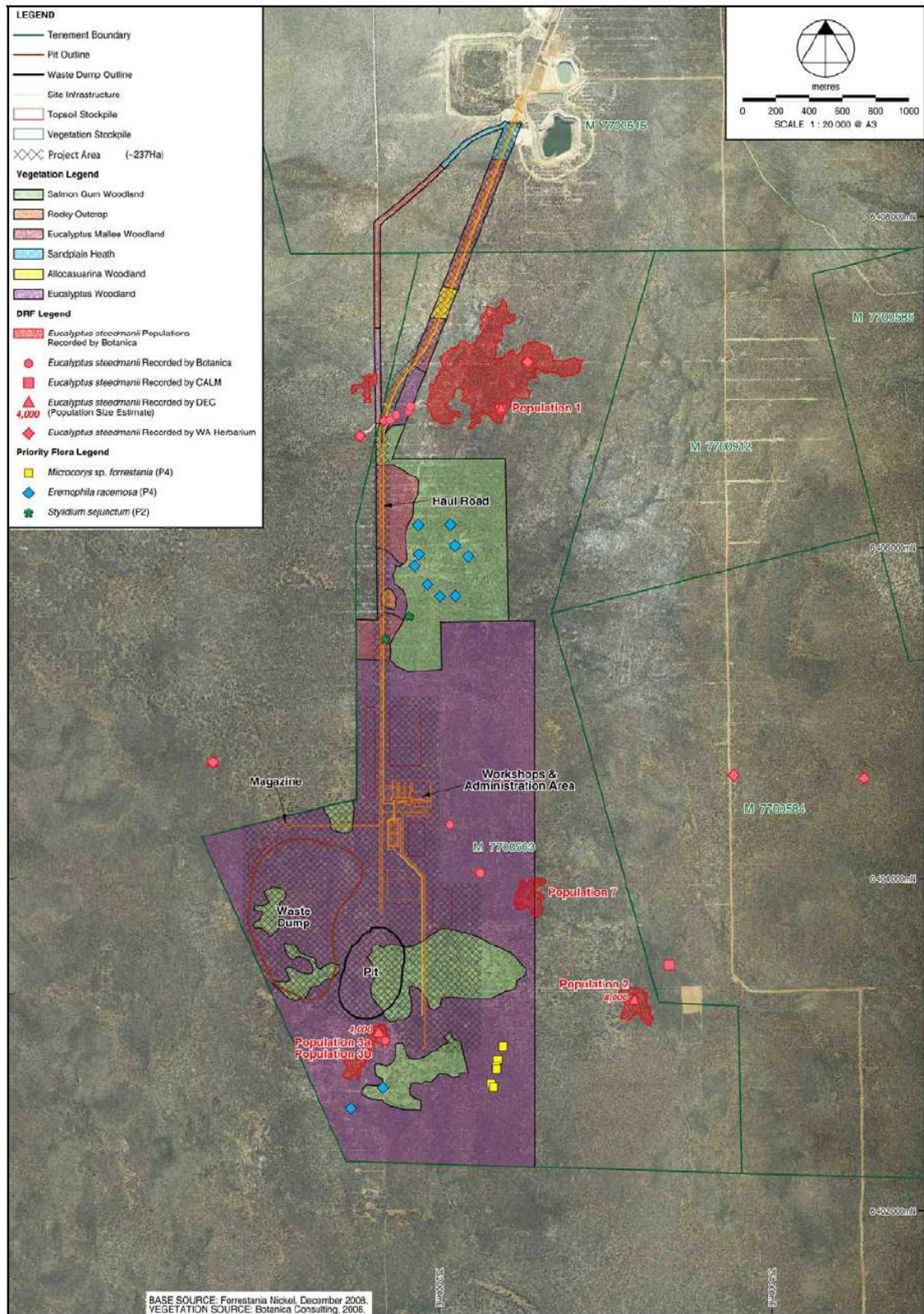


Figure 3: *Eucalyptus steedmanii* within and adjacent to the Spotted Quoll project area.

Appendix E: *Forrestania Eucalyptus steedmanii* Monitoring Program Review

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Forrestania *Eucalyptus Steedmanii* Monitoring Program Review

April 2014

Prepared for
Western Areas Limited



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Report Reference: 17602-13-SRV-1Rev0_140403

Forrestania Eucalyptus Steedmanii Monitoring Program Review

Prepared for
Western Areas Limited



Job Number: 17602-13

Reference: 17602-13-SRV-1Rev0_140403

Revision Status

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A	19/02/2014	Draft Issued for Client Review	R. Archibald A. Gove M. Barnes	V. Clarke
0	03/04/2014	Draft Issued for Client Review	R. Archibald	

Approval

Rev	Date	Issued to	Authorised by	
			Name	Signature
A	19/02/2014	P. Knapton	S. Atkinson	
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Abbreviations

Abbreviation	Definition
DEC	Department of Environment and Conservation (now DPaW)
DEHWA	Department of Environment, Water, Heritage and the Arts
DFES	Department of Fire and Emergency Services
DPaW	Department of Parks and Wildlife
DRF	Declared Rare Flora
EPA	Environmental Protection Authority
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
GIS	Geographical Information System
SD	Standard Deviation
The plan	The most recent plan prepared to satisfy EPBC Ref 2008/4443 (Coffey 2009a) is referred to: the Plan.
The plans	The Steedman's Gum Conservation Plan (Coffey 2009a) and the Eucalyptus Steedmanii Management Plan - Spotted Quoll Mine, Shire of Kondinin, prepared by Coffey (2009b). The earlier plan (Coffey 2009b) was written in response to, although not formally required under, Ministerial Statement 808. Collectively, these plans are referred to as the Plans in this report.
The Project	Spotted Quoll nickel mines (the Project), situated 160 km south of Southern Cross in Western Australia
WSA	Western Areas Limited

Executive Summary

Western Areas Ltd operates the Spotted Quoll nickel mine (the Project) situated 160 km south of Southern Cross in Western Australia. Approval for the Project was granted by the State (Ministerial Statement 808) and Commonwealth Governments (EPBC Ref 2008/4443) in 2009. There are conditions in both approval documents that require populations of *Eucalyptus steedmanii* (Steedman's Gum) located within and adjacent to the Project to be protected from mining impacts, monitored for health and abundance, and remediated in the event of an impact being detected.

E. Steedmanii is a small tree that is declared as rare flora under the *State Wildlife Conservation Act 1950* and *Vulnerable status under the Environment Protection and Biodiversity Conservation Act 1999*. A management plan, required under EPBC Ref 2008/4443, (*Steedman's Gum Conservation Plan*) was prepared in 2009. It is virtually identical to an earlier plan (*Eucalyptus Steedmanii Management Plan*) written in response to, although not formally required under, Ministerial Statement 808.

Astron Environmental Services was commissioned to review the current monitoring program for *E. steedmanii*. This necessitated a review of the 2009 management plans, focusing on the monitoring program outlined within them. It included an analysis of the data collected in the monitoring program to date, particularly for tree health, reproduction, and dust deposition measured in dust gauges.

The replacement of two 2009 management plans for *E. steedmanii* in the Project area with one new management plan is proposed. This would resolve the issue of having one monitoring program that is guided by two management plans, and would enable the revised plan to incorporate information as at 2014, and provide an opportunity to refine the current monitoring program.

The review identified opportunities to improve both the effectiveness and the efficiency of the monitoring program. Monitoring data to date indicates that *E. steedmanii* is generally very healthy and has not been negatively affected by construction or operations associated with the mine. Given this, it is recommended that the frequency of some of the monitoring activities could reasonably be reduced. The current risk of impact is low for dust and other threatening processes, and variation in results for tree health and reproduction from one monitoring survey to the next, is minimal and not declining. However, monitoring effectiveness could be improved by incorporating additional measures during each survey: tree health ratings using a finer scale and rating abundance of fruit on each tree.

For additional contingency, an adaptive monitoring schedule should be considered so that the program can respond to any concerning trends or events that are revealed from monitoring. In developing this schedule, key threats to *E. steedmanii* health were re-examined. In the case of dust, a potentially threatening level (control limit) of deposition was defined using a control chart approach. An exceedance of the control limit should trigger further monitoring and investigation prior to determining the need for a management response. One of the proposed responses to such an exceedance would be to assess levels of dust that had deposited on plants at the location of concern. This would enable the link between the proposed control limits to be evaluated and modified if necessary. Further, it will allow dust deposition to be tested more conclusively as a cause of decline in tree health, should decline be detected. An adaptive approach to monitoring was also suggested for other possible threats arising from the Spotted Quoll operations.

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1 Introduction

1.1 Project

Western Areas Ltd (WSA) operates the Spotted Quoll and Flying Fox nickel mines (the Forrestania Project) situated 160 kilometres (km) south of Southern Cross in Western Australia. Approval for the Spotted Quoll Project (the Project) comprising an open cut mine and associated infrastructure on Mining Lease 77/00583 and the haul road on Mining Lease 77/00545 was granted by the State (Ministerial Statement 808) and Commonwealth Governments (EPBC Ref 2008/4443) in 2009.

1.2 Approvals and Conditions

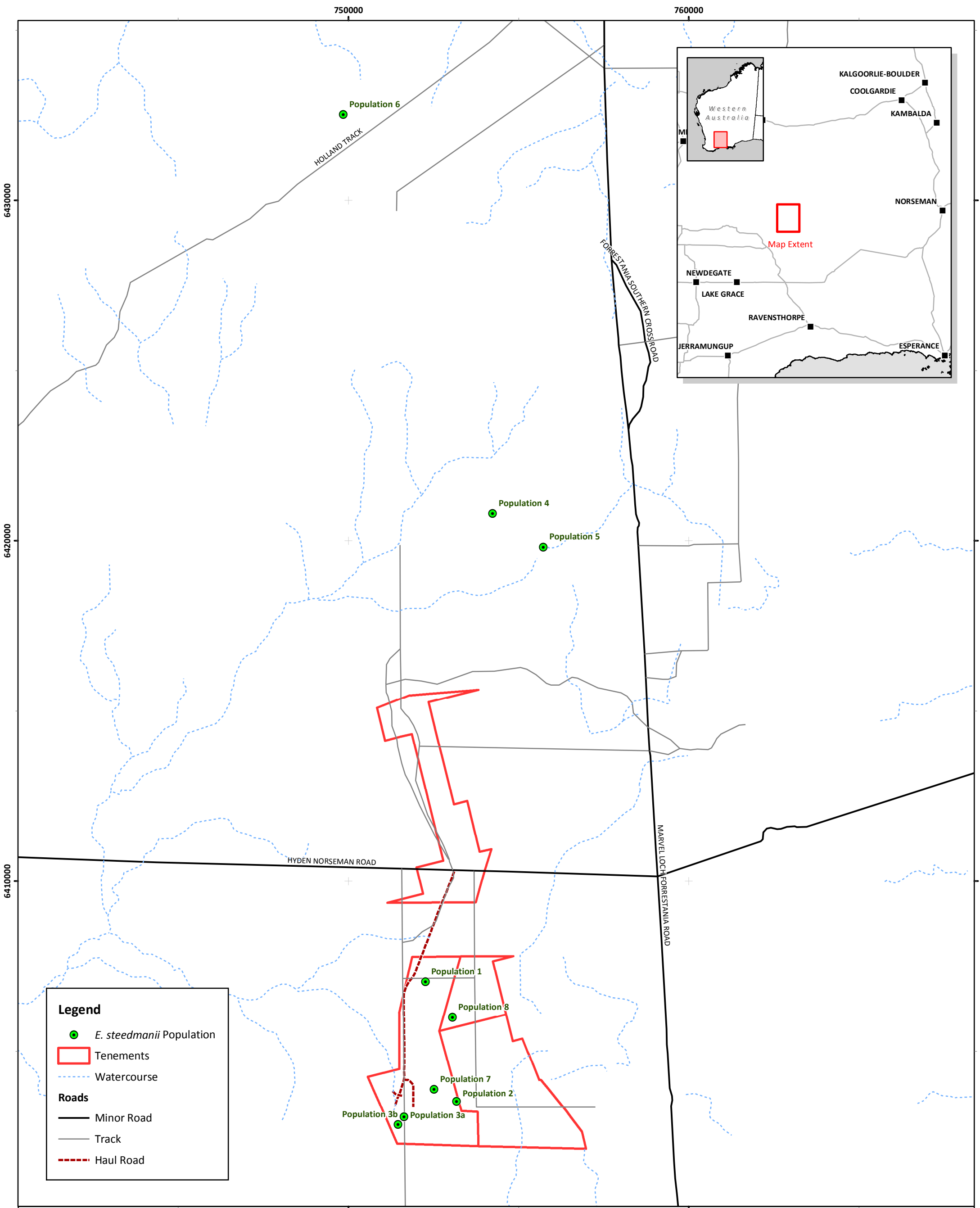
There are conditions attached to both approvals that require populations of *Eucalyptus steedmanii* (Steedman's gum) located within and adjacent to the Project to be protected from mining impacts, monitored for health and abundance, and remediated in the event of an impact being detected (Section 6 in Ministerial Statement 808 and Condition 1 of EPBC Ref 2008/4443). The main difference between the approval conditions is the requirement for a management plan under EPBC Ref 2008/4443: the *Steedman's Gum Conservation Plan*. This plan was prepared by Coffey (2009a) and is virtually identical to an earlier plan entitled the *Eucalyptus Steedmanii Management Plan - Spotted Quoll Mine, Shire of Kondinin*, prepared by Coffey (2009b). The earlier plan (Coffey 2009b) was written in response to, although not formally required under, Ministerial Statement 808. Collectively, these plans are referred to as *the Plans* in this report; however, for simplicity, generally only the most recent plan prepared to satisfy EPBC Ref 2008/4443 (Coffey 2009a) is referred to: *the Plan*.

1.3 *Eucalyptus steedmanii*

Eucalyptus steedmanii is a small tree commonly occurring in a multi-stemmed or mallee form (Brown et al. 1998). The species is declared as rare flora under the Western Australian *Wildlife Conservation Act 1950* and a protection status of Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The distribution of *E. steedmanii* was believed to have been restricted to seven known populations within 24 km of each other (Coffey 2009a). Four of these populations (1, 2, 3a and b and 7) are located near the Project area, two are located some 5 to 10 km to the north (4 and 5) and the final one (6) is approximately another 10 km north northwest (Figure 1 and Figure 2). In addition, a number of individual trees near operational areas and roads within the Project area have also been mapped by Botanica (2009). Since 2009, the population boundaries have been re-surveyed and mapped and an additional population has been identified (Population 8) (Figure 2). This population was identified by Botanica in October 2009 (Botanica 2014).

A number of threatening processes with the potential to negatively affect *E. steedmanii* were listed in the Plan (pp. 13, Coffey 2009a). These include:

- "Direct loss attributable to native vegetation clearing activities
- Unintentional clearing of individual plants or populations
- Indirect loss due to associated mining impacts, e.g. dust, spillage of saline water
- Loss of plants or populations due to fire or fire management activities; and
- Impact on pollinators."



Legend

- *E. stedmanii* Population
- Tenements
- - - Watercourse

Roads

- Minor Road
- Track
- Haul Road

Western Areas Ltd
Forrestania ES Monitoring Program Review

Figure 1: *E. stedmanii* Population Locations



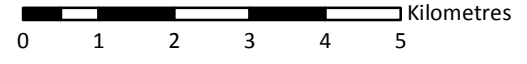
Author: R. Archibald

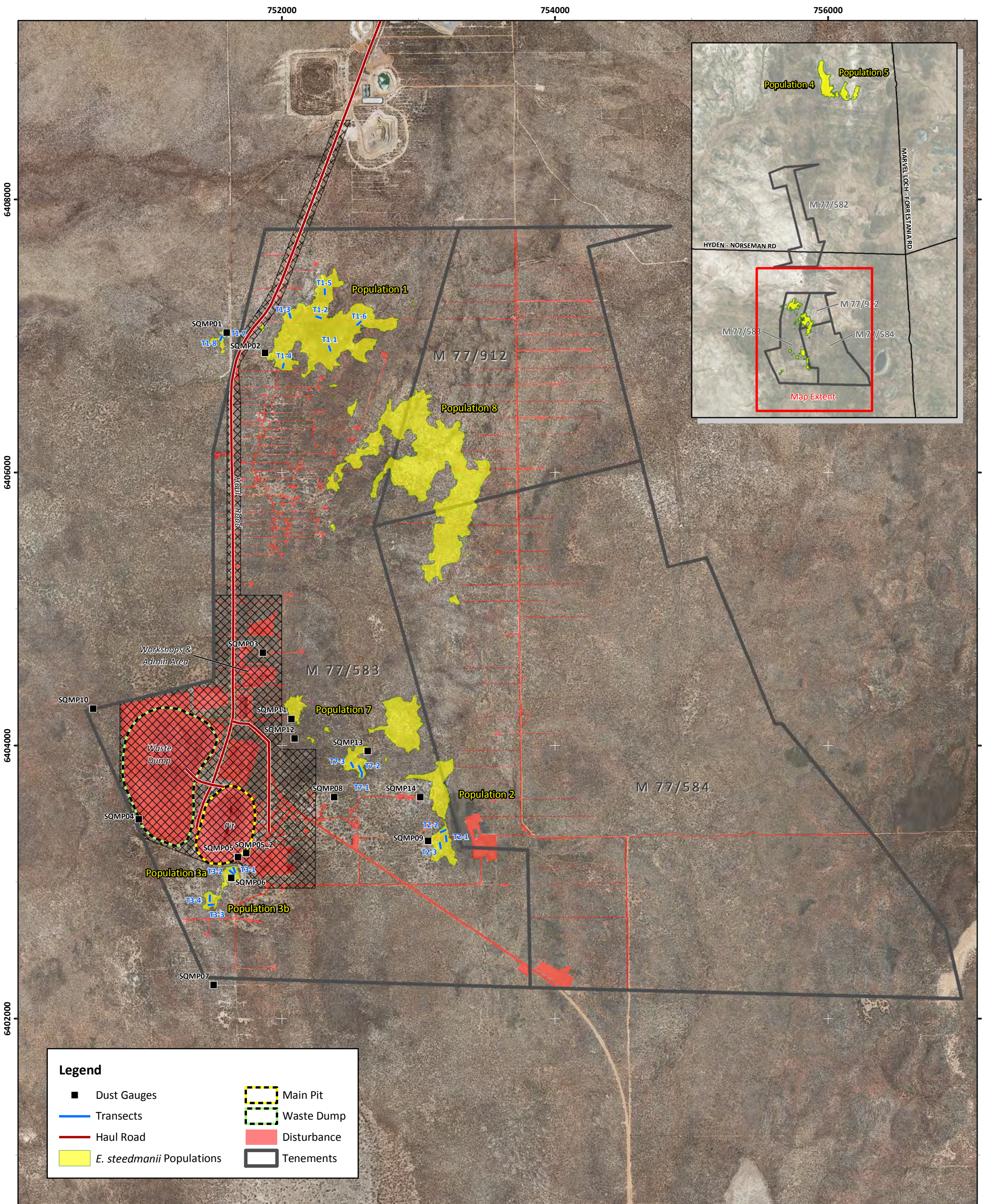
Date: 16-01-2014

Drawn: C. Dyde

Figure Ref: 17602-14-GDR-1RevA_20140116_Fig01

Datum: GDA 1994 - Projection: MGA Zone 50 - Scale: 1:100,000 (A3)





Legend

- Dust Gauges
- Transects
- Haul Road
- *E. steedmanii* Populations
- ▭ Main Pit
- ▭ Waste Dump
- ▭ Disturbance
- ▭ Tenements

Western Areas Ltd
Forrestance ES Monitoring Program Review

Figure 2: *E. steedmanii* Populations and Associated Transects & Dust Gauges



Author: R. Archibald	Date: 16-01-2014
Drawn: C. Dyde	Figure Ref: 17602-14-GDR-1RevA_20140116_Fig02

Datum: GDA 1994 - Projection: MGA Zone 50 - Scale: 1:25,000 (A3)

0 500 1,000 1,500 2,000 Metres

1.4 Monitoring of Eucalyptus steedmanii by Western Areas Ltd

Monitoring of tree health and dust deposition within the populations of *E. steedmanii* has been undertaken since 2009 in accordance with specifications within section 4.7 in the Plans. The various activities, parameters and their frequency of monitoring for the pre-construction and post-construction stage are outlined in Table 1. At the post-closure stage, all of the activities listed in Table 1 are to be monitored in the same way and at the same frequency until rehabilitation is completed, at which stage a biannual frequency will occur for two years.

Table 1: Summary of monitoring requirements in the pre-construction and post construction stages as specified under the Plan (Coffey 2009a).

Period	Activity	Parameters	Populations	Frequency
Prior to construction	Population extent and census	Area and plant density	1 to 8 [^]	Once
	Plant health monitoring	Plant Condition Rating Reproductive Status (Presence of seed and Seed development)	1 to 7	Not specified
	Dust deposition	Weight per unit area per unit time	At-risk populations and control areas*	Monthly
Construction & operation	Census	Plant density Plant Condition Rating Reproductive Status	1 to 8 [^]	Four yearly
	Plant health monitoring	Visual observations and photographs	1, 3A/3B and plants identified by Botanica (2009)	Weekly
	Plant health monitoring	Plant Condition Rating Presence of seed Seed development	1,2, 3A/3B and 7	Monthly
			4, 5 and 6	Annually
	Dust deposition	Weight per unit area per unit time	At-risk populations and control areas*	Monthly
Fuel Load	Unspecified	Areas surrounding Spotted Quoll operations	Annual	

Notes:

[^] Since the Plan was prepared by Coffey (2009a), Population 8 was identified and included in censuses (Botanica 2014)

*At-risk populations with respect to dust deposition were described in Coffey (2009a) as those adjacent to the haul road and those to the south of the pit; therefore, Population 1, 3a and 3b. Dust gauges and *E. steedmanii* monitoring transects at Population 2 and 7 are therefore assumed to be controls for dust (that is, sites where no impact of dust from operations is expected).

The most recent report on the health of *E. steedmanii* in the Project area was completed in January 2014 (Botanica 2014). This monitoring report concluded that all populations were in "excellent" condition according to the rating system of Keighery (1994). In addition, percentage cover of *E. steedmanii* is either stable or increasing, the proportion of trees with mature fruit was either stable or increasing and no differences between populations near and further away from the mining area were apparent for all measured parameters.

1.5 Report Objectives

The objective of this report is to review the existing monitoring program and make recommendations for on-going monitoring. In the process of achieving this aim, the Plans (Coffey 2009a,b) were reviewed and any significant changes that lent support to amendments to the monitoring program are highlighted in this report. Recommendations for on-going monitoring were also informed by analysis of all available monitoring data collected to date and presented in this report.

2 Methodology

2.1 Review of Management Plans

The *Eucalyptus steedmanii* Management Plan - Spotted Quoll Mine, Shire of Kondinin (Coffey 2009b) and the *Steedman's Gum Conservation Management Plan, Spotted Quoll Mine, Shire of Kondinin* (Coffey 2009a) were reviewed in light of new information and circumstances since the original preparation of the Plans.

2.2 Review of Alignment of Monitoring Program to Environmental Values, Management Targets and Threats

Monitoring plans formulated under the Monitoring and Evaluation framework of the International Union for the Conservation of Nature are recognised as best practice for achieving well designed and targeted monitoring programs (see Stem et al. 2005; Hockings et al. 2006). By applying the Pressure-State-Response model, the framework focuses monitoring towards the measurement of progress against management targets (OECD 1993). As such, the framework requires the identification of:

- the current state of environmental values (current state)
- the target state for these values that satisfies both compliance and WSA's objectives (target state)
- threats to the attainment of these target states (pressure)
- management actions required to attain target states (response).

The framework emphasises an adaptive approach whereby plans are regularly reviewed and updated in light of new information.

2.3 Analysis of Monitoring Data

Monitoring data for the parameters outlined in Table 1 were analysed with the exception of:

- fuel load
- data for recruitment (unavailable)
- census results.

Data available for analysis included the six populations of *E. steedmanii* that are covered in the regular monitoring program (Populations 1 to 5, and 7) and the dust gauges located closest to these populations. Data from 2009 to 2013 were examined. In addition, the results of the latest census in January 2014 for all eight populations are discussed.

2.3.1 Tree reproduction

Reproduction for *E. steedmanii* within each population was defined by the proportions of trees with mature, immature or no fruit. Surveys were conducted on a monthly cycle, although the commencement and conclusion of monitoring varied between populations (Figure 1). Ideally, the detection of a trend in the time series data would be tested by a statistical test, such as a linear regression, in which the slope of the relationship is compared against a flat line (that is, slope = 0); a significant negative slope would indicate a decline over time. However, due to the simple categorisation of reproductive state, the contrasting lengths and frequency of monitoring at control and potential impact sites, and the apparent lack of temporal variation in the data, a visual appraisal

of the data rather than the application of statistical techniques, was deemed to be the most appropriate method of analysis.

2.3.2 Tree health

Individual tree health was scored using a four-point system developed by Botanica (2009): 3 = very healthy, 2 = moderate health, 1 = poor health, 0 = dead. Again, as explained in Section 2.3.1, given the use of only a few categories and low level of variation in the data (Figure 2), visual assessment rather than statistical tests were deemed to be more appropriate.

2.3.3 Dust

Dust deposition was measured from gauges established at various permanent locations (Figure 2). As the period over which gauges were open was sometimes variable, deposition rates were expressed on a weight per unit area, per day basis. Analysis of temporal trends in dust deposition focussed on the gauges which were closest to each of the *E. steedmanii* populations (distance ranged from 25 to 160 metres (m)). However, as the duration of dust sampling at the gauge closest to Population 7 (SQMP13) was truncated, a longer-term sample, 260 m from the population, was also examined (SQMP08). For Population 1, transects were widely separated, so two gauges were examined, the one closest to Transect 4 (SQMP02) and the one closest to Transect 7 (SQMP01). Temporal changes in dust deposition were tested using linear regression with model residuals checked for normality and equal variance following the analyses. Analyses were carried out in R (R Core Team 2012). A significant result was deemed to be $P < 0.05$.

2.3.4 Change in Tree Health with Distance from Potential Dust Source

The effect of distance from potential dust sources on tree health was also tested for individual trees and groups of trees (all trees within a transect) suited to this type of analysis. For individual trees, those that were suitable were within monitoring transects that were close, and ran approximately perpendicular to, a potential emission source. Trees within two transects met these criteria within the Project area: transect 3 and transect 7 at Population 1. For analysis of groups of trees (mean value for a transect), the eight transects at varying distance from the haul road within Population 1 were suitable. The relationship between distance to potential source and mean tree health per transect was plotted and analysed using linear regression with model residuals checked for normality and equal variance following the analyses. Analyses were carried out in R (R Core Team 2012) with a significant result deemed to be $P < 0.05$.

2.4 Control Charts and Trigger Levels for Dust Deposition

To assist in the interpretation of dust monitoring data, control charts were developed. Control chart analysis is an empirically robust and intuitive approach to comparing a potentially impacted period with a pre-impact (baseline) period. Control charts were initially developed to monitor manufacturing processes and to indicate when a process had diverged from required specifications. However, today they are increasingly being applied to environmental monitoring, particularly in the identification of significant environmental change (Anderson and Thompson 2004, Gove et al. 2013, Stringell 2013).

An advantage of control charts over other methods is their ability to account for natural variation within the baseline period and to test whether current data (possibly impacted) exceeds natural variation. Here, control charts have been applied to the dust deposition data to identify the level of variation to date. If no impact on *E. steedmanii* health and reproduction were detected within this

period, it would be logical to use the control limits developed for this period as safe bounds of deposition within which an impact is unlikely.

Mean deposition (mg/m²/day) for selected gauges in proximity to *E. steedmanii* populations was calculated. With limited data available before operations commenced, all data were considered to form the baseline period. Ideally, baseline data should not demonstrate a clear upward or downward trend (that is, slope should = zero). Following convention, control limits were established using two and three standard deviations (SD) from the mean value of the baseline period (Gove et al. 2013). Exceedance of a 2 SD limit is generally associated with an early warning that triggers an investigation, whereas exceedance of 3 SD generally triggers a management decision.

3 Results and Discussion

3.1 Review of Management Plans

The Plans were reviewed and updated with information available as at January 2014. Given the Plans were virtually identical, Astron has created one new plan to replace the existing two (Coffey 2009a,b). The new plan is titled: *Steedman's Gum Conservation Management Plan for Operational and Closure Stages - Spotted Quoll Mine*. This new plan was prepared to satisfy EPBC Ref 2008/4443 as well as to outline a monitoring plan to comply with conditions under State Ministerial Approval 808. Changes of a significant or technical nature that frame or inform the monitoring plan are summarised in Table 2. Justification for recommended changes to the monitoring plan is given throughout the remainder of this document.

Table 2: Summary of updated information and suggested changes with respect to the current monitoring program specified under the management plan (Coffey 2009a). All section numbers refer to existing management plan (Coffey 2009a).

Page	Paragraph/ Section	Existing content	Recommended change/addition	Implications for management and monitoring
1	3	<i>Establishment of an open pit mine</i>	Open cut mining is completed and operations have been underground since November 2010.	Quantity of dust emissions expected to be less.
13	1	Threats to <i>Eucalyptus steedmanii</i> populations include: <i>Indirect loss due to associated mining impacts, e.g. dust, spillage of saline water</i>	Clearer statement of the most likely causes of indirect loss and inclusion of dust suppression as a threat given that it is listed on pp. 15 of the existing Management Plan. <i>Dust and spillage of saline water and the use of saline water for dust suppression along unsealed roads.</i>	Foster greater awareness of the most important threats. Recording instances of the specific threats listed is important for tracking causes of any changes in plant health that may be observed.
15	<u>4.5</u>	<i>Dust is likely to be a hazard</i>	From the literature and from review of the monitoring data at the site, it is not clear that dust deposition at levels being caused by the operations is a hazard. Therefore, insert <i>more</i> before <i>likely</i> .	Risk of impact from dust may be overstated.
17	<u>4.7</u>	-	Explicit statement of control and potential impact areas.	Monitoring results more readily interpretable.
17 to 18	<u>4.7</u>	Specified monitoring frequencies	Reduce frequency of selected measures (see Table 5 for recommended frequency). See Section 3.3 of this report for justification.	More efficient monitoring.
17 to 18	<u>4.7</u>	Use of the word <i>plant</i>	Replace <i>plant</i> with <i>E. steedmanii</i> where there is potential confusion for <i>plant</i> to mean species other than <i>E. steedmanii</i> .	Clearer description of activities required.
17 to 18	<u>4.7</u>	Monitoring methods	Addition of finer scale measure of tree health and rating for abundance of reproduction.	More sensitive and informative data that will enable control charts to be developed in the future for these metrics.
17 to 18	<u>4.7</u>	-	Inclusion of a simple dust deposition rating for <i>E. steedmanii</i> .	Improve ability to determine whether any impact on plant health is due to dust or from other variables.
17 to 18	<u>4.7</u>	-	Use of control charts to trigger increased frequency of monitoring.	Opportunity for early management intervention if required.
18 to 19	<u>4.8</u>	Contingency Planning	Requirement for monitoring to be adaptive in the event of high dust deposition, saline water spill or reduction in plant health.	Monitoring frequency will be increased depending on circumstances (data) and incidences (for example, saline water spill or fire).

3.2 Review of Alignment of Monitoring Program to Environmental Values, Management Targets and Threats

3.2.1 Environmental Values

It is clear from the Plans that the environmental value to be managed by WSA are *E. steedmanii* populations 1, 2, 3A/3B and 7 and all individuals of this species within the WSA tenement boundaries that are outside the clearing envelope (see Figure 1). These populations are the potential impact sites (at-risk sites) with respect to all threats that have been identified (Table 3), except for dust deposition. Based on Coffey (2009a), sites with the greatest potential for impact from dust deposition were Populations 1, 3a and 3b. As such, the remaining populations (2, 4, 5, and 7) are considered control sites for dust deposition impacts. However, the classification of these as control sites may need to be reviewed with the acquisition of additional monitoring data over time. Population 8, not mentioned in the Plan (Coffey 2009a), has been treated as a control site to date (Botanica 2014) and is monitored in the four yearly censuses.

3.2.2 Management Targets

Based on Ministerial Statement 808 and EPBC Ref 2008/4443, the management target is to maintain the health and abundance of *E. steedmanii* within the WSA tenement boundary.

3.2.3 Threats

Threats are identified in the Plan (Coffey 2009a) and a summary of these with suggested modifications are outlined in Table 3. There is no indication in the Plans that threats from saline water spills, fire, saline water used for dust suppression, pollinator activity and uncontrolled vehicle access are directly monitored. Direct monitoring mechanisms for spillage of saline water, fire and uncontrolled vehicle access are now suggested in Table 3. Based on risk of impact and difficulty in applying direct methods of monitoring, indirect methods represent the most practical and reasonable approach for impacts from saline water for dust suppression and pollinator activity to be monitored.

Table 3: Summary of major threats to *E. steedmanii*, methods to monitor these threats as outlined in the Plan (Coffey 2009a) and proposed changes in the new plan. All section numbers refer to existing Plan.

Threat	Existing methods	Proposed changes
Native vegetation clearing activities	Census every four years. Plant health monitoring weekly near haul road and monthly elsewhere. WSA Environmental staff supervision.	No change. Weekly to quarterly and monthly to quarterly*. No change.
Unintentional clearing of individual plants or populations	Census every four years. Plant health monitoring weekly near haul road and monthly elsewhere. WSA Environmental staff supervising clearing.	No change. Weekly to quarterly and monthly to quarterly*. No change.
Dust	Dust deposition gauges measured monthly.	Quarterly frequency*.

Threat	Existing methods	Proposed changes
Spillage of saline water	No direct method listed.	Under the section 4.3 <i>On-site Awareness</i> , state that the Manager of dewatering operations must notify the Environmental Manager of any incidence of a spill. Under Section 4.7 <i>Monitoring Program</i> state that the incidence and extent of any spill within <i>E. steedmanii</i> populations will be recorded and reported in annual reports.
Saline water from dust suppression	No direct method.	No change. Continue to monitor indirectly (that is, by monitoring plant health). Under Section 4.8 <i>Contingency Planning</i> , if any loss occurs, it is stated that the cause will be investigated. It is assumed that if any loss of <i>E. steedmanii</i> health occurs near the haul road, the investigation will encompass salinity of soil and plant tissue.
Fire or fire management activities	No direct method.	Under Section 4.7 <i>Monitoring Program</i> , indicate that incidence and extent of any fire or fire control activities within <i>E. steedmanii</i> populations will be recorded and reported in annual reports.
Impact on pollinators	No direct method.	No change. Continue to monitor indirectly (that is, by monitoring reproductive status). The risk of impact is suspected to be very low and direct monitoring would require a major on-going investment.
Impacts from uncontrolled access by vehicles	No direct method.	Monitor presence of vehicle tracks during monitoring surveys and general surveillance. Section 4.7 <i>Monitoring Program</i> , indicates that the incidence and extent of any new and uncontrolled vehicle tracks within <i>E. steedmanii</i> populations will be recorded and reported in annual reports.

Note:

* Justification for change in frequency is outlined in Section 3.3.

3.2.4 Adaptive Monitoring

Monitoring under Section 4.7 of the Plans should have given recognition to the need for an adaptive approach to monitoring. In particular, it is recommended that in the event that there is a heightened risk of the failure of attaining the management target (for example, control limits for dust were to be exceeded), monitoring frequency should be increased for particular metrics, or for particular metrics depending on location (Table 4).

Table 4: Adaptive monitoring schedule and triggers relevant to threats that are directly monitored.

Threat	Trigger	Response
Dust	Exceedance of Control Limit 2 (3 standard deviations from mean) for dust deposition in gauges.	Monitor dust deposition on plants (dust deposition rating) in the population adjacent to the dust gauge on a monthly basis until dust deposition as measured in gauges fall below Control limit 2.
	For each population: if mean dust deposition rating is 3 or above, or any tree assessed during monitoring surveys is rated as 4 for dust deposition.	Undertake plant health monitoring at this population and at the nearest reference population on a monthly basis until dust deposition ratings return below the trigger.
Miscellaneous	Report of the following within an <i>E. steedmanii</i> population in the WSA tenements: Unintentional clearing Spillage of saline water Fire and fire management activity Uncontrolled vehicle access.	If the affected area does not include a current monitoring transect, a new transect to be established. Undertake plant health monitoring within the affected area on a quarterly basis for 12 months.

3.3 Analysis of Monitoring Data

3.3.1 Tree Reproduction

Proportions of *E. steedmanii* trees in the three stages of reproduction have remained relatively consistent over time and vary little from one survey to the next (Figure 3). The one exception was the apparent increasing trend in proportion of trees with fruit at Population 1 over the 2009 to 2013 period. It is unsurprising that there was little variation from month to month. In general, once fruit form on *Eucalyptus* species, they can persist for many months or even a year or more (Ruthrof 2001). More surprising in this case, was the lack of a cyclical pattern of periods of fruit absent and fruit present as is the case for most plant species. The lack of variation from survey to survey would suggest that the current sampling regime is excessive.

The largest contrast between populations was between Population 2, in which most trees had fruit, and Population 7 in which only approximately 60% of trees possessed fruit. Although data are limited for Population 4, it appears that the trees in this population with immature fruit did not transition to trees with mature fruit, but rather, to trees without fruit. Overall, the differences between control populations (4 and 5) and potential impact populations (1, 2, 3 and 7), and the trends at the potential impact sites (stable or increasing), do not provide evidence of an impact on reproduction from WSA operations. This is further supported by the census conducted in January 2014 which also included Population 8 (Botanica 2014).

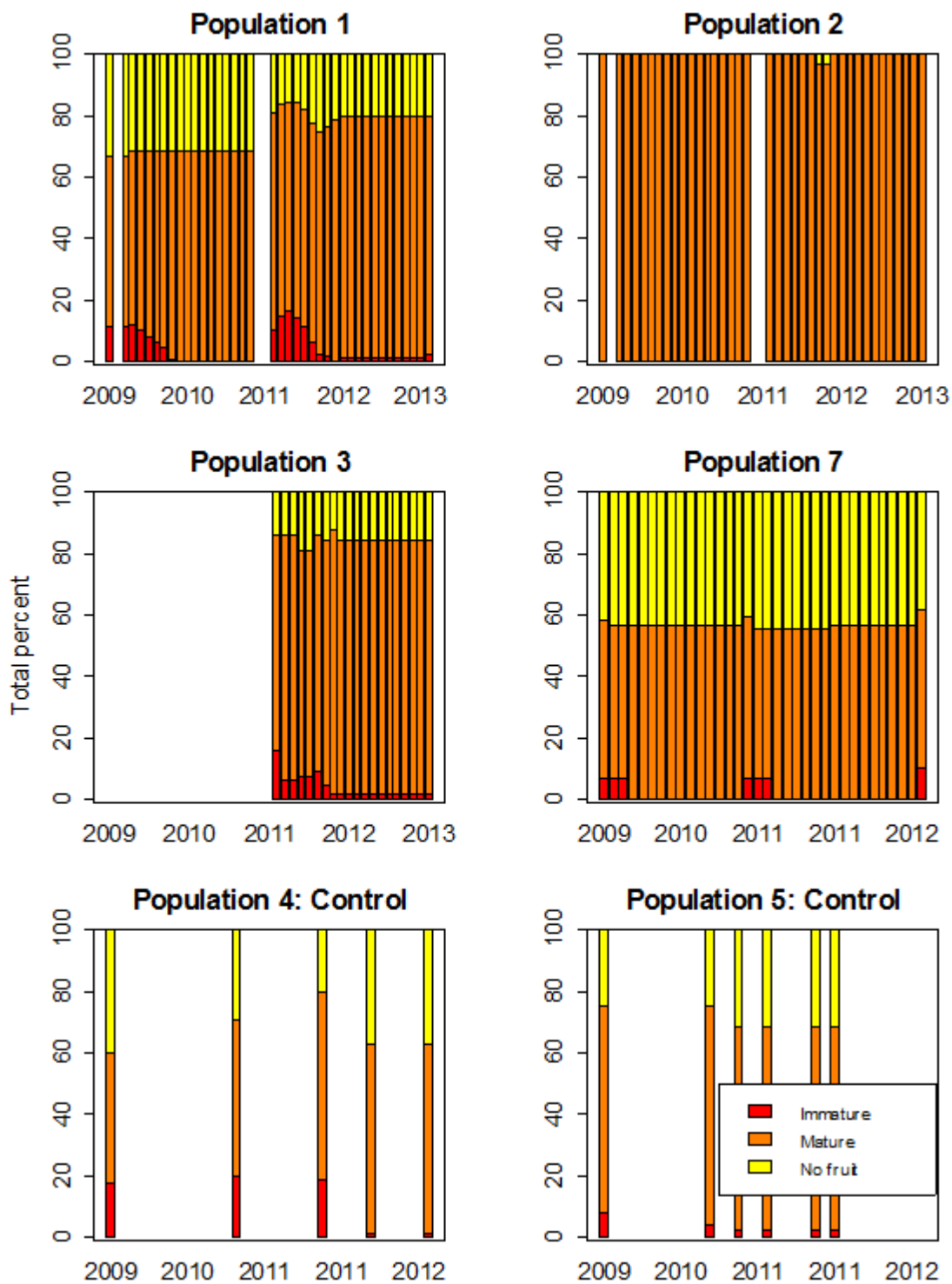


Figure 3: Reproductive status of *E. steedmanii* over time, based on the proportions of trees in transects in each population with mature, immature or no fruit. For n: Population 1 = 110, Population 2 = 40, Population 3 = 38, Population 4 = 94, Population 5 = 90 and Population 7 = 47.

3.3.2 Tree Health

As with the data for reproduction, mean tree health scores displayed very little change over the survey period (Figure 4), indicating no evidence for a decline in health within the populations. Mean health within all populations was above 2.5 for all of the survey period, highlighting the apparent consistent good health of the trees. In addition, only one of the sample trees died (Transect 2, Population 4 (Control), December 2011) and this was the only tree which scored a 1 during the survey period. As noted for reproduction, the general absence of change from month to month indicates that a less frequent sampling regime, such as quarterly, may be more appropriate. The latest census results support the trends described here (Botanica 2014).

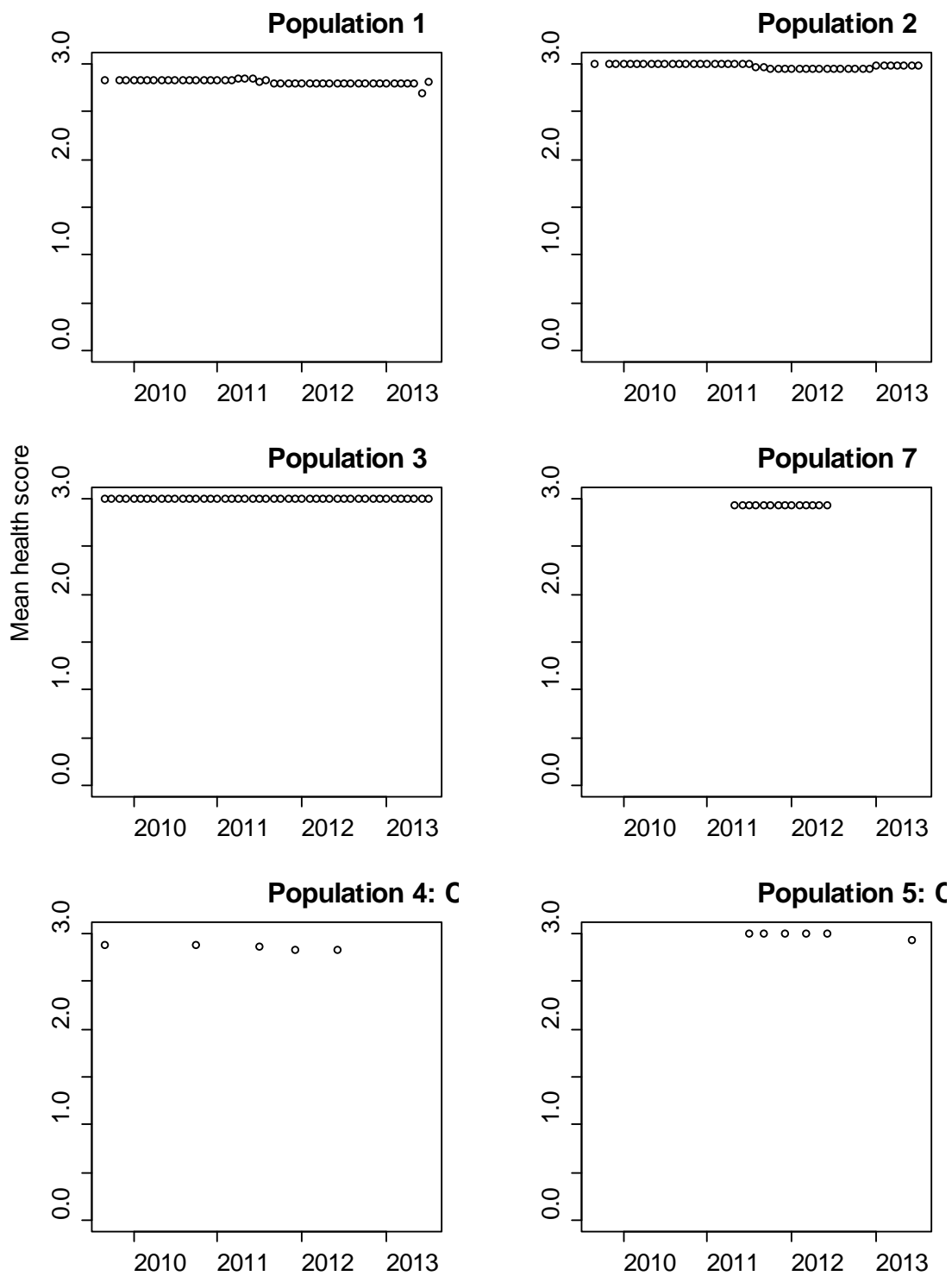


Figure 4: Change in mean health score of *E. steedmanii* in transects within each population over time. Trees were rated as: 3 = very healthy, 2 = moderate health, 1 = poor health, 0= dead.

3.3.3 Dust Deposition

For dust deposition gauges nearest to *E. steedmanii* populations, there were no clear increases in deposition over time with the exception of gauge SQMP13 at site 7, an indicative control site (Figure 5). However, the increase for gauge SQMP13 was not significant. Deposition for potential impact sites was stable or declining. Deposition within gauge SQMP06 located near population 3, exhibited a significant decline in dust load over time ($F_{1,47} = 15.89$, $P < 0.001$, $R^2 = 0.25$).

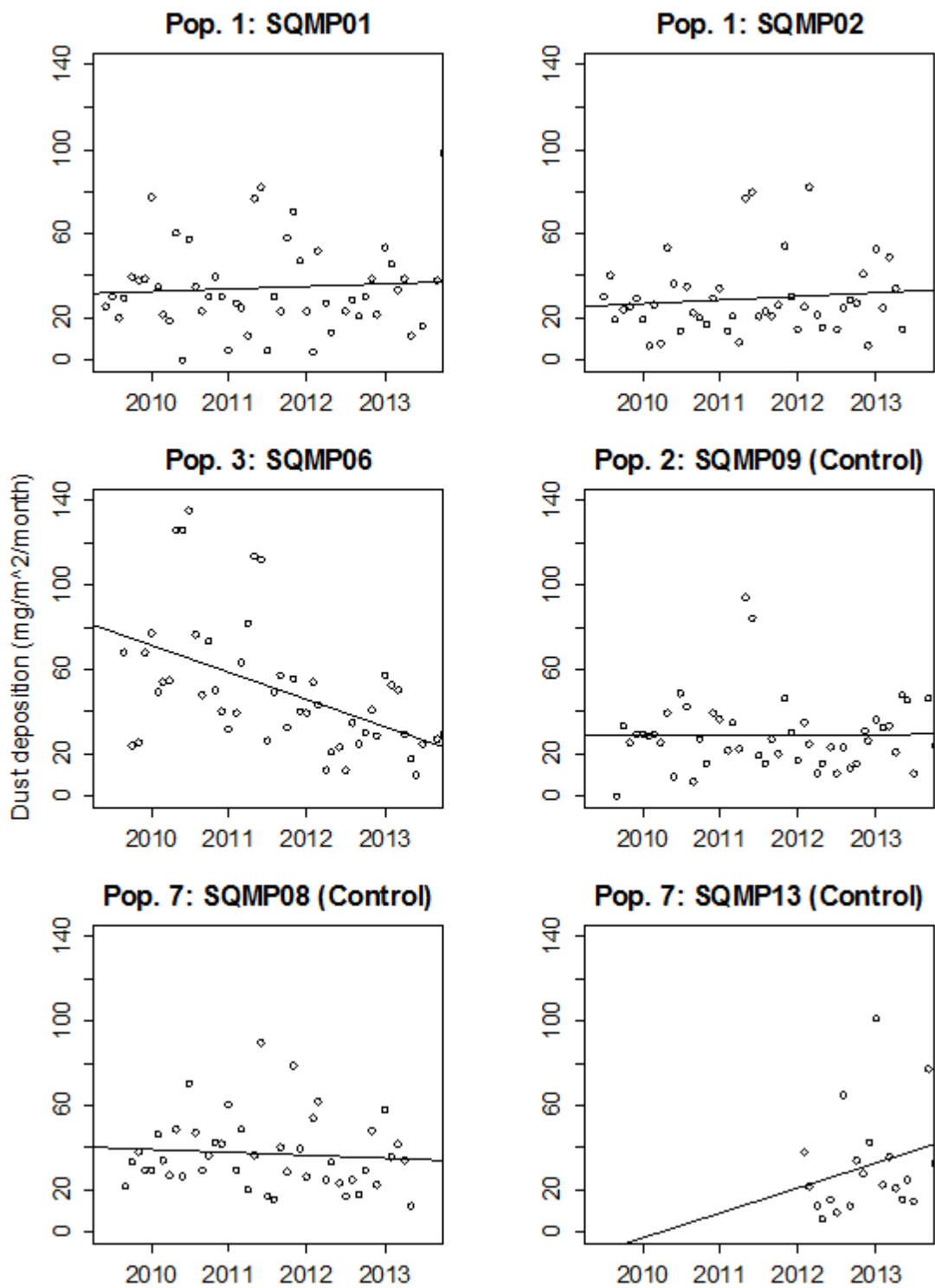


Figure 5: Dust recorded in gauges in proximity to *E. steedmanii* populations. Gauge SQMP06 was the location associated with a significant change in dust load. Two dust gauges were included for Population 1 (near Transects 7 and 4). As the nearest gauge to Population 7 had a limited availability of data, a dust gauge site 260 m distant was also examined.

3.3.4 Tree Health with Distance from Potential Dust Source

No transect exhibited a decline in mean health scores in relation to distance from potential dust sources (Figure 6). Within Population 1, mean score per transect exhibited a slight but insignificant ($F_{1,6}=0.25, P=0.63$) increase in average plant health score with increased proximity to the potential dust source (Figure 7). Given these results and the good level of health at all potential impact sites, there is no evidence that dust has had an impact on tree health.

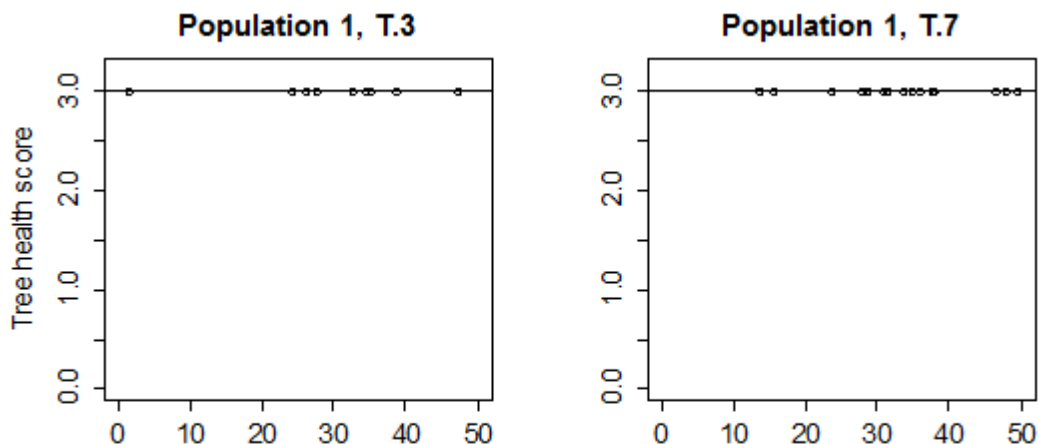


Figure 6: Health scores for July 2013 and distance from potential dust sources. Transects were selected due to their location, perpendicular to a potential source; in this case, the haul road.

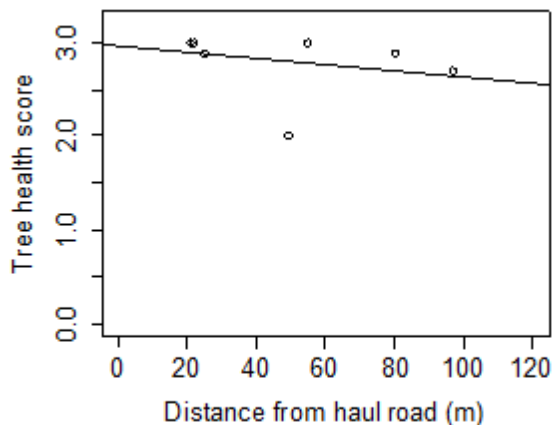


Figure 7: Mean tree health score by transect in Population 1 as a function of distance from haul road, in July 2013.

3.3.5 Control Charts for Monitoring Dust Loads

Control charts for monitoring dust deposition in the gauges closest to the populations were developed (Figure 8). The majority of the deposition rates were within established control limits. The exception was the most recent value for gauge SQMP01 (transect 7, Population 1) in which the value exceeded the second control limit.

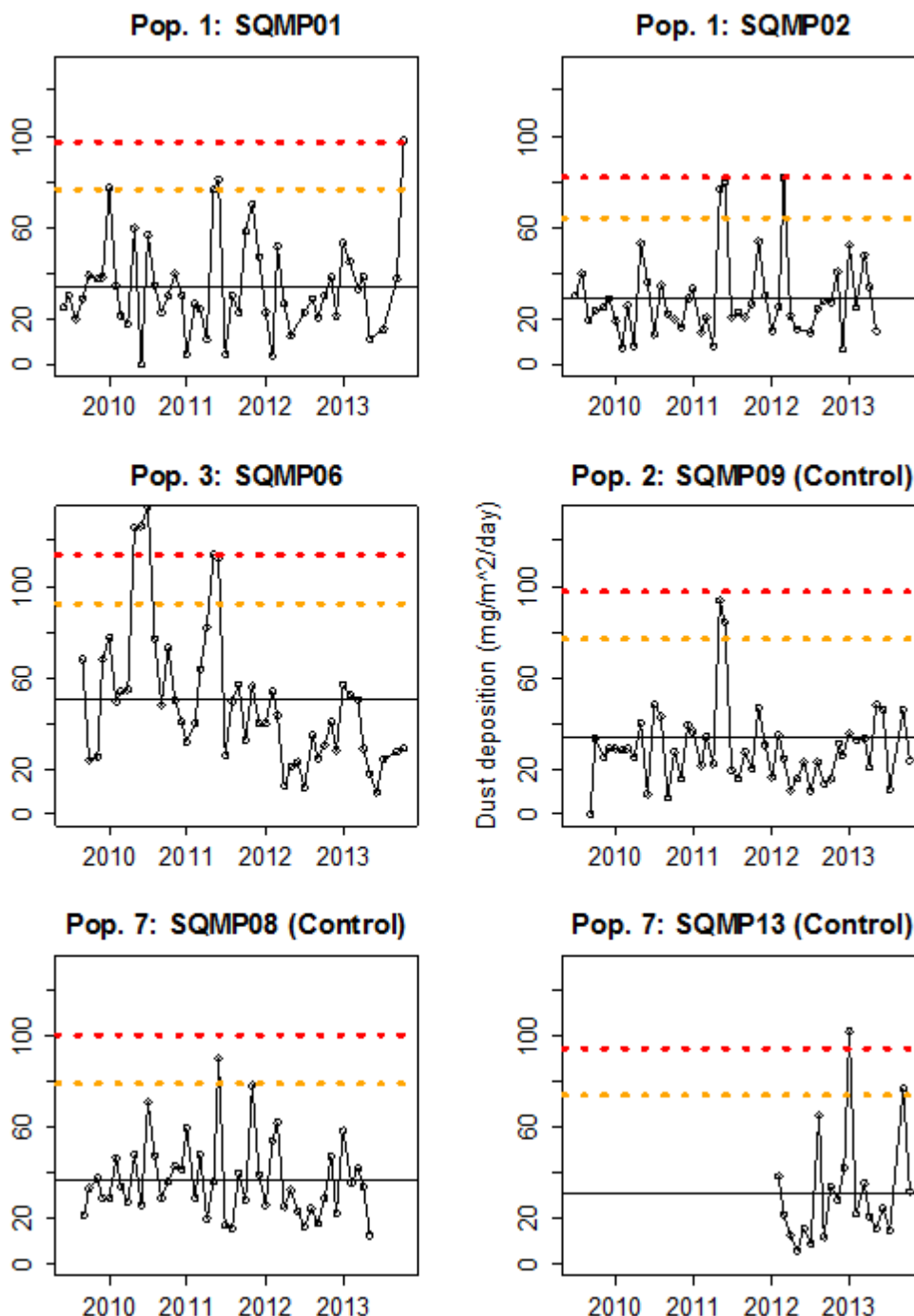


Figure 8: Control charts for dust deposition gauges near *E. steedmanii* populations. The dark horizontal line is the mean of all values. The orange dotted line represents the first control limit (2 standard deviations beyond the mean value). The red dotted line represents the second control limit (3 standard deviations beyond the mean value).

Published literature on the effects of dust on plants is lacking, especially for plants in the arid zone of Australia. It has been proposed that relatively high dust concentrations (between 6 and 14 g/m²/day) are needed to have adverse effects on perennial vegetation (Farmer 1993). This level of deposition is several orders of magnitudes higher than the highest dust loads recorded in the Project area. Thompson et al. (1984) found reductions in photosynthesis with dust loads of 5 to 10 g/m², which would require at least 100 days of continual dust accumulation in the Project area. These levels are unlikely; particularly given that rain and wind are likely to prevent such build ups. Even

with moderate levels of dust deposition, plants in arid and semi-arid environments may be less likely to suffer from moderate levels of dust deposition due to the fact that they are exposed to dust naturally. Further, during the dry summer season when dust is likely to be abundant, many species in the arid and semi-arid zone are physiologically inactive; therefore, any impacts may be less likely in comparison to plants in mesic environments.

Given the absence of an impact on *E. steedmanii* to date, the control limits based on 2 SD and 3 SD for each of the gauges would represent conservative limits beyond which an alert and management decision would be triggered, respectively. The suggested response in these circumstances was outlined in Table 4. Additionally, a quarterly frequency of collection of dust deposition data would represent a more appropriate level of monitoring given the level of risk. Control charts based on the same data in Figure 8, but recalculated by quarter, are presented in Figure 9. These are the recommended control limits to use for future monitoring.

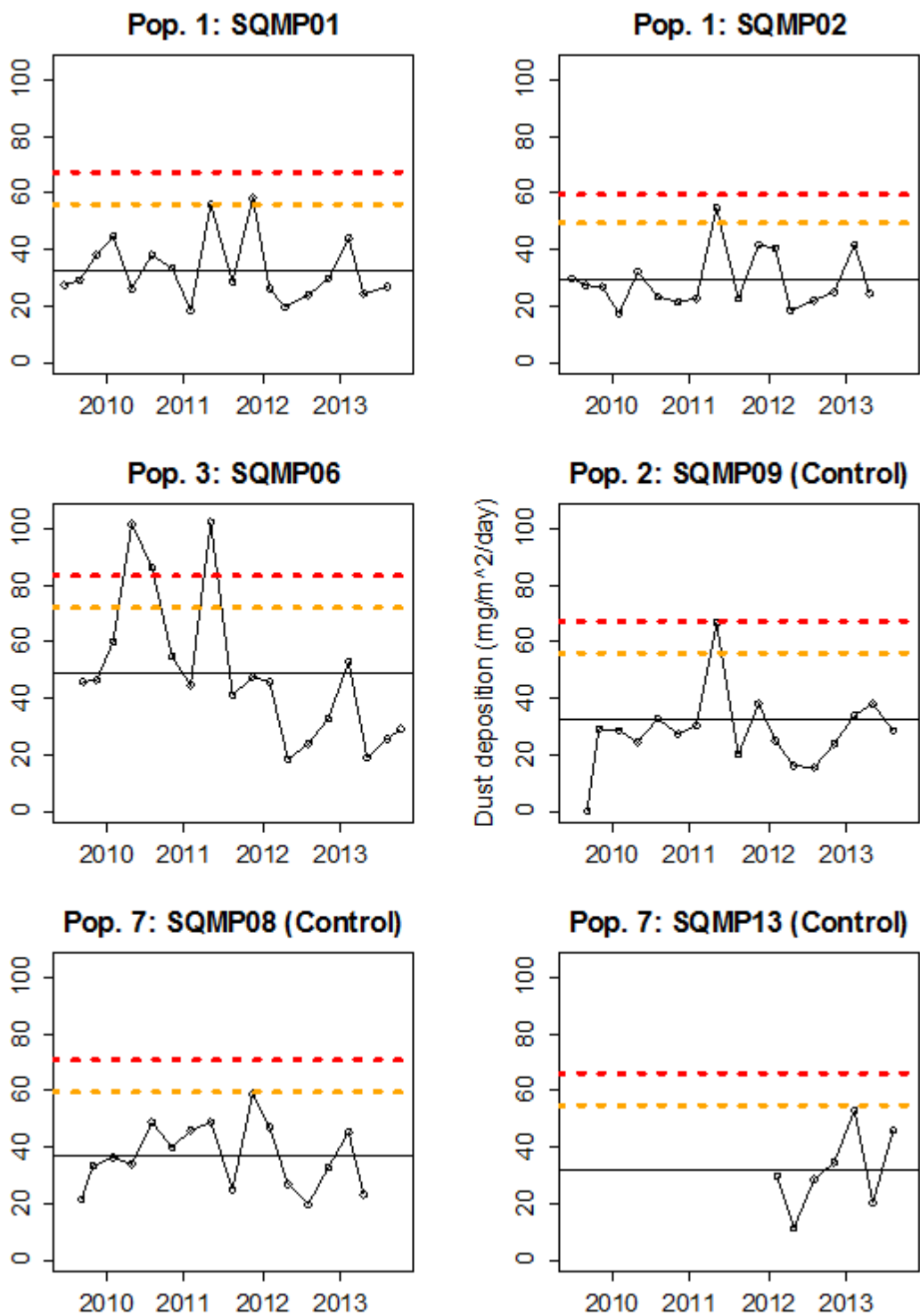


Figure 9: Control charts for dust deposition gauges near *E. steedmanii* populations, based on composite quarterly samples. The dark horizontal line is the mean of all values. The orange dotted line represents the first control limit (2 standard deviations beyond the mean value). The red dotted line represents the second control limit (3 standard deviations beyond the mean value).

3.4 Recommended Modifications to the Monitoring Program

Based on the review of the monitoring program, including the data analysis, some changes in the frequency of monitoring activities were recommended; these are summarised in Table 5. The

recommended monitoring schedule for the key threats not mentioned in Table 5 was outlined in Table 3. Monitoring of key threats should occur concurrently with all monitoring activities listed in Table 5 as well as incidentally with any other onsite activities by all WSA staff (that is, a general surveillance approach).

Table 5: Proposed changes to the schedule of primary activities in the monitoring program for *E. steedmanii*.

Activity	Populations	Current frequency	Recommended frequency
Census	1 to 8	Four yearly	Four yearly
Plant health monitoring (observations)	1, 3A/3B and plants identified by Botanica (2009)	Weekly	Quarterly
Plant health monitoring (ratings)	1,2, 3A/3B and 7	Monthly	Quarterly
	4, 5 and 6	Annually	Annually
Dust deposition	At-risk populations (1, 3A/3B) and control areas (2 and 7)	Monthly	Quarterly
Fuel Load	Areas surrounding Spotted Quoll operations	Annual	Annual

The following assessments (Sections 3.4.1 to 3.4.3 below) should also be made for each sample tree along transects during plant health monitoring. Data from these assessments will improve the ability to detect trends in plant health and reproductive abundance. In the case of dust deposition ratings, data will assist WSA to determine whether a high rate of dust deposition in a gauge is necessarily related to a high level of dust deposition on a plant

3.4.1 Dust Deposition on *Eucalyptus steedmanii*

A simple 1 to 5 rating for the quantity of dust deposition on plants is recommended to be used for all sample trees in the monitoring program (Table 6). These ratings will improve the ability to link dust deposition in gauges to impacts on *E. steedmanii*, should they occur.

Table 6: Proposed dust deposition rating for plants formulated by Astron.

Dust deposition rating	Dust deposition descriptor	Definition
1	Negligible	No dust obviously visible on plant. Virtually no cloud of dust when plant is shaken. No trace of dust when rubbing plant.
2	Low	Thin layer of dust apparent on leaves / stems. Dust may or may not come off when plant is shaken. Only very small amount of dust can be rubbed off. Amount of dust too little to be noticeable between fingers.
3	Moderate	Plant obviously covered in dust but leaf colour plainly visible. Dust falls off in a thin cloud when plant is shaken. Dust can be rubbed off plant. Grit/powder noticeable between fingers, smear thin when wet.
4	High	Plant covered in dust, but leaf colour is faintly visible through dust layer. Dust falls off in a cloud when plant is shaken. Dust can be rubbed off plant. Grit/powder noticeable between fingers, smear opaque when wet.
5	Extreme	Dust is caking the plant thickly, leaf/stems take on colour of dust. Dust falls off in a thick cloud when plant is shaken. Dust can be rubbed off leaves or stems. Dust feels powdery/gritty between fingers, smear clayey when wet.

3.4.2 Tree Health

The inclusion of an additional simple and rapid tree health scoring system with a wider range of scores is recommended. The method proposed is a modified version of the Grimes (1978) system which includes scores for the density of green foliage within the crown (Figure 10), scores for the abundance of dead branches by size, and the abundance of epicormic growth (Figure 11). A tree health score is derived from the addition of the three components. This method has been used in published studies of eucalypt health in Western Australia (for example, Archibald et al. 2011). The scoring method that is currently used by WSA should also continue to be used in parallel to provide the option for consistent long-term analysis in the future.

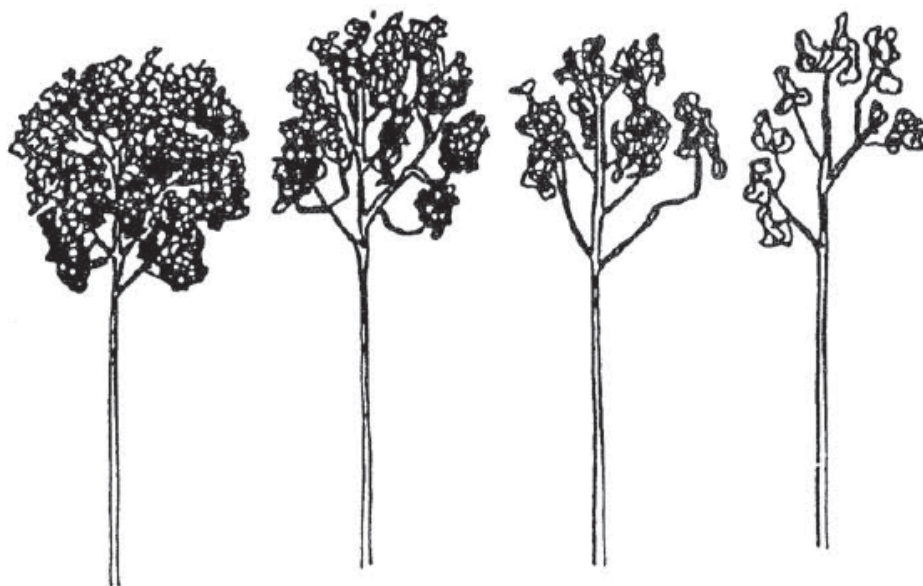


Figure 10: Crown density scale component of Grimes (1978) system for scoring visual health. A tree with no leaves = 0.

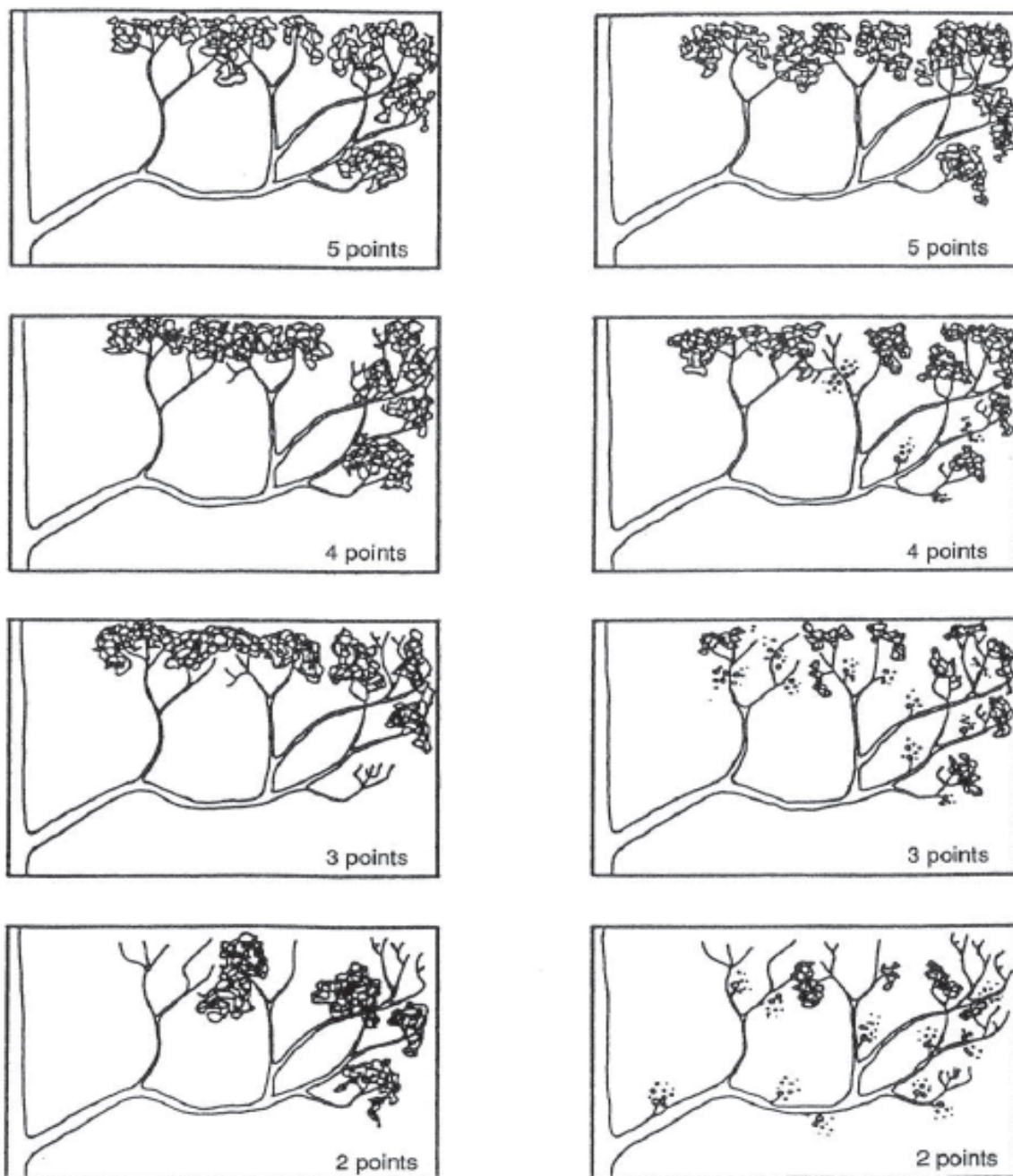


Figure 11: Dead branches and epicormic growth components of Grimes (1978) system for scoring visual health.

3.4.3 Abundance of Fruit

A better description of the reproductive output of the populations would be gained by introducing a simple rating system of abundance of fruit for each tree. Presently, presence-absence data do not provide an account of fruit abundance across the population: this is the most ecologically relevant descriptor. The rating system presented in Souter et al. (2009) should be used for each sample tree in future monitoring surveys and censuses (Table 7). The rating should be applied to both types of fruit (immature and mature) if both are present on the one tree.

Table 7: Proposed rating system for abundance of fruit. Rating system from Souter et al. 2009.

Abundance Rating	Descriptor	Definition
0	Absent	Attribute not present.
1	Scarce	Attribute is present but not readily visible.
2	Common	Attribute is clearly visible throughout the crown.
3	Abundant	Attribute dominates the appearance of the crown.

4 Conclusions

The replacement of two 2009 management plans for *E. steedmanii* in the Project area with one new management plan is proposed. This resolves the issue of having one monitoring program that is guided by two management plans. It enables the revised plan to incorporate the information as at 2014, and it also provides an opportunity to review and revise the current monitoring program: the main objective of this report.

The review identified opportunities to improve both the effectiveness and the efficiency of the monitoring program for *E. steedmanii* as required under EPBC Ref 2008/4443; it is recommended that:

- the frequency of some of the monitoring activities could reasonably be reduced because:
 - monitoring to date has presented no evidence that *E. steedmanii* has been negatively affected by construction or operations at the Spotted Quoll mine
 - variation in results for plant health and reproduction from one monitoring survey to the next, is minimal
 - the risk of impact is low for dust and the other threatening processes associated with the operation of the mine and because variation in results for plant health and reproduction from one monitoring survey to the next is minimal.
- monitoring effectiveness could be improved by incorporating additional measures during each survey: tree health ratings using a finer scale and rating abundance of fruit on each tree
- for contingency, an adaptive monitoring schedule should be considered so that the program can respond to any concerning trends or events that are revealed from monitoring; circumstances that would trigger an alteration to the monitoring program, and the nature of these alterations, were suggested.

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