



YOONGARILLUP Mineral Sands Project

State Forest - Area A Management Plan



Mining Tenements M70/0458, M70/0459

Doral Reference: DMS-YG-EMP-6.1

Revised October, 2016

Prepared for Doral Mineral Sands Pty Ltd by



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Statement of limitations

Reliance on Data

In the preparation of this report, Ecoedge has relied on data, surveys, analyses, designs, plans and other information provided by the Client and other individuals and organisations, most of which are referred to in the report. Unless stated otherwise in the report, Ecoedge has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report are based in whole or in part on the data, those conclusions are contingent upon the accuracy and completeness of the data. Ecoedge will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, unavailable, misrepresented or otherwise not fully disclosed to Ecoedge.

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Summary

This Condition Environmental Management Plan (Condition EMP) is submitted in accordance with **Ministerial Statement No. 1030 Condition 7** for the Yoongarillup Mineral Sands Project by Doral Mineral Sands Pty Ltd. The table below presents the environmental management target/s to measure achievement of the conditioned environmental objective that must be met through implementation of this Condition EMP.

Title of proposal	Yoongarillup Mineral Sands Project
Proponent	Doral Mineral Sands Pty Ltd
Ministerial Statement number	1030
Purpose of this Condition EMP	The State Forest – Area A Management Plan is submitted to fulfil the requirements of condition 7 of the above Statement.
EPA's environmental objective for the key environmental factor/s	<p><u>Landform</u> <i>To maintain the variety, integrity, ecological functions and environmental values of landforms</i></p> <p><u>Flora and Vegetation</u> <i>To maintain representation, diversity, viability and ecological function at the species, population and community level.</i></p> <p><u>Terrestrial Fauna</u> <i>To maintain representation, diversity, viability and ecological function at the species, population and assemblage level.</i></p> <p><u>Rehabilitation and Decommissioning (Integrating Factor)</u> <i>To ensure that premises are closed, decommissioned and rehabilitated in an ecologically sustainable manner, consistent with agreed outcomes and land uses, and without unacceptable liability to the State</i></p>
Condition environmental objective	The proponent shall ensure that Area A is decommissioned and rehabilitated to support functional landforms, soil profile, ground and surface water systems and ecological communities, that are suitable for continued use of this area as State forest.

Corporate endorsement

I hereby certify that to the best of my knowledge, the Condition EMP provisions in within this State Forest - Area A Management Plan are true and correct and address the legal requirements of condition 7 of Ministerial Statement No. 1030.

[Signature of duly authorised proponent representative]

Name: *Andrew Tomlinson*
Designation: *General Manager*

Signed:

Date:

[Signature]
14/10/16

1 Introduction

Doral Mineral Sands Pty Ltd (Doral) Yoongarillup Mineral Sands Project (the Project) is situated 17 km south of Busselton (Figure 1). The proposal is located within a 152 ha development envelope predominantly comprised of cleared farmland. Within the State Forest No. 33 (SF33) portion of the development envelope is 8.9 ha of Whicher Scarp vegetation (Area A) that will require clearing (

Figure 2). Once ore has been extracted, Area A will be rehabilitated and returned to use as State Forest.

The Project received State approval under the *Environmental Protection Act 1986* (Ministerial Statement 1030) (Environment Protection Authority (EPA) 2016) on 7 June 2016 and Commonwealth approval under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC No. 2016/6521) on 8 August 2016.

1.1 Requirement for Management Plan

This Condition EMP 'State Forest – Area A Management Plan' (Area A MP) is submitted in accordance with **Ministerial Statement No. 1030 Condition 7** for the Yoongarillup Mineral Sands Project by Doral Mineral Sands Pty Ltd. The purpose of the Area A MP is to detail the proposed methodology for and monitoring of the clearing, mining and subsequent rehabilitation of Area A to satisfy Condition 7 of Ministerial Statement 1030.

Where possible, this Area A MP has been prepared in accordance with EPA Environmental Assessment Guideline No. 17 (EAG17) (EPA, 2015a), the associated Condition EMP template for Management-based objectives (EPA, 2015b), and EPA Environmental Protection Bulletin No. 19 (2015c).

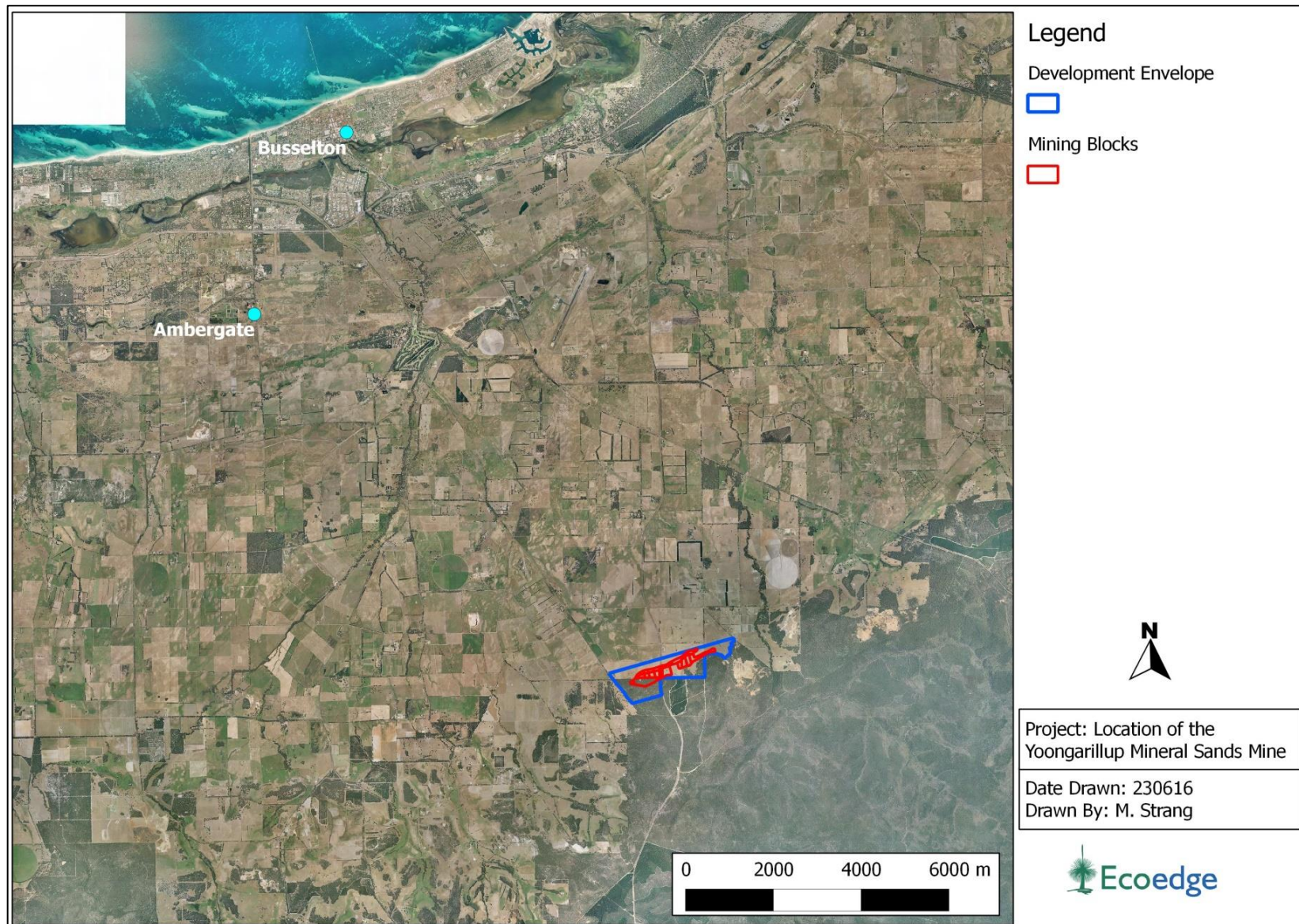


Figure 1. Location of the Yoongarillup Mineral Sands Project.

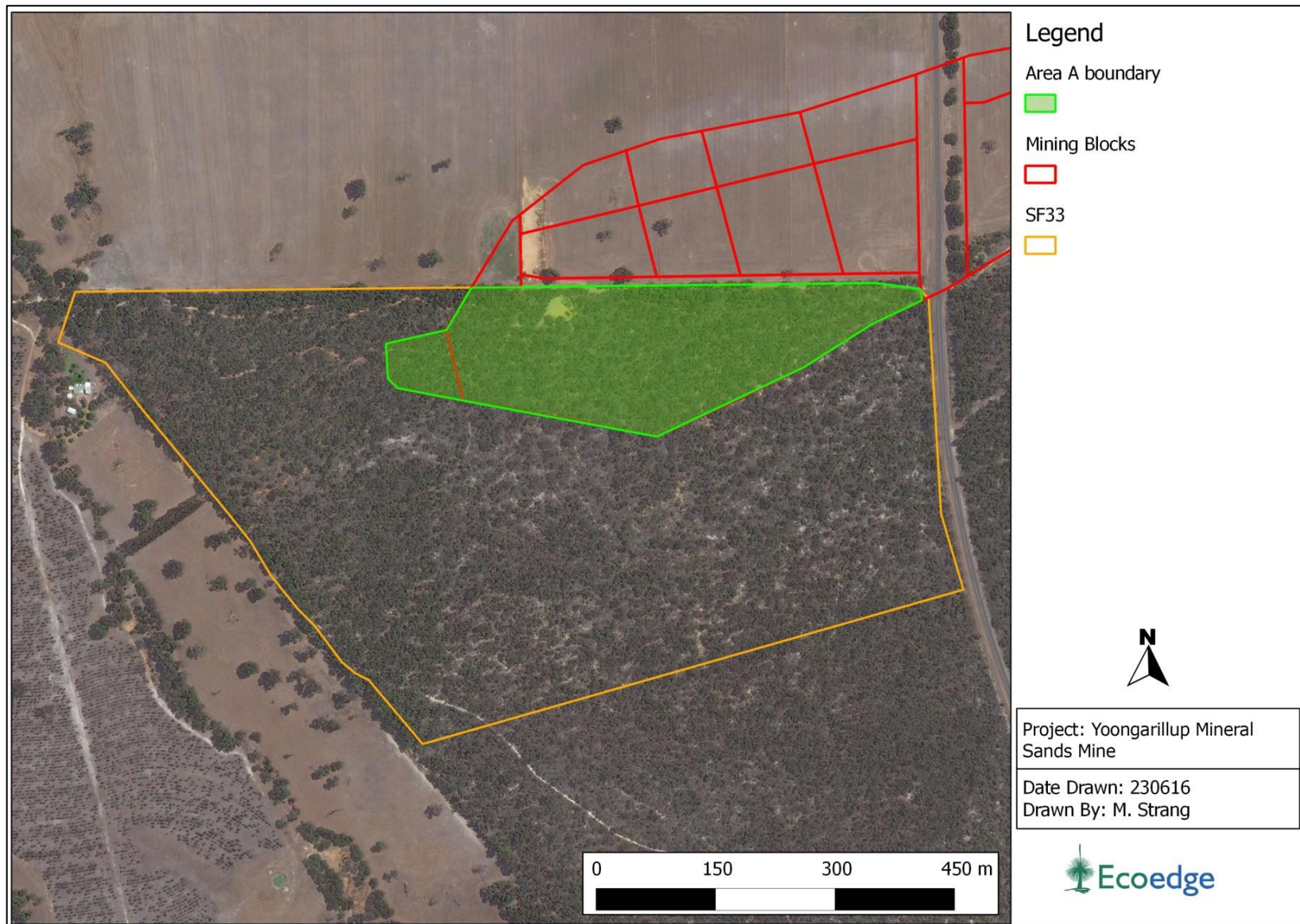


Figure 2. Location of 'Area A' within SF33.

1.1.1 Condition 7 of Ministerial Statement 1030

Condition 7-2 of MS 1030 requires Doral to develop an Area A MP for the project. Condition 7 is included below; conditions relevant to this plan are in bold text:

7-1 The proponent shall ensure that Area A, (as shown in Figure 3 and delineated by the co-ordinates specified in Table 5 of Schedule 2¹), is decommissioned and rehabilitated to support functional landforms, soil profile, ground and surface water systems and ecological communities, that are suitable for continued use of this area as State forest.

7-2 Prior to ground disturbing activities the proponent shall prepare a State Forest – Area A Management Plan in consultation with the Department of Parks and Wildlife, and submit this plan to the CEO. The Management Plan shall:

- (1) ensure that clearing and mining of the Area A is undertaken in stages to ensure progressive rehabilitation;**
- (2) ensure that if clearing is to be undertaken, the proponent shall thoroughly inspect the area for Black Cockatoo breeding activity, in particular nesting, and if the area is found to be in use, clearing in the area shall be postponed until such time as determined suitable, on the advice of the Department of Parks and Wildlife;**
- (3) ensure that if clearing is to be undertaken, a qualified terrestrial native fauna spotter shall thoroughly inspect the area for the presence of conservation significant fauna, and implement suitable mitigation measures for each species, which may include retrieval and translocation, on the advice of the Department of Parks and Wildlife;**
- (4) ensure that the topsoil removed from Area A is stored only within Area A, and is stored for a maximum of 18 months;**
- (5) specify the fencing and access requirements to Area A;**
- (6) specify the method of clearing vegetation, including the retention of any vegetative material for rehabilitation within Area A;**
- (7) specify the topsoil removal, storage (location and time), and resspreading procedures within Area A;**

¹ References are to figures and tables in MS 1030, not this Area A MP.

- (8) specify the timing of mining, and return of soil profile and landforms;**
- (9) specify measures, including the timing of operations, to prevent weeds and dieback from establishing in Area A;**
- (10) specify the placement of mining infrastructure to ensure that progressive rehabilitation can occur;**
- (11) specify measurable, achievable, realistic and timing specific completion criteria, to ensure the management objective in condition 7-1 is achieved;**
- (12) specify the monitoring program to report on completion criteria progress;**
- (13) specify any other management actions that will be implemented to ensure the management objective in condition 7-1 is achieved; and**
- (14) be consistent with the Department of Mines and Petroleum and EPA Guidelines for Preparing Mine Closure Plans.**

7-3 After receiving notice in writing from the CEO that the State Forest – Area A Management Plan satisfies the requirements of condition 7-2, the proponent shall:

- (1) implement the management actions and monitor in accordance with the requirements of the State Forest – Area A Management Plan; and
- (2) continue to implement the State Forest – Area A Management Plan until the CEO has confirmed by notice in writing that it has been demonstrated that the objective in condition 7-1 has been met and therefore the implementation of the management actions and monitoring is no longer required.

7-4 The proponent may review and revise the State Forest – Area A Management Plan, in consultation with the Department of Parks and Wildlife.

7-5 The proponent shall review and revise the State Forest – Area A Management Plan as and when directed by the CEO.

7-6 The proponent shall implement the latest revision of the State Forest – Area A Management Plan, in consultation with the Department of Parks and Wildlife, which the CEO has confirmed by notice in writing, satisfies the requirements of condition 7-2.

1.2 Objectives and Scope

This Area A MP has been prepared to ensure that the proposed activities are undertaken in accordance with relevant legislation, policies and guidelines. The management actions and mitigation measures outlined in the Area A MP are designed to ensure that impacts upon

the environment are minimised, and that any impacts that do occur are managed appropriately.

1.2.1 Condition Environmental Objective

The condition environmental objective for the Project, as stated in Condition 7-1, is 'The proponent shall ensure that Area A is decommissioned and rehabilitated to support functional landforms, soil profile, ground and surface water systems and ecological communities, that are suitable for continued use of this area as State forest.'

1.2.2 Key Environmental Factors

The Key Environmental Factors (KEFs) that will be affected by the Project are Landforms, Flora and Vegetation and Terrestrial Fauna, which are all part of the overall Land theme, with Rehabilitation and Decommissioning as an Integrating Factor (EPA, 2013). Impacts to the KEFs that will result from the Project are outlined below. This Area A MP will address the management of actual and potential impacts to these KEFs.

Landforms

The EPA defines Landforms as "A distinctive, recognisable physical feature of the earth's surface having a characteristic shape produced by natural processes." (EPA, 2015d).

The EPA Objective for the Landforms KEF is "To maintain the variety, integrity, ecological functions and environmental values of landforms." (EPA, 2015d).

Area A is situated on the lower slopes of the Whicher Scarp and comprises a gentle slope that ranges from about 60 m ASL on the southern boundary to 50 m ASL in the northwest corner. Slopes range from 2.0° in the western part of Area A to 3.5° in the eastern part. A broad, shallow swale is present at the western extremity of Area A.

Under the Project, all of Area A, except for a (4 m) buffer around the boundary, will be progressively excavated to a depth of up to 7.4 m. Topsoil, and subsoil/overburden² where available, will be stockpiled within Area A and the remaining underlying ore will be transported outside of Area A for the removal of the mineral sands component. Backfilling of the pit will involve return of sand and clay tails, overburden, subsoil/overburden and then topsoil to re-establish the landform.

It is expected that, through the implementation of management actions detailed in this Area A MP, the EPA objective for this KEF will be achieved.

² Note that subsoil is not able to be salvaged from most of Area A as ore is present at or very near to the land surface. Where it and any overburden is present, this will be stripped and stockpiled for use in rehabilitation. As this material is not true 'subsoil', it is referred to as subsoil/overburden.

Flora and Vegetation

The EPA Objective for the Flora and Vegetation KEF is “To maintain representation, diversity, viability and ecological function at the species, population and community level.”

The aspects of the Project which would affect this key environmental factor are:

- Clearing of 8.9 ha of Whicher Scarp vegetation from within Area A
- Clearing of 6 individuals of the Declared Rare Flora (DRF) *Davesia elongata* subsp. *elongata*
- Possible introduction of *Phytophthora* dieback into Area A
- Possible introduction of new weed species into Area A and/or increased presence post-mining of weed species that are currently present in Area A, as a result of disturbance.

The Project will directly impact the Whicher Scarp Floristic Community Type C1 (FCT C1). While there are other restricted floristic community types located within the larger development envelope in the area of the State forest, they are unlikely to be impacted by mining or ancillary operations. The proposal will necessitate the clearing of 2.8 ha of FCT C1. According to Department of Parks and Wildlife (DPaW) figures, this equates to 5.2% of the known mapped extent of FCT C1 (EPA, 2015e).

The DRF *Davesia elongata* subsp. *elongata* is known from a total population of 1,606 individuals. Six plants are proposed to be cleared, which equates to approximately 0.4 % of the known individuals. The local population in the area of State forest within the development envelope currently comprises seven plants. It is considered that, due to the majority of plants being cleared and the habitat being removed, this population may be lost (EPA, 2015e).

While there will be unavoidable impacts on Flora and Vegetation resulting from the Project, when considered in totality, including the offset(s) that will be secured, it is expected that the EPA objective for this KEF will be achieved.

Terrestrial Fauna

The EPA Objective for this KEF is “To maintain representation, diversity, viability and ecological function at the species, population and assemblage level.”

The environmental aspects of the Project which would affect this key environmental factor are:

- Clearing of 107 potential Black Cockatoo nesting trees, of which ten contained hollows with larger entrances (~ greater than 12cm) that appeared big enough and

orientated favourably to possibly allow the entry of a black cockatoo into a suitably sized branch/trunk (although none of these showed any evidence of current or past use by black cockatoos).

- potential impacts on conservation significant fauna species (including all three species of Black Cockatoos, *Phascogale tapoatafa* ssp Southern Brush-tailed Phascogale (S3), *Merops ornatus* Rainbow Bee-eater (S5), *Macropus irma* Western Brush Wallaby - P4 and *Isoodon obesulus fusciventer* Quenda – P4), from the loss of habitat due to clearing

The representation, diversity, viability and/or ecological function for site-specific species, populations or communities, which will be affected by the Project are described below:

- The results of the Level 2 Fauna survey undertaken by Harewood (2014) suggests that impacts from the project on fauna, in particular those of conservation significance will be in most instances negligible or low. This conclusion is based on the fact that the site does not contain the preferred habitat of some species and therefore they are unlikely to be present. Where species have been confirmed as present in the works footprint or nearby, impacts are also likely to be low as large areas of habitat of at least similar quality are present outside of the 8.9 ha works footprint and the loss of this relatively small area of habitat is considered very unlikely to alter the conservation status of any species or population currently utilising the general area for some purpose. With respect to species identified as being of possible regional or local significance (i.e. local endemics, those at the limit of their range or comprising potentially unique or rare assemblages) impacts are also considered unlikely to be of significance in any instance for similar reasons as detailed above (i.e. large areas of habitat of at least similar quality are present outside of the 8.9 ha works footprint).
- Two potentially unique/rare reptile assemblages identified on site are also unlikely to be significantly impacted upon, these being *Lerista elegans/Lerista distinguenda* and *Morethia lineoocellata/Morethia obscura*. While individuals of both groups are likely to be displaced by proposed works both assemblages have significant overlapping ranges and are often recorded together.

While there will be unavoidable impacts on Flora and Vegetation resulting from the Project, when considered in totality, including the offset(s) that will be secured, it is expected that the EPA objective for this KEF will be achieved.

Rehabilitation and Decommissioning

In 2006, the EPA stated the primary objective for rehabilitation as “To minimise environmental impacts resulting from permanent change to ecosystems. This requires the

return of rehabilitated areas to self-sustaining and functional ecosystems comprised of local provenance species.” (EPA, 2006)

As stated in EPA (2013), the EPA Objective for the Rehabilitation and Decommissioning Integrating Factor is “To ensure that premises are closed, decommissioned and rehabilitated in an ecologically sustainable manner, consistent with agreed outcomes and land uses, and without unacceptable liability to the State.”

The quality and standard of activities undertaken during decommissioning and rehabilitation of native vegetation in Area A will have a direct influence on the re-establishment of values of all the identified KEFs.

The management targets, approach and actions outlined in this Area A MP have been designed to achieve both the 2006 and 2013 EPA Objectives for decommissioning and rehabilitation. It is intended that the vegetation re-established within Area A will be self-sustaining within 10 years i.e. require no more intensive management to maintain its state than is currently required, and suitable for continued use as State Forest. The re-established vegetation will be comprised of species that were present in Area A prior to mining, grown from locally sourced, local provenance seed or plant material and both large and small scale woody debris will be re-introduced to the site in quantities sufficient to encourage recolonisation by native fauna.

1.3 Legislation and Regulatory Framework

All relevant state and commonwealth environmental legislation and guidelines shall be complied with throughout the project. Those that relate to this Area A MP in Western Australia are listed below:

- *Conservation and Land Management Act 1984* (WA)
- *Environment Protection and Biodiversity Conservation Act 1999* (Cth)
- *Environmental Protection Act 1986* (WA)
- Environmental Protection (Clearing of Native Vegetation) Regulations 2004 (WA)
- Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia. Guidance Statement No. 51 (Environmental Protection Authority 2004)
- *Rights in Water and Irrigation Act 1914* (WA)
- Terrestrial Biological Surveys as an Element of Biodiversity Protection. Position Statement No. 3 (Environmental Protection Authority 2002)
- *Wildlife Conservation Act 1950* (WA)

1.3.1 Partnership with DPaW

In their comments on the draft version of this plan, DPaW have indicated that the key management objective for the Department for this area of State forest within Area A will be conservation. Doral will work in partnership with DPaW to ensure that Area A is able to be integrated back into the adjacent State Forest, and continue to be used as State Forest (with a management objective of conservation, as specified by DPaW, 2016a), after rehabilitation and decommissioning.

2 Context, Scope and Rationale

2.1 Requirements of the Condition

This Area A MP is submitted in accordance with Condition 7 of Ministerial Statement 1030 for Doral's Yoongarillup Mineral Sands Project. The requirements of these conditions are addressed in the following sections of the Area A MP:

Condition	Section in Area A MP
7-2(1) ensure that clearing and mining of the Area A is undertaken in stages to ensure progressive rehabilitation	4
7-2(2) ensure that if clearing is to be undertaken, the proponent shall thoroughly inspect the area for Black Cockatoo breeding activity, in particular nesting, and if the area is found to be in use, clearing in the area shall be postponed until such time as determined suitable, on the advice of the Department of Parks and Wildlife;	6
7-2(3) ensure that if clearing is to be undertaken, a qualified terrestrial native fauna spotter shall thoroughly inspect the area for the presence of conservation significant fauna, and implement suitable mitigation measures for each species, which may include retrieval and translocation, on the advice of the Department of Parks and Wildlife	6
7-2(4) ensure that the topsoil removed from Area A is stored only within Area A, and is stored for a maximum of 18 months	9.3
7-2(5) specify the fencing and access requirements to Area A	3
7-2(6) specify the method of clearing vegetation, including the retention of any vegetative material for rehabilitation within Area A	9.1
7-2(7) specify the topsoil removal, storage (location and time), and resspreading procedures within Area A	9.3
7-2(8) specify the timing of mining, and return of soil profile	9.2

Condition	Section in Area A MP
and landforms	
7-2(9) specify measures, including the timing of operations, to prevent weeds and dieback from establishing in Area A	7, 8
7-2(10) specify the placement of mining infrastructure to ensure that progressive rehabilitation can occur	4
7-2(11) specify measurable, achievable, realistic and timing specific completion criteria, to ensure the management objective in condition 7-1 is achieved	3.2, 4.4, 5.5, 6.4, 7.4, 8.4, 9.1.3, 9.2.6, 9.3.4, 9.4.5, 9.5.2 and Summarised in section 10
7-2(12) specify the monitoring program to report on completion criteria progress	3.5, 4.7, 5.8, 6.7, 7.7, 8.7, 9.1.6, 9.2.9, 9.3.7, 9.4.8, 9.5.4
7-2(13) specify any other management actions that will be implemented to ensure the management objective in condition 7-1 is achieved	3.3, 4.5, 5.6, 6.5, 7.5, 8.5, 9.1.5, 9.2.8, 9.3.5, 9.4.6
7-2(14) be consistent with the Department of Mines and Petroleum and EPA Guidelines for Preparing Mine Closure Plans.	Throughout

2.2 Rationale and Approach in Meeting the Environmental Objective

Results of baseline surveys and a number of assumptions and uncertainties inform the management approach for meeting the environmental objective stated in **Section 1.2.1**. The identified management actions, management targets and proposed review and revision of management actions are aligned with the overall management approach.

2.2.1 Data Gaps

Data gap	Response
Fire risk and fire management	A Fire Management Plan will be prepared prior to clearing of Area A
<i>Phytophthora</i> dieback management	A <i>Phytophthora</i> dieback Management Plan for Area A will be prepared in October 2016
Pre-mining density of Black Cockatoo habitat trees in Area A	See Section 2.2.3
Weed status of Area A	See Section 2.2.3
Soil moisture baseline data	See Section 2.2.3
Depth to groundwater baseline data	See Section 2.2.3
Surface soils and soil chemistry baseline data	See Section 2.2.3
Pre-mining topography	See Section 2.2.3

2.2.2 Results of Baseline Surveys

Data from floristic quadrat-based surveys of native vegetation, including information about native and introduced species composition, cover and abundance is available as ‘baseline data’ from Mattiske (2012) and Ecoedge (2014). However, it is intended that these quadrats will be re-scored in spring 2016 to re-establish the baseline against which stated completion criteria relating to the rehabilitation of native vegetation will be measured.

Baseline surveys for other parameters relating to Area A will commence in spring/summer of 2016, providing an anticipated 12 months of data prior to clearing.

2.2.3 Baseline Surveys to be Undertaken

- Comprehensive species list for Area A, including collection of detailed information on introduced and native species cover and abundance will be undertaken in spring of 2016 (relates to **Sections 7, 9.3 and 9.4**)
- Re-assessment of Ecoedge and/or Mattiske Area A floristic quadrats will be undertaken in spring of 2016 (relates to **Section 9.4**)
- Establishment of herbaceous species monitoring transects (including stratified random placement of 5 x 5 m quadrats) will be undertaken in autumn of 2017 (relates to **Section 7.7.7**)
- Pre-clearing assessment of Black Cockatoo habitat tree density in Area A will be undertaken in spring of 2017 (relates to **Section 9.4.5**)
- Surface soils survey to assess soil physical, chemical and biological characteristics will be undertaken in January 2017 (relates to **Sections 9.2 and 9.3**).

- Landscape Function Analysis survey, including infiltration rates, soil compaction will be undertaken in January 2017 (relates to **Sections 5, 9.2 and 9.3**)
- Topographic survey to determine pre-mining ground surface levels will be undertaken in January 2017 (relates to **Section 9.1**)
- Leaf water potential assessment at minesite and reference monitoring sites (indicate whether unintended dewatering is occurring); to commence in September, 2016 (relates to **Section 5**)
- Soil moisture assessments; intended to commence in spring 2016 (relates to **Section 5**), dependent on the issue of a Regulation 4 permit for bore installation from DPaW
- Depth to groundwater assessments; intended to commence in spring 2016 (relates to **Section 5**), dependent on the issue of a Regulation 4 permit from DPaW

2.2.4 Key Assumptions and Uncertainties

- That external factors will not prevent the mining of Area A being undertaken within the intended 10-12 month timeframe
- That there will be no lasting impacts on groundwater levels or flows resulting from the Project
- That native vegetation that is comparable to what was present in Area A prior to mining can be re-established on the returned soil profile
- How many of the native species not able to be re-established through revegetation practices implemented may regenerate from topsoil and/or be introduced to Area A from the adjacent State Forest

2.2.5 Management Approach

In Guidance Statement No. 6 (EPA, 2006), the EPA identifies a key aim of rehabilitation as being to ensure the long-term stability of soils, landforms and hydrology required for the sustainability of sites. The EPA states that the second main purpose of rehabilitation is, or should be, to partially or fully repair the capacity of ecosystems to provide habitats for biota and services for people, and lists the consequences of failure to rehabilitate natural ecosystems to appropriate standards as including:

1. Reduction in the quality and quantity of habitats for plants, animals, fungi and microbes resulting in net loss of biodiversity
2. Reductions in essential ecosystem functions such as carbon sequestration, water table stabilisation, etc
3. Impacts on adjacent natural vegetation due to weed invasion, changes to hydrology, loss of connectivity, etc

4. Environmental hazards and management costs that must be borne by society.
5. Reductions in the economic values of sites (forestry, grazing, tourism, etc.)
6. Loss of visual amenity and heritage values
7. Failure to meet environmental conditions/commitments requiring additional remediation work or loss of bonds
8. Loss of image and reputation for proponents

Both key objectives of rehabilitation, and all of the above potential consequences of poor quality rehabilitation, have guided the development of this Area A MP.

Where possible, impacts of the project were avoided, and where this was not possible, they were minimised.

In formulating management actions for the rehabilitation of Area A, an extensive desktop study including an analysis of available research and consultation with recognised experts and experienced practitioners was undertaken to determine current best-practice. From this information and advice, an assessment of the options that are appropriate and realistic to implement at Yoongarillup, based on the limiting factors of site-based and regulatory constraints, was carried out. The management actions developed for the project were devised to maximise the quality of rehabilitation of Area A, and were prioritised on this basis.

2.2.6 Rationale for Choice of Completion Criteria

The completion criteria for Area A are designed to allow assessment against Condition 7-2 subsections 1 to 14 in MS1030.

- The completion criteria that have been chosen for Area A are auditable, specific, measurable, achievable, relevant and time-bound
- For criterion specific evaluation and re-evaluation, timing and methods are provided.
- The completion criteria are designed to meet the land use objectives consistent with the State forest management purpose of conservation
- The completion criteria that have been chosen for Area A are all based on a consideration of the current state of the key environmental factor (where it is known) and what would be realistic and feasible to achieve in light of the significant disturbance to the natural state of the local environment that will result from the mining activities.
- Completion criteria for (the re-establishment of) the Flora and Vegetation KEF were chosen based on an analysis of the potential for successful recruitment or reintroduction of each of the species currently present in Area A. This analysis was undertaken by suitably qualified highly experienced personnel in this field, and

considered potential recruitment from topsoil, direct seeding and seedlings grown from seed and from vegetative material (cuttings). Many of the species present in Area A are not currently germin-able or propagatable.

- Flora and Vegetation KEF targets were designed with a focus on the re-establishment of identified Area A vegetation 'keystone' species. This species subset was prepared by a botanist with more than 25 continuous years' experience in surveying vegetation on the Whicher Scarp.
- Completion criteria for the Terrestrial Fauna KEF were chosen to ensure that impacts to native fauna as a result of clearing are kept to an absolute minimum. Under the proposed mine schedule, there is sufficient time to enable clearing to occur outside of the Black Cockatoo breeding season, and for a trapping program to be implemented to remove as many individuals of other conservation significant species (including but not limited to the Southern Brush-tailed Phascogale, Quenda, Coastal Plains Skink, Speckled Stone Gecko, Black-backed Hooded Snake and the Forest Toadlet), from the clearing area as possible.
- Completion criteria for the Landforms KEF were chosen to ensure that the rehabilitated site blends into the surrounding landscape. This is commensurate with current best practice and is a realistic and feasible target for the Project.

Completion Criteria are presented within each relevant section of the Area A MP and agglomerated in **Table 2**.

3 Fencing and Access

Addressing MS1030 Condition 7-2(5)

3.1 Description of Proposed Works

It is intended that access to the section of Goulden Road that is within Area A will be blocked in accordance with City of Busselton guidelines and approvals as soon as is possible, mostly likely in the first quarter of 2017, to restrict access and minimise the risk of spreading *Phytophthora* dieback and weeds. Access will be blocked using a combination or choice of fences, gates and/or large logs to prevent vehicle access around closure points. Doral intends to ensure the longest lag-time possible before clearing of vegetation, to allow for any habitat to continue to be used and for the collection of as much vegetative material for use in rehabilitation, such as seed and cuttings, as possible. As such, a temporary fence comprised of star pickets and a high visibility plastic 'daisy chain' or flagging with appropriate warning signage will be installed along the southern, eastern and western boundaries of Area A in the first quarter of 2017, to demarcate the boundary, with the permanent fence installed just prior to clearing.

Any access to pedestrians or vehicles will be strictly limited to prevent the spread of dieback.

Within the southern, eastern and western boundaries of Area A, a 4 m buffer is intended to be established to accommodate a 1 m safety bund, light vehicle access track and boundary fence. These sides of the boundary will be fenced with a kangaroo and rabbit resistant fence in November / December 2017 as the first stage of clearing, prior to entering the area for mining. The northern boundary of Area A, where it joins Goulden Road, will remain delineated although open for the duration of mining, and will be fenced during decommissioning and rehabilitation, before rehabilitation of native vegetation. The exact location of the fence along the southern, eastern and western boundaries will be determined onsite by a licensed surveyor and shall be reasonably conservative to minimise the need for clearing where possible. The fence will be situated at least 300 mm inside the Area A boundary to allow for a 300 mm anti-vermin skirt. Only vegetation within Area A will be removed or impacted during fence construction, and where a tree is present on the boundary line, it will be kept intact, however on the inside of Area A where possible.

The kangaroo resistant, rabbit proof fence specifications are as follows:

- 1.8 m ringlock fencing, installed to a height of 1.5 m with the remaining 300 mm anti-vermin skirt bent to lie parallel with the ground, facing towards the expected direction of future pressure from kangaroos. This 'apron' will face away from Area A and remain flat on the surrounding ground and additionally secured with rocks or soil where required.
- 800 mm of rabbit mesh, attached to the ringlock fence described above to a height of 500 mm, with the remaining 300 mm anti-vermin skirt to lie parallel with the ground, facing outwards the expected direction of future pressure from rabbits. This 'apron' will face away from Area A and will be secured with rocks or soil (as recommended by the Department of Agriculture and Food WA (DAFWA), (DAFWA, 2015)).

A schematic diagram of this fence design is shown in Error! Reference source not found.. Rabbit proof mesh fence and apron attached to the base of a traditional ringlock fence.

Immediately upon construction of the fence, and for the duration it remains in place, full height shade cloth will be attached to the fence on all sides of Area A to minimise windblown viable plant reproductive material from weed species and other edge effects (wind, dust, light, etc) impacting on vegetation in SF33 south of Area A.

Two sets of full-height lockable steel gates will be installed, one in the South western corner and one in the south eastern corner, to facilitate emergency and monitoring access. During decommissioning and rehabilitation, the northern boundary of Area A will also be fenced. It is likely that additional (lockable) gates will also be installed at this time.

It is proposed that Area A, including the portion of Goulden Road within it, will remain inaccessible to the public until 2025, based on the current mining and rehabilitation schedules, plus a 5 year exclusion period to protect rehabilitated native vegetation.

3.2 Completion Criteria

- Vehicle access to Goulden Road within Area A is restricted in the first quarter of 2017
- The eastern, southern and western boundaries of Area A are fenced prior to entering the area for mining (circa. November/December 2017)
- The northern boundary of Area A is fenced during decommissioning and rehabilitation, before rehabilitation of native vegetation
- For 5 years post-rehabilitation of native vegetation, herbivores are excluded from Area A and there is no evidence of grazing within Area A

3.3 Management Actions for Achieving Completion Criteria

Install, monitor and maintain closure points, fence and access gates as required to ensure access continues to be restricted and herbivores continue to be excluded from Area A.

Review specified management actions quarterly and revise as necessary to ensure the consistent achievement of Completion Criteria.

3.4 Key Performance Indicators (KPIs)

- Presence of unauthorised vehicles or pedestrians within Area A
- Presence of herbivores / evidence of grazing within Area A

3.5 Monitoring to Assess Against KPIs

- Restriction of vehicle access to Goulden Road within Area A confirmed by visual inspection; outcome included in rehabilitation reporting.
- Installation of fencing and shade cloth to Area A eastern, southern and western boundaries prior to entering the area for mining confirmed by visual inspection; outcome included in rehabilitation reporting.
- Installation of fencing and shade cloth to the northern boundary of Area A during decommissioning and rehabilitation, before rehabilitation of native vegetation, confirmed by visual inspection; outcome included in rehabilitation reporting.
- Inspections for grazing impacts and evidence of unauthorised access will be undertaken no less than monthly and more frequently as required for 5 years, as part of the rehabilitation monitoring program detailed in **Section 9.4.8**.

3.6 Contingency Measures

Pest animal management and/or control will be undertaken if required to remove animals that have gained access to Area A. This will be carried out either by Doral staff manually

herding animals out of the enclosure (in the case of kangaroos) or engaging pest animal contractors as required.

An electric top wire may be added to the fence if required to further restrict kangaroo access to Area A.

4 Scheduling and Placement of Mine Infrastructure

Addressing MS1030 conditions 7-2(1), 7-2(8) and 7-2(10).

4.1 Closure Objectives

- All mining and processing equipment and structures are removed from site
- The planned schedule of mining for Area A facilitates successful rehabilitation of native vegetation

4.2 Description of Proposed Works

A timeline of the proposed mine and rehabilitation schedule is provided in **Table 1**.

4.2.1 Mine Schedule

It is intended that mining in Area A will commence in the first quarter of 2018. Mining would be undertaken in three stages, commencing in west and progressing eastwards, and continue for approximately 10 months until approximately November 2018. (refer Table 1 Gantt chart showing schedule of mining and rehabilitation of Area A and Figure 4 and 5)³.

Pit void backfill and soil profile return is intended to be undertaken on an approximate three-month lag, i.e. Stage 1 will be mined Jan-Mar 2018 and returned April – June 2018, Stage 2 will be mined April – June 2018 and returned July – September 2018, etc. Return of soil profiles would commence immediately once mining of a Stage is completed.

The mining schedule has been specifically designed to optimise the timing of topsoil stripping and replacement. Due to the timing requirements to allow for dry stripping and replacement of topsoil, and also the restriction on topsoil storage time, there is limited flexibility in schedule of rehabilitation. As such, rehabilitation of the soil profile and landform will be undertaken progressively, while topsoil removal and replacement will both be undertaken across Area A in a single stage. To deviate from this plan, topsoil would either be stripped or replaced in suboptimal conditions, e.g. when it is wet, or at a suboptimal time e.g. not just prior to winter rains, respectively.

It is intended that topsoil will be replaced in the autumn of 2019.

Rehabilitation of native vegetation will take place immediately upon replacement of topsoil, in autumn and winter 2019.

³ Figure 4 shows the stages of mining of Area A, not mining blocks, as is shown in other figures.

4.2.2 Mine Infrastructure

No permanent or long term (i.e. greater than 12 months) infrastructure will be installed in Area A.

The only mine infrastructure that will be temporarily located within Area A is a mobile (skid mounted) hopper and associated equipment to pump mined ore to the concentrator plant location approximately 800 m from Area A; no permanent infrastructure will be constructed.

It is intended that the hopper unit will be constantly moving relative to the ore face, and is unlikely to remain in any one position for more than 4 weeks.

Table 1. Gantt chart showing schedule of mining and rehabilitation of Area A.

Area A Rehabilitation and Monitoring Activity	Spring 17	Summer 16/17	Autumn 17	Winter 17	Spring 17	Summer 17/18	Autumn 18	Winter 18	Spring 18	Summer 18/19	Autumn 19	Winter 19	Spring 19	Summer 19/20	Autumn 20	Winter 20	Spring 20	Summer 20/21	Autumn 21	Winter 21	Spring 21	Summer 21/22	Autumn 22	Winter 22	Spring 22	Summer 22/23	Autumn 23	Winter 23	Spring 23	Summer 23/24	Autumn 24	Winter 24	Spring 24
Seed collection																																	
Baseline 10 x 10 m quadrat monitoring pre-clearing																																	
Install identifying and continuous plastic chain boundary demarcation																																	
Installation of contingent irrigation system to state forest vegetation boundary																																	
Erect fence roo resistant fence and shade cloth along boundary to remaining vegetation																																	
Vegetation cleared. Vegetative material to be kept is stockpiled																																	
Topsoil and subsoil stripped and stockpiled																																	
Mining																																	
Soil profile rehabilitation (sand tails)																																	
Soil profile rehabilitation (overburden cap and subsoil)																																	
Northern (Goulden Rd) boundary fence installed																																	
Topsoil placement																																	
Direct seeding																																	
Tubestock planting																																	
Supplementary seeding if required																																	
Supplementary planting if required																																	
Herbaceous spp monitoring																																	
10 x 10 m quadrat, complete species list and grazing monitoring																																	
Undertake weed control as required																																	
Undertake insect, e.g. grasshopper control as required																																	

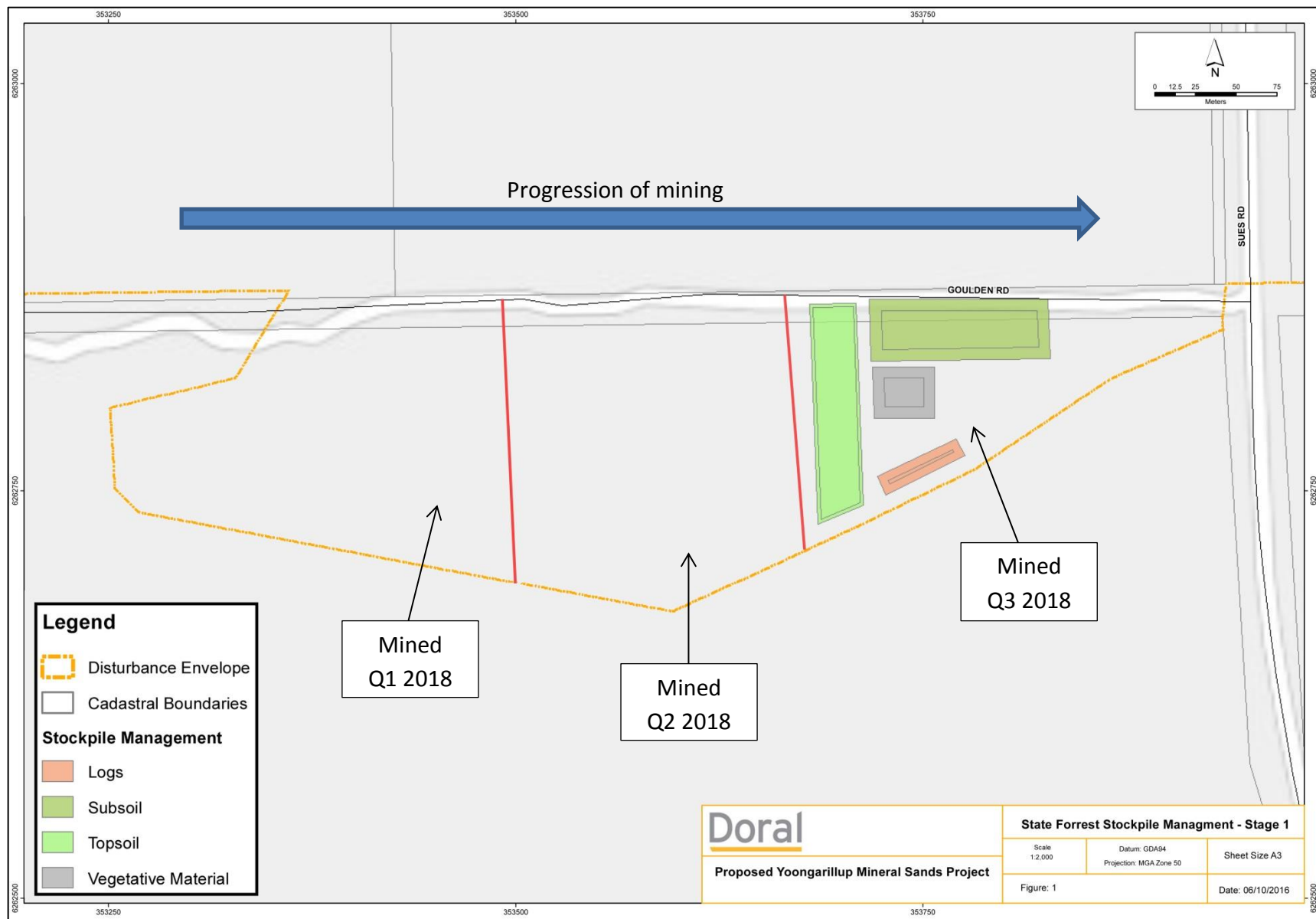


Figure 3. Schedule of mining for Area A and proposed location of stockpiles of Area A materials within Area A in Stage 1.

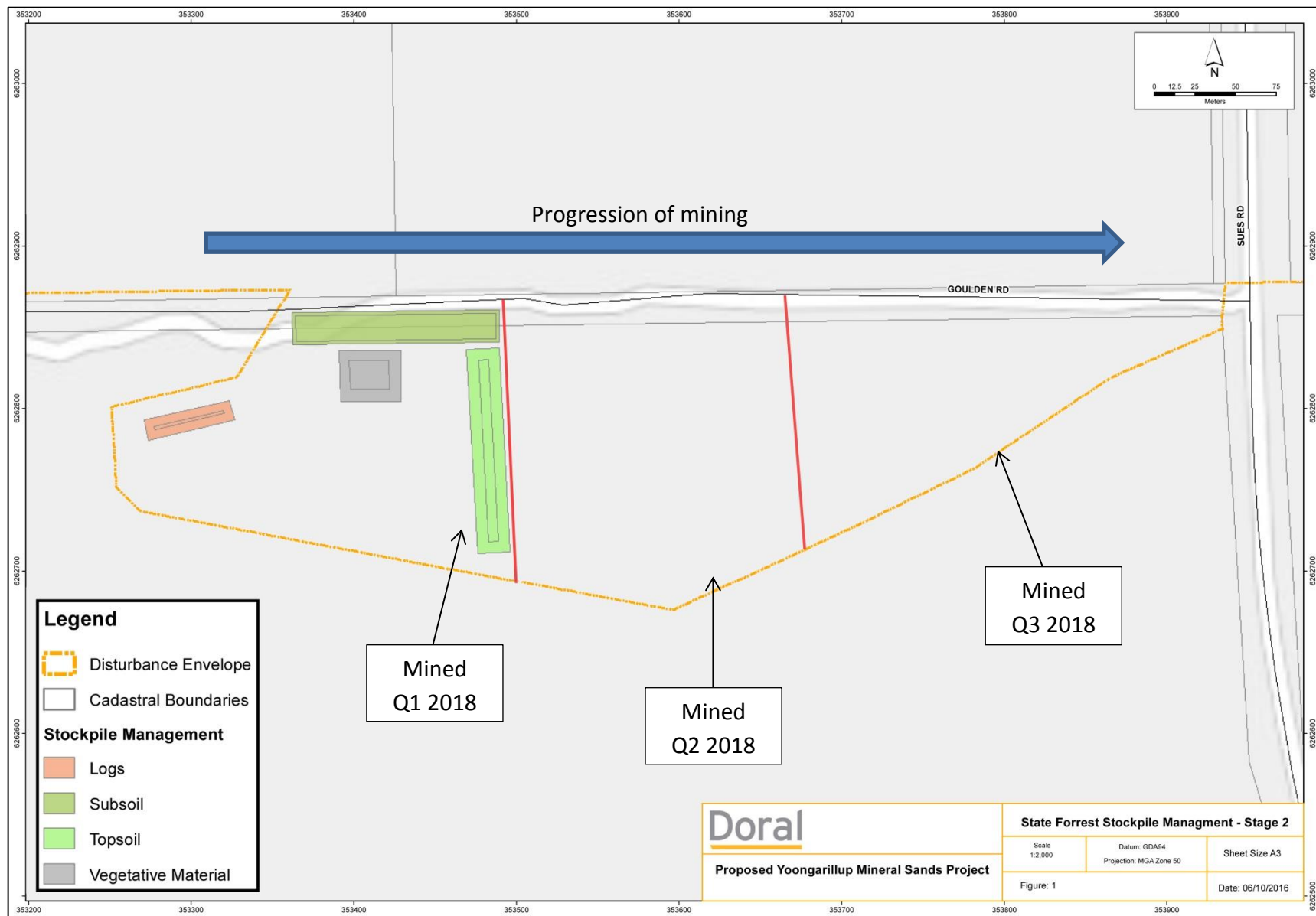


Figure 4. Schedule of mining for Area A and proposed location of stockpiles of Area A materials within Area A in Stage 2.

4.3 Potential or Actual Impact

The risks of infrastructure remaining in the pit and inhibiting the ability to undertake rehabilitation are negligible due to the process and schedule of mining, under which mining equipment is constantly moving forward concurrent with tailing occurring immediately in the void left behind.

Area A mine voids will only remain open for a period of three months before they are tailed. As such, the risk of potential drawdown-related edge effects is only likely to apply for a combined maximum of 12 months (taking into consideration a 3-month lag in the rehabilitation of Stage 3), and very likely less than this as only one third of Area A will be open at any one time.

The risk of an economic downturn interrupting mining operations and subsequently impacting on the mine schedule and ability to undertake rehabilitation as proposed is unlikely, as Doral has already secured a contract for sale of mineral to ensure the ongoing viability of the mine.

If topsoil is not returned in autumn, impacts in the form of reduced germination of native species are likely to result (Rokich, *et al.*, 2000).

4.4 Completion Criteria

- Area A progressively rehabilitated as per **Table 1**
- Topsoil able to be respread in autumn (during the months of March, April, May)

4.5 Management Actions for Achieving Completion Criteria

Maintain the planned schedule of mining for Area A.

4.6 Key Performance Indicators

- Progressive rehabilitation of Area A
- Timing of topsoil resspreading

4.7 Monitoring to Assess Against KPIs

Ongoing monitoring of consistency of actual mine progress with the planned mine schedule within the constraints as outlined in Schedule 1 of MS 1030, which limits mining operations to 3 years. The planned mine schedule facilitates achievement of both the above completion criteria.

4.8 Contingency Measures

Mining of Area A is scheduled to commence in the summer of 2017/2018, and topsoil must be replaced in autumn of 2019. As such, there is a 15-17 month window during which Area must be mined and rehabilitated; this allows some flexibility to adapt management responses if necessary.

5 Ground and Surface Water Management

Addressing MS1030 Condition 7-1

5.1 Closure Objectives

- Ensure that groundwater recovers from drawdown
- Surface and groundwater levels and quality are consistent with surrounding areas
- Surface and groundwater flows are consistent with surrounding areas

5.2 Description of Pre-mining State

Parsons Brinckerhoff (2013) carried out hydrogeological investigations and modelling for the Project Area. They recognized three aquifers occurring locally; the Superficial, Leederville and Yarragadee aquifers. In 2012 Doral installed groundwater monitoring bores for the Yoongarillup Project Area (Parsons Brinckerhoff, 2013). These bores were designed to monitor both the Superficial and the Leederville Aquifers in areas surrounding proposed mining activities. The closest of these monitoring bores to Area A (just to the north of the proposed pit, at the western end) is MB03.

Monitoring data from August 2012 to November 2014 show the Static Water Level (SWL) at MB03 ranging from 10.18 to 8.26 m (depth from the surface). However, it has been noted that this bore tests the Leederville Aquifer and not the Superficial Aquifer, the base of which is considered to be at most 6 m to 9 m below the surface (Doral, 2015). Monitoring data from August 2012 to November 2014 show the Static Water Level (SWL) at MB03 ranging from 10.18 to 8.26 m (depth from the surface). However, it has been noted that this bore tests the Leederville Aquifer and not the Superficial Aquifer, the base of which is considered to be at most 6 m to 9 m below the surface (Doral, 2015).

Doral is in the process of installing additional groundwater monitoring bores, as well as soil moisture monitoring bores, in State Forest adjacent to Area A.

No surface flow of water, except for very brief periods after heavy rain, occurs within Area A.

5.3 Description of Proposed Works

Area A mine pits will be mined on a slight incline from the deepest point and then mined moving upgradient in order to retain pit water drainage to within a sump at the deepest point on the pit floor. This form of dewatering is known as 'passive' as no dewatering apparatus (e.g. spears) are used to actively abstract water and groundwater drawdown below the base of the pit is highly unlikely to occur.

Throughout the project, Doral will work under the Groundwater Operating Strategy (AQ2, 2016) and terms of the dewatering licenses.

5.4 Potential or Actual Impact

It is considered to be unlikely that drawdown will be experienced in the Mowen Member south of the mine (Parsons Brinckerhoff, 2015). A drawdown of up to 1 m was predicted for a small area in State Forest to the west of Area A, extending up to 50 m from the edge of the pit. Parsons Brinckerhoff consider that less than 1 m drawdown is likely to be within the natural variability of the water table. Mining related dewatering is predicted to occur in the Superficial sediments to the north of the proposed pit, however the Superficial aquifer is not known to occur within Area A.

The mining process for Area A has been designed to facilitate accelerated backfill of the pit by preferentially tailing from the southernmost interface of the void and thereby reducing the period of dewatering risk to approximately one month. Approximately 80 m of the southern pit wall is expected to be exposed at any one time.

Any groundwater drawdown is expected to recover to 90% of pre-mining levels within 3 years and to 100% of pre-mining levels within 5 years, although as stated above, drawdown is not predicted to occur within Area A.

- Disruption of the ground and water systems could cause loss of vegetation adjacent to and within Area A
- Long-term drawdown of groundwater outside of the natural range would likely lead to loss of vegetation that depends on groundwater
- Disruption of surface and subsurface water flows because of altered drainage characteristics within Area A could lead to difficulties with re-vegetation or establishment of some species

5.5 Completion Criteria

- Groundwater will recover to 90% of pre-mining levels within 3 years and 100% of pre-mining levels within 5 years
- Groundwater levels in “potential impact area” monitored bores are stable within the range of variation of surrounding “reference” monitoring bores and show the same seasonal patterns as surrounding “reference” monitored bores (Refer to the Flora and Vegetation Monitoring Plan)
- Groundwater quality (pH, EC, Total Dissolved Salts, Total Acidity, Total Alkalinity, chloride, sulphate, Al, Fe and Mn) in “potential impact area” monitored bores is within the range monitored within the surrounding areas
- Groundwater levels in “potential impact area” monitored bores are stable within the range of variation of surrounding monitoring bores and show the same seasonal patterns as surrounding monitored bores

- Drainage lines flow in the same direction and to the same catchments as they did pre-mining

5.6 Management Actions for Achieving Completion Criteria

Implement mine operations and schedule, and Groundwater Operating Strategy (AQ2, 2016) as planned, including:

- Doral will ensure that the schedule of production and a table of monitoring bore details will be kept up to date
- The extraction from the Superficial aquifer shall not exceed 220,000 kL/a
- The extraction from the Yarragadee aquifer shall not exceed 1,600,000 kL/a
- Review specified management actions quarterly and revise as necessary to ensure consistent achievement of Completion Criteria.

5.7 Key Performance Indicators

- Groundwater levels during mining and at 3 years and 5 years post-mining
- Groundwater quality measurements

5.8 Monitoring to Assess Against KPIs

A summary of the proposed monitoring of groundwater levels and quality is provided here. The monitoring program is detailed in full in the Groundwater Operating Strategy (AQ2, 2016).

Nine groundwater monitoring bores were installed for the Yoongarillup project area as directed by Parson Brinckerhoff in 2012 (PB, 2012). These bores were designed to monitor both the Superficial and Leederville aquifers in areas surrounding proposed mining activities. Those bores installed down-gradient of the proposed mine pit are adequately designed to monitor water from the Superficial aquifer, but those up-gradient from the pit are not screened at optimal depths to monitor the Superficial aquifer and therefore new bores are proposed to be installed prior to commencing operations, eight of which will provide data relating to groundwater within and surrounding Area A (**Figure 5**).

Nine soil moisture monitoring bores will be installed around Area A and at nearby reference sites (**Figure 6**).

The following will be assessed:

- Monthly monitoring of local (mine site and vicinity) bores and quarterly monitoring of regional bores to measure surface and groundwater quality utilising appropriate field meters and samples analysed at a National Association of Testing Authorities (NATA) accredited laboratory.

- Monthly monitoring of bores to determine whether groundwater levels return to 90% of pre-mining levels within 3 years and 100% of pre-mining levels within 5 years
- Monthly monitoring of soil-moisture levels in bores adjacent to Area A
- Monthly monitoring of plant stress levels in vegetation adjacent to Area A using a pressure chamber (increased fortnightly if adverse impacts detected)

Data from each monitoring period will be collated and analysed against baseline and calibration values and data collected during previous monitoring periods to identify trends and outlier records. All monitoring data will be consistently maintained and kept for the duration of the monitoring, until project closure.

5.9 Contingency Measures

Following a review of the mine schedule, contingencies that may be implemented if appropriate include:

- Mining to ore floor with geologist supervision to make certain that the underlying Mowen clays (potentially acid sulphate soils) are not excavated, with water level recovery as soon as possible after ore mining completion
- Mitigate the effect of dewatering activities by accelerating backfill of the pit in the affected area

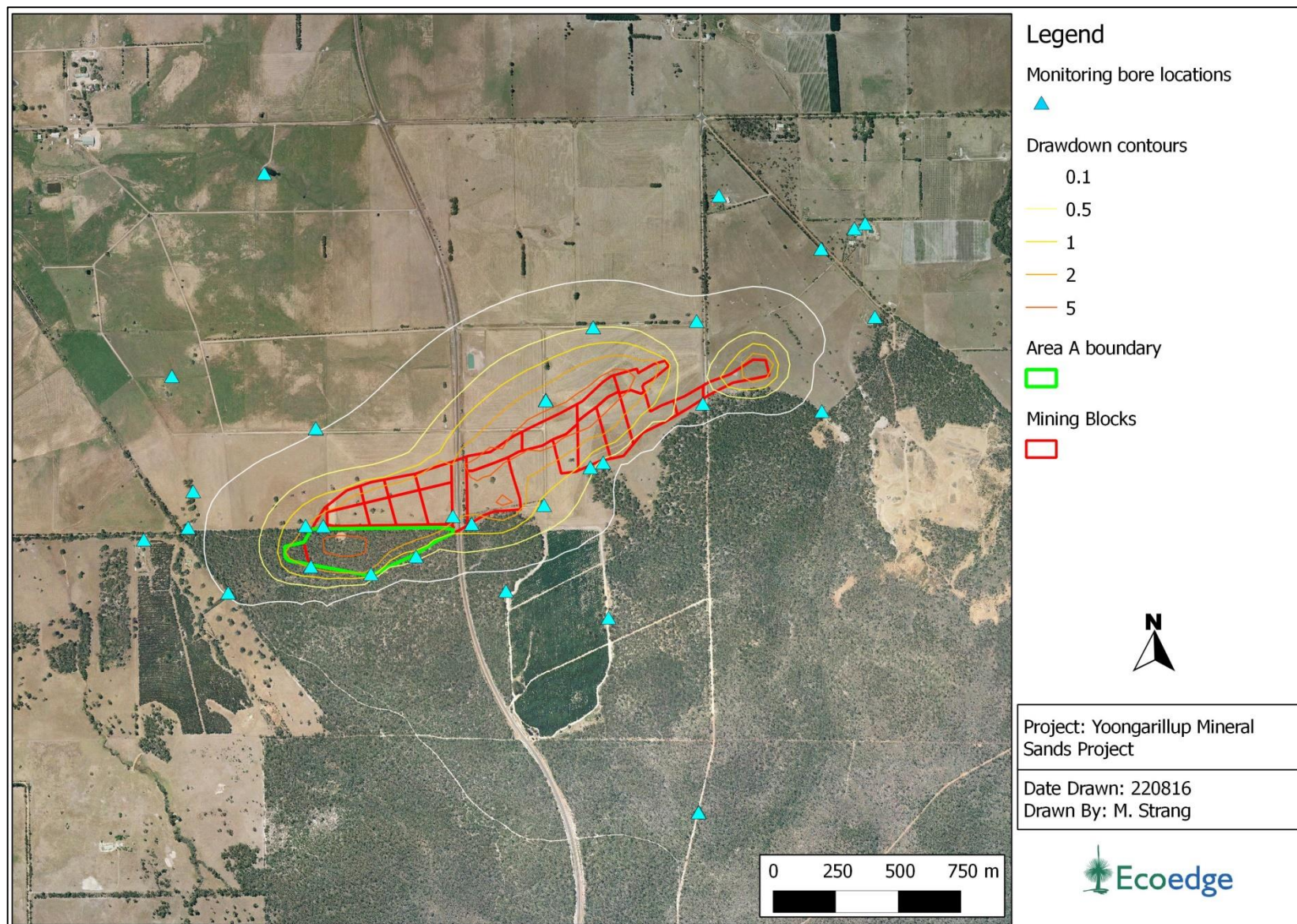


Figure 5. Location of existing and proposed groundwater monitoring bores in relation to predicted groundwater drawdown contours.

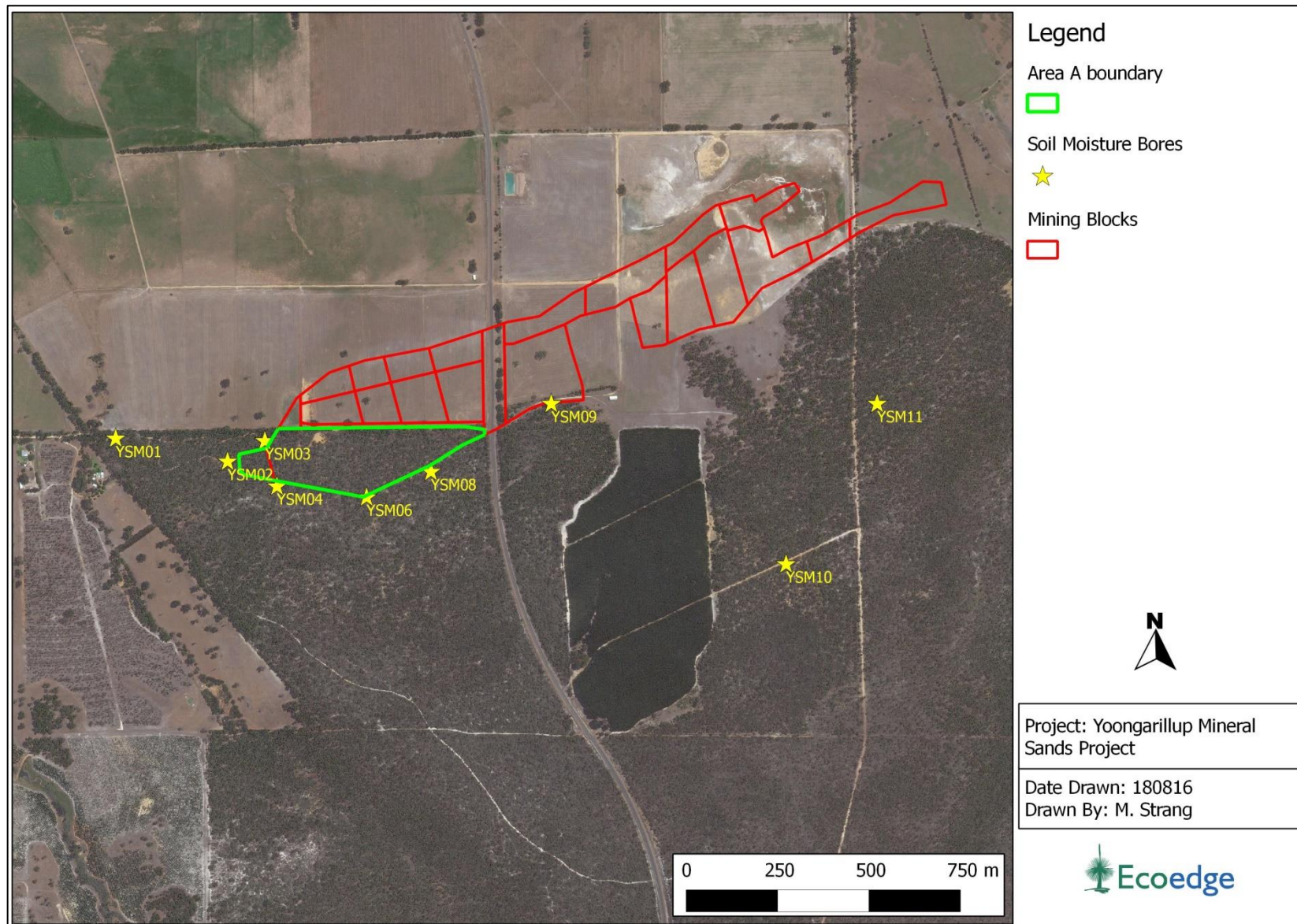


Figure 6. Locations of proposed soil moisture monitoring bores.

6 Fauna Management

Addressing MS1030 Conditions 7-2(2) and 7-2(3)

6.1 Closure Objectives

Minimise direct and indirect impacts on individuals and/or their habitat which may occur during proposed clearing works.

6.2 Description of Pre-mining State

According to (Harewood 2014), 110 black cockatoo habitat trees (trees with a diameter at breast height of ≥ 50 cm) were identified in Area A. 44 of these (~41%) were not observed to contain hollows of any size. Fifty six (~52%) contained one or more “small” hollows (~ less than 12cm entrance size) and at the time considered not to be suitable for black cockatoos to use for nesting purposes. Ten (~9%) trees contained hollows with larger entrances (~ greater than 12cm) that appeared big enough and orientated favourably to possibly allow the entry of a black cockatoo into a suitably sized branch/trunk, though none of the trees containing large hollows showed any evidence of current or past use by black cockatoos.

Besides the three species of black cockatoo, a range of other fauna species of conservation significance are likely or are known to occur within the development envelope, these being:

- Coastal Plains Skink (*Ctenotus ora*) – Priority 3
- Rainbow Bee-eater (*Merops ornatus*) – Schedule 5 and Migratory
- Cattle Egret (*Ardea ibis*) – Schedule 5 (JAMBA) and Migratory
- Great Egret (*Ardea alba*) - Schedule 5 (JAMBA) and Migratory
- Southern Brush-tailed Phascogale (*Phascogale tapoatafa ssp*) – Schedule 3
- Western Brush Wallaby (*Macropus irma*) – Priority 4
- Quenda (*Isodon obesulus fusciventer*) – Priority 4

An addition three species of local significance are also known to occur, these being:

- Speckled Stone Gecko (*Diplodactylus polyophthalmus*);
- Black-backed Hooded Snake (*Parasuta nigriceps*); and
- Forest toadlet (*Metacrina nichollsi*).

Note: For the purposes of this report the term black cockatoo is in reference to Baudin’s black cockatoo *Calyptorhynchus baudinii*, Carnaby’s black cockatoo *Calyptorhynchus latirostris* and the forest red-tailed black cockatoo *Calyptorhynchus banksii naso*.

6.3 Potential or Actual Impact

Previous survey work within and near Area A identified the presence of potential black cockatoo breeding habitat and a number of other conservation significant fauna (Harewood 2014). These species are the focus of the Fauna Management section of the Area A MP.

The ten trees that contained hollows with larger entrances, and possibly others, have the potential to be used for nesting, their removal may have a direct impact on black cockatoos. Other animals (e.g. possums) also use hollows of various sizes; as such, there is the potential for direct and indirect impacts on these resulting from the removal of trees.

The habitat of some of the other fauna species of conservation significance will be cleared. While the loss of this habitat is not likely to significantly impact on the overall status of any of these species, there is potential for individuals to be killed or injured during clearing operations.

6.4 Completion Criteria

- No trees containing hollows in current use by black cockatoos for nesting purposes felled/disturbed during clearing operations
- All hollow trees inspected for occupancy by other fauna species with animals encountered being captured and relocated or allowed to vacate of their own accord
- 100% of animals encountered in hollows will be relocated or allowed to move on of their own accord prior to felling
- 100% of trapped/captured fauna that is alive and well will be relocated prior to clearing
- Direct and indirect impacts on vertebrate fauna that are present during vegetation clearing will be minimise as much as reasonable and practicable

6.5 Management Actions for Achieving Completion Criteria

6.5.1 Fauna Management Personnel

The fauna management program detailed below will be carried out by one or more “fauna specialists” this being:

“a person who holds a tertiary qualification specialising in environmental science or equivalent, and has a minimum of 2 years work experience in fauna identification and surveys of fauna native to the region being inspected or surveyed, or who is approved by the DPaW District CEO as a suitable fauna specialist for the bioregion, and who holds a valid fauna licence issued under the *Wildlife Conservation Act 1950*.”

The “fauna specialist” will be responsible for the implementation of all aspects of the fauna management program including but not limited to:

- Pre-clearing indications and training to site personnel involved in clearing
- Obtaining relevant approvals and licences relating to fauna capture and handling
- Pre-clearing hollow assessment
- Pre clearing trapping
- Animal capture and handling during site clearing
- Post clearing reporting

6.5.2 Pre-clearing induction and training

Prior to the commencement of vegetation clearing and earthworks, the site supervisors and machinery operators will be inducted in fauna management procedures to ensure compliance with all relevant sections of this management plan.

This will include but will not be limited to:

- Details on individual trees or areas of vegetation that are to be retained/cleared;
- The importance of fauna and fauna habitats located on site including the fact that that all native fauna is protected by law;
- The need to implement an appropriate clearing technique to minimise the possibility that any fauna present maybe are injured or killed;
- Retention of remnant vegetation outside of the designated clearing area;
- Fauna protection and relocation to nearby native vegetation during clearing;
- Procedures to be implemented when fauna is encountered; and
- Mandatory requirement for fauna specialist 'spotting' during clearing.

6.5.3 Licencing

Fauna specialist personnel will obtain a "licence to relocate fauna" (Regulation 15) licence from the DPaW prior to the commencement of this work. The licence application will include if required a 'Translocation Proposal' for threatened fauna that maybe captured during the proposed fauna management program for review and approval by DPaW. The proposal will detail the number and types of animals likely to be captured and a preferred release site

6.5.4 Pre-Clearing Tree Hollow Assessment

Where possible, staged clearing will be undertaken to avoid the breeding season of black cockatoos. The breeding season for the three black cockatoo species generally occurs between July and February (which includes an incubation period of ~29 days and a nesting period of ~70 to ~75 days).

It is however possible for breeding to take place outside of this period and therefore, irrespective of when clearing is undertaken, and within a week prior to clearing commencing

the entire area to be cleared at during that stage will be inspected by a suitably qualified and experienced fauna specialist for evidence of black cockatoo breeding activity.

The primary focus of this inspection will be the trees previously identified during the fauna assessment (Harewood 2014) as containing potential large hollows, however all trees suspected of containing hollows of any size will be inspected for evidence of occupancy with particular emphasis on breeding black cockatoos.

Prior to clearing commencing all hollows will be physically checked for Black Cockatoos occupancy. This will be done either by a qualified tree climber, an elevated platform, extension ladder extendable mirror or a remote camera.

If a tree is found to be in use by black cockatoos, clearing in the area shall be immediately postponed. A 50 m wide exclusion zone will be created around the tree in questions where no activity is to take place until such time as the tree is confirmed to be no longer in use and on the advice of DPaW.

During this phase, all habitat trees (e.g. hollow bearing trees, potential hollow bearing trees and all other fauna containing habitat trees, including trees with nests, dreys and termitaria likely to be occupied by fauna) within the clearing zone will be clearly marked and recorded for reference during clearing operations. An appropriate course of action will be implemented prior to or during clearing to minimise the risk of harm to animals which may be inhabiting the structures question. Trees containing hollows confirmed as being in use by fauna may need to be left in place for a period of time in some circumstances. This will be at the discretion of the supervising fauna specialist.

6.5.5 Pre-Clearing Fauna Trapping

A fauna trapping program aimed at relocating as many fauna species present as reasonable and practicable prior to clearing taking place will be carried out. The focus of the trapping program will be conservation significant species (e.g. coastal plains skink, phascogales and quenda) in addition to more common species such as the brushtail possums, bobtails and snakes.

Trapping will take place over a minimum of five nights and will preferably commence in the week prior to clearing taking place. Traps will be progressively removed from the clearing area as vegetation removal advances.

The trapping will utilise a combination of cage, Elliott, pit and funnel traps. The exact number and configuration of traps will be at the discretion of the supervising fauna specialist but will be at a density sufficient to capture the primary target species.

Traps will be baited with “universal bait” (peanut butter, rolled oats and sardines) and will be checked within three hours of sunrise every morning. During clearing operations traps will be checked on a more regular basis.

Active searching of the site will also be carried out concurrent with the trapping program and will involve racking leaf litter, turning logs etc. while searching for fauna.

Captured animals will be relocated into the adjoining national park/state forest (subject to approval for DPaW), but at a distance to minimise the chances of recolonisation.

6.5.6 Site Clearing

Contact with DPaW should be made as soon as the date of commencement of site clearing works is known so as to ensure the appropriate DPaW personnel are notified i.e. Regional Wildlife Officer.

A suitably qualified and experienced fauna specialist will be present as a 'spotter' on site at all times when clearing is being undertaken to carry out any animal handling required.

During site works areas requiring clearing should be clearly marked and access to other areas restricted to prevent accidental clearing of vegetation to be retained.

All areas will be inspected by the fauna specialist in a targeted and systematic manner for the presence of fauna immediately prior to clearing. This will involve active searching of microhabitats and include the raking of leaf litter, turning logs and other debris while searching for fauna. Animals encountered will be captured and relocated.

Clearing works should be done in a direction that gives more mobile fauna the opportunity to move into retained vegetation adjoining the site.

As detailed in **section 6.5.3**, all hollows will be physically checked for occupancy prior to being felled. This will be done either by a qualified tree climber, an elevated platform, extension ladder extendable mirror or a remote camera. If a hollow is found to be occupied an attempt to capture the animal will be made. If it is not possible to remove fauna from a hollow the tree will be left standing for at least one night to provide the opportunity for the animal to move on its own accord.

All hollow bearing trees will be felled, if possible, in a manner that minimises the chance of any fauna species inhabiting the hollows being injured or killed. This will include felling trees in a direction where hollow entrances are facing upwards and lowering trees to the ground using an excavator equipped with a tree grabber as opposed to pushing the trees over with no restraint.

Hollows within felled trees will be examined for fauna species immediately after felling and animals will be captured and relocated if present.

Stockpiling should be sited as far away from retained bushland as possible. Workers involved in the removal of stockpiled material should be made aware that displaced fauna may shelter within piles of vegetation.

If fauna is found to be present in stockpiles the fauna specialist on site should attempt to catch the animal so it can be relocated nearby. Dreys found should be removed from any trees that are to be stockpiled. If stockpiles are removed in the absence of the fauna specialist and a WRP is encountered, then the DPaW should be notified by those involved.

The attending fauna specialist will have appropriate equipment to administer immediate emergency care to any injured/displaced fauna (e.g. calico bags, box/cage).

Native fauna injured during clearing or otherwise considered unsuitable for relocation (e.g. bird nestlings) will be taken to the pre-designated veterinary clinic or a DPaW nominated wildlife carer (DPaW's Wildcare 24hr hotline number is 9474 9055).

The clearing site and associated infrastructure will be maintained in a clean and tidy state to ensure that feral or other animals are not attracted to the site. All rubbish, in particular putrescibles waste (i.e. foodscraps) are not expected to be present however will be removed from the site on a regular basis if required.

Where practical tree hollows, hollow logs, stags and stumps salvaged from clearing activities will be retained and used for site rehabilitation to provide microhabitat structures. These will contribute to the faster establishment of ecosystem reconstruction on rehabilitated areas and provide habitat and shelter for fauna using and traversing the rehabilitation areas.

After initial site works are complete, a fauna exclusion fencing will be installed around the final clearing area.

6.5.7 Review of Management Actions

Review specified management actions after the trapping program is completed to assess for its comprehensiveness, and again during clearing. Revise management actions and clearing methodologies as necessary to ensure the consistent achievement of Completion Criteria.

6.6 Key Performance Indicators

- Number of trees containing hollows in current use by black cockatoos for nesting purposes that are felled/disturbed during clearing operations.
- Proportion of individuals of other fauna species encountered in other hollow bearing trees that are captured and relocated or allowed to vacate area of their own accord
- Proportion of animals captured/trapped that are relocated prior to clearing
- % of deaths and injuries recorded against total number of individuals captured and relocated or allowed to vacate area of their own accord

6.7 Monitoring to Assess Against KPIs

Onsite supervision during clearing shall effectively act as continuous monitoring.

6.8 Contingency Measures

The effectiveness of the management measures employed will be monitored continuously during clearing works. If it becomes clear that some methods being used are ineffective or can be improved, then site works should be ceased (if warranted) and new processes developed/implemented as required.

6.9 Reporting

A post clearing fauna relocation report will be prepared by the attending fauna specialist. This will detail methods employed and the results including a list of the species and number of animals encountered/captured (including deaths and injuries).

7 Weed Management

Addressing MS1030 Condition 7-2(9)

7.1 Closure Objective

No evidence that new weed species⁴ (environmental and declared) are persisting or that weed competition is restraining sustainable establishment of native species.

7.2 Description of Pre-mining State

Observations of Area A show that the area is relatively weed free with no declared weeds observed (A. Reeves, pers comm., August, 2016). Weed cover will be quantified in baseline surveys undertaken in autumn and spring, 2017.

Weed intrusion is minor along the Goulden Road access track between Area A and the farm land to the north. Pasture renovation has recently been undertaken on the farm land which has considerably reduced the weed burden. This in turn will limit the potential for weed intrusion into Area A from the agricultural pasture.

The introduced species present in disturbed areas within Area A are limited to annual weed species such as *Arctotheca calendula* (capeweed) *Hypochaeris radicata* (flatweed), *Cotula turbinata* (funnel weed) and *Poa annua* (winter grass). Significantly, invasive perennial environmental roadside weed species and bulb weed species are absent from the site.

7.3 Potential or Actual Impact

Introduction of new weed species and spread of existing weeds beyond their current extent.

7.4 Completion Criteria

- No new weed species (environmental or declared) introduced into Area A
- Within 5 years of rehabilitation, mean weed cover in 25 m² monitoring sub-quadrats is no greater than 150% of baseline levels

⁴ A naturalised non-indigenous plant species, that adversely affects the health, survival or regeneration of local provenance indigenous plant species in Doral Mineral Sands rehabilitation and unmined forest

7.5 Management Actions for Achieving Completion Criteria

Weed hygiene measures will largely correspond to those instigated to control the spread of *Phytophthora* Dieback. These are covered in detail in **Section 8**.

Access to Goulden Road will be blocked in the first quarter of 2017 to help manage *Phytophthora* dieback and weed risks.

The first 10 m within the northern boundary, along Goulden Road, has some of the highest densities of weeds within Area A. In order to be able to salvage and reuse topsoil from this portion of Area A that is not infested with *Phytophthora* dieback without compromising rehabilitation, vegetative material and topsoil stripped from this area will be stored separately. Prior to clearing, and as soon as the requested Regulation 4 permit is issued or approval under Ministerial Statement 1030 is granted, whichever occurs first, weed control will be undertaken within this area to minimise flowering and seed set, and will continue regularly until clearing occurs.

Mattiske (2012) recorded an observation of the declared weed *Zantedeschia aethiopica* (Arum Lily) in State Forest east of Sues Road. These locations have been digitised from survey data, and are shown in **Figure 7**. Doral is willing to actively control these infestations in consultation with DPaW.

In accordance with a DPaW Regulation 4 permit (yet to be granted), the interface between Area A and the agricultural land will be sprayed on or before 31st October 2016 with a very low concentration knock down herbicide such as glyphosate to kill all weed species with the intention to prevent flowering and the production of viable seed.

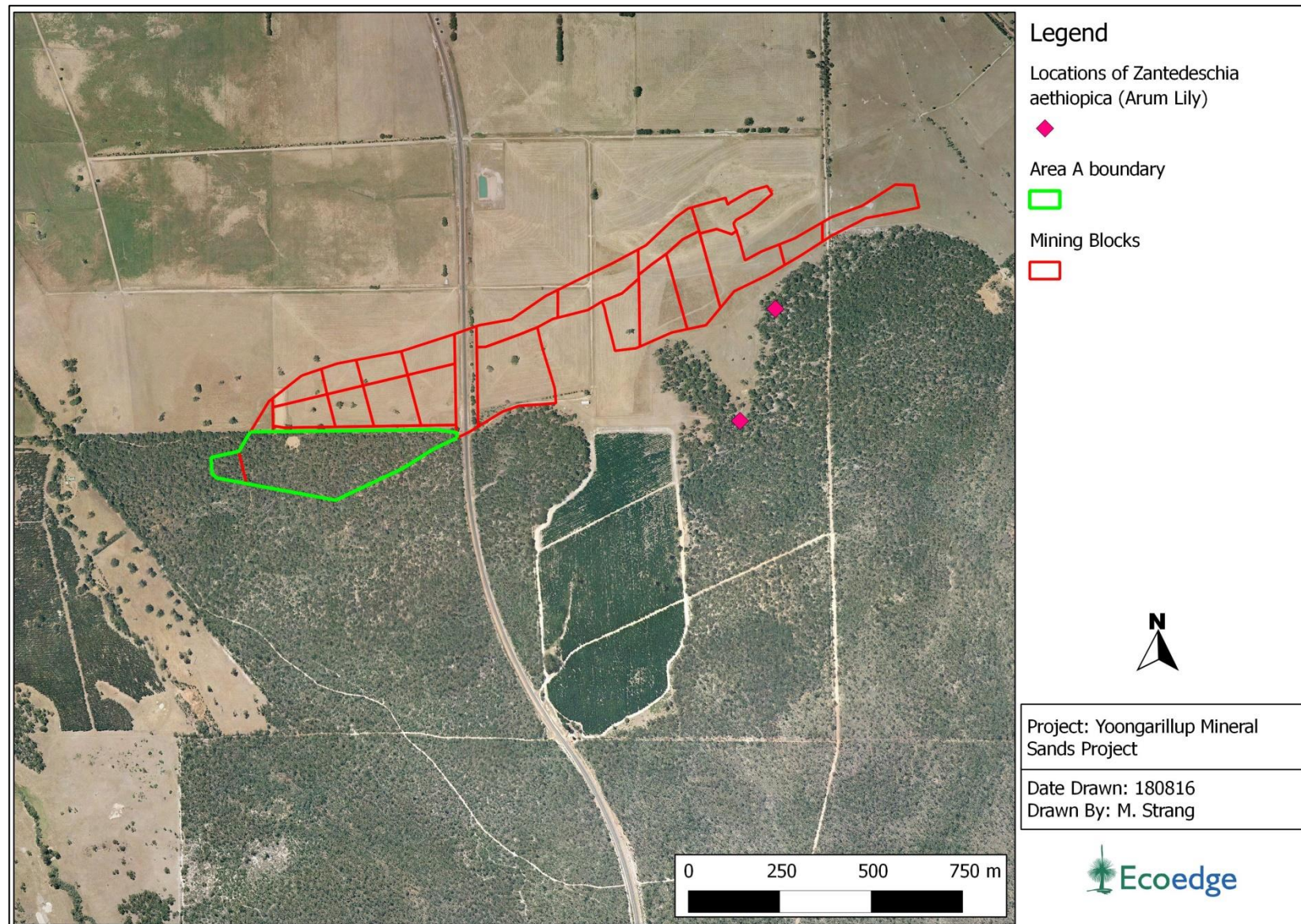


Figure 7. Location of *Zantedeschia aethiopica* (Arum Lily), digitised from records taken by Mattiske (2012).

A chemical fire break will be used around the active mining site as required to kill weed species to prevent seed set. Where practical selective herbicides i.e. Fusilade, will be used to kill grass weeds.

In sensitive areas, a 'weed wiper' or 'rope wick applicator' will be used to apply herbicides directly to weed species to avoid herbicide overspray or drift onto native species.

Immediately upon construction of the fence, and for the duration it remains in place, full height shade cloth will be attached to the fence on all sides of Area A to minimise windblown viable plant reproductive material from weed species and other edge effects (wind, dust, light, etc) impacting on vegetation in SF33 south of Area A.

7.6 Key Performance Indicators (KPIs)

- % weed cover in 25 m² monitoring quadrats
- Presence of previously unrecorded weed species

7.7 Monitoring to Assess Against KPIs

In order to assess the presence of weeds within Area A prior to clearing, monitoring of weed and native species cover and abundance will be undertaken in autumn and spring 2017 using stratified random sampling of 5 x 5 m quadrats placed along four transects 160 m to 280 m long, passing north-south from the edge of the private property and extending least 120 m into SF33⁵ (**Figure 8**). The quadrat size of 25 m² has been chosen to facilitate more accurate estimation of herbaceous species cover/abundance. The non-native species currently occurring in the Doral mining lease SF33 are all herbaceous taxa (Ecoedge, 2014). For a more detailed description of the weed monitoring transects, see **Appendix 3**.

Prior to the period of mine operation (pre-rehabilitation), the section of the transects within Area A will form part of the Area A Management Plan. Following rehabilitation of Area A, fifteen permanent 100 m² floristic monitoring quadrats will be set up in Area A as part of the Area A Management Plan (see **Section 9.4.8**). Within each of these, a 5m x 5m sub-quadrat will be used to more closely monitor the cover and abundance of herbaceous species (both native and exotic).

Within the monitoring program, weed cover and abundance will be assessed biannually, in spring and autumn.

Monitoring data will be collected and analysed to determine weed species present and the average mean weed cover and abundance within each quadrat. This information will guide

^{5 5} In this document "SF33" refers to that part of the State Forest sub-area of Doral mining lease M70/459 (Doral Mineral Sands, 2014) that is outside of Area A as defined in Ministerial Statement 1030 (Government of Western Australia, 2016).

management actions to control weed infestations, and enable the comparison of weed presence within Area A pre- and post-mining.

7.8 Triggers

Triggers:

- Mean weed cover in 25 m² monitoring quadrats reaches 150% of baseline levels
- Any new weed species being found with Area A

Response:

- Increase frequency of weed treatments
- Review and revise weed control methods as necessary

7.9 Contingency Measures

Weed control methods such as chemical application will be modified as required to achieve the best practice solution. The use of targeted spray application and adaptive techniques such as weed wipers or rope wick technology will be implemented where required to selectively treat weeds.

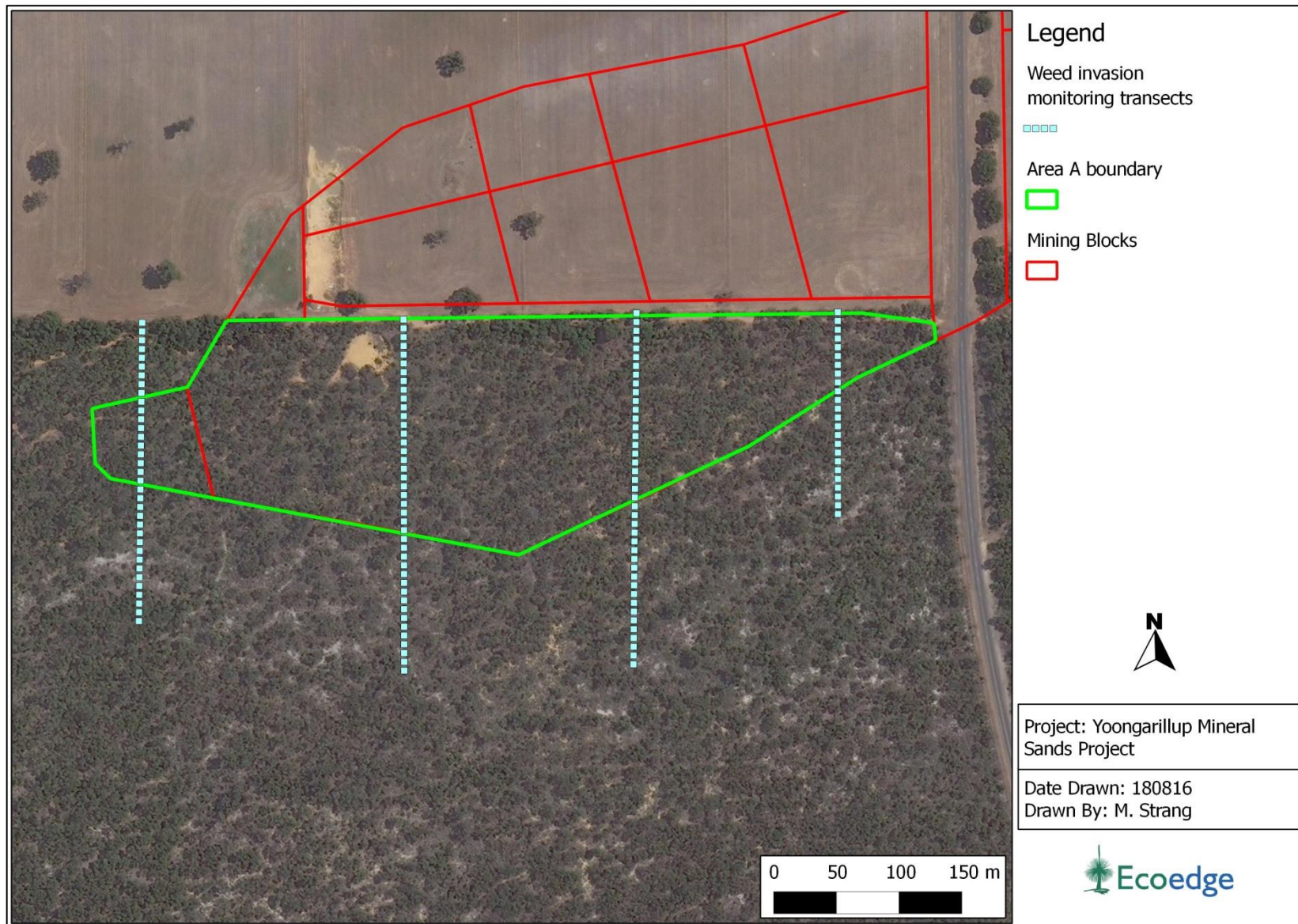


Figure 8. Locations of weed monitoring transects.

8 *Phytophthora* Dieback Management

Addressing MS1030 Condition 7-2(9)

8.1 Closure Objective

At the cessation of mining, parts of Area A mapped in 2016 as 'uninfested' will remain unaffected by *Phytophthora* dieback. This will be measured through *Phytophthora* dieback mapping post-mining in consultation with DPaW.

8.2 Description of pre-mining state

DPaW were engaged in July 2016 to re-interpret the site for *Phytophthora* Dieback and update the 2012 dieback mapping.

The majority of the assessment area was found to be uninfested (DPaW, 2016b). Uninfested areas had a dominant second storey of healthy *Banksia grandis*, *Banksia attenuata*, *Persoonia longifolia* and pockets of *Xylomelum occidentale*. The understorey contained an abundance of healthy indicator species including *Adenanthos barbiger*, *Hakea* sp., *Isopogon* sp., *Leucopogon* sp., *Patersonia* sp., *Xanthorrhoea gracilis* and *Xanthorrhoea preissii*.

Four infestations were mapped within Area A. Disease distribution is mostly associated with tracks intersecting Area A and water pooling on the northern boundary track (Goulden Road). Two infested areas occur along the northern boundary, one in the south west and one in the eastern third of Area A (**Figure 6**).

All tracks intersecting uninfested forest are categorised as Disease Risk Roads.

8.3 Potential or Actual Impact

If specified management actions are not followed, there is the potential for *Phytophthora* Dieback to be spread throughout Area A. This would result in a significant reduction in the variety and number of species likely to ever re-establish in Area A, compromising the quality, diversity and potentially the resilience of the recreated vegetation community and fauna habitat, and also potentially increasing the risk of erosion through decreased vegetation cover.

It is unlikely that species diversity targets would be attained if *Phytophthora* Dieback infested a large proportion of Area A.

8.4 Completion Criteria

- Assessed 5 years after rehabilitation of native vegetation, the area of *Phytophthora* Dieback mapped within Area A is no larger than that was mapped in 2016

This completion criteria has been set based on the proposal to deep-bury all known infested topsoil, subsoil and vegetative material (as mapped by DPaW in August 2016 including the

mapped 40 m buffer), and to only replace topsoil from mapped Disease Risk Roads (according to DPaW, 2016b) back to the same location (Goulden Road track). Under this proposal, and provided appropriate hygiene measures are in place and observed, it is considered unlikely that the size of dieback infestations will reach current (2016) levels within the proposed 5 year timeframe for monitoring of rehabilitation; as such this is considered a reasonable completion criteria.

8.5 Management Actions for Achieving Completion Criteria

It is proposed that overburden from one of the mining blocks east of Sues Road that has a similar clay content to that in Area A will be used in the soil profile reconstruction within Area A. Investigations undertaken by Doral show that soil material suitable for use as overburden occurs in the soil profile of these blocks between the depths of 1.5 – 7 m. Prior to use in rehabilitation, soil samples from these blocks will be sent to Murdoch University's Centre for *Phytophthora* Science and Management for testing to determine their *Phytophthora* status. No overburden from these blocks would be used in Area A soil profile reconstruction unless it is known to be dieback free. Should any *Phytophthora* species be isolated from these samples and none of this overburden be suitable for use, a homogeneous mix of co-disposed sand and clay tails would need to be used in soil profile reconstruction.

A *Phytophthora* Dieback Management Plan will be developed in October 2016 to reflect the results of the August and October 2016 surveys. The following management actions have been identified as a minimum to manage the dieback infestations within Area A.

No equipment or plant will enter State Forest 33 beyond the boundary of Area A.

Immediately upon taking access of the site, all infestations will be clearly demarcated onsite with flagging tape and/or bunting and signage around their perimeters. This demarcation will remain in place until clearing occurs. The demarcated area will be checked monthly to ensure flagging tape remains in place.

Goulden Road, which is known to be infested in the western portion, will be blocked as soon as possible, currently likely to be in the first quarter of 2017.

Clearing of vegetation and stripping of topsoil and subsoil/overburden from Area A will be undertaken in dry conditions in summer.

Respreding of topsoil and subsoil/overburden will occur in autumn, under dry conditions.

All vegetation, topsoil and root matter from infested areas (**Figure 9**), potentially excluding some which, if DPaW agree, would be retained to undertake treatment trials (see **Section 8.5.1.1** below), will be removed and deep-buried in one of the mine pits in the paddock area west of Sues Road, outside of Area A.

In order to reduce the threat of *Phytophthora* dieback whilst maximising the topsoil resource available for use in rehabilitation, it is proposed that topsoil from undetermined 'Disease Risk Roads' (**Figure 9**), including parts of Goulden Road, plus a 10 m buffer either side, will be removed and stockpiled on sterile, weed free sand tails on either Block 15 or Block 17, and stored there for potential reuse. The potential re-introduction of this topsoil back into Area A would be assessed by Doral during topsoil replacement. Should it be required to achieve topsoil targets, it would only be placed along the Goulden Road track, which was designated as a 'Disease Risk Road' by DPaW (2016).

All Doral field staff and earthmoving contractors and will be educated during site induction and weekly meetings regarding the presence of dieback, access and movement restrictions, signage recognition and necessary hygiene measures to minimise the risk of contaminating the dieback free areas.

Surface water movements, such as around topsoil stockpiles, will be controlled to prevent flow to un-infested areas.

Vehicle movements between infested and un-infested areas will be restricted, and all vehicles will be cleaned before entering uninfested areas. Where possible, clean machinery will be kept inside Area A once it is inside, i.e. reducing all vehicle movements in and out of the protected area as much as possible.

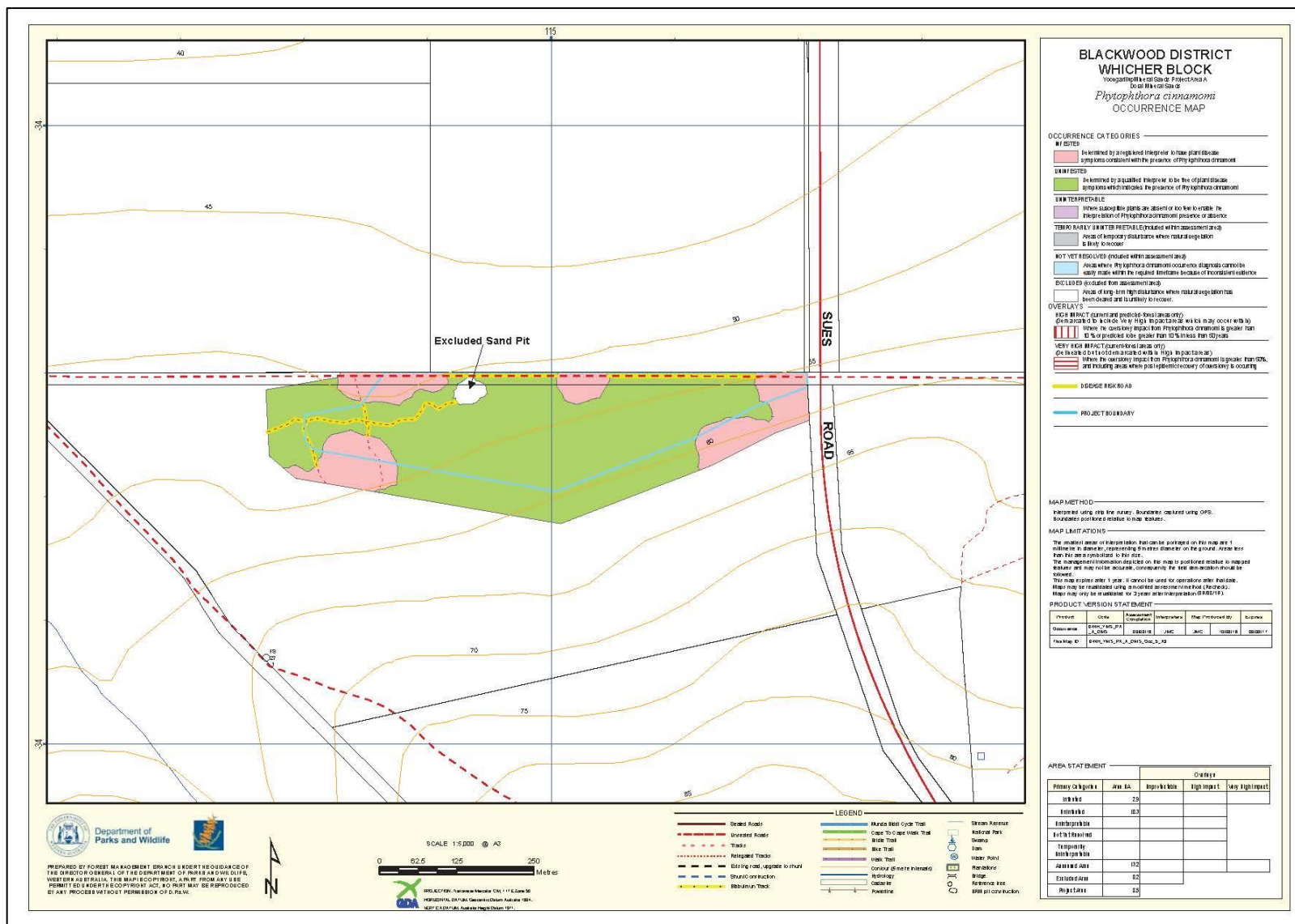


Figure 9. *Phytophthora* occurrence map, showing the locations of Disease Risk Roads in yellow.

Clean on entry point(s) and other hygiene measures will be established as recommended in the Dieback Management Plan.

Specified management actions will be reviewed quarterly and revised as necessary to ensure the consistent achievement of Completion Criteria.

8.5.1.1 Proposed Trial

Doral proposes that during mining operations, a trial is undertaken to determine whether management actions exist that could render infested topsoil or subsoil uninfested. It is proposed that some of the infested topsoil from Area A be retained and moved to cleared farmland east of Sues Road. There, a variety of methodologies including the application of fungicides, heating, composting and other options would be applied to the soil to see whether any of these are successful at eradicating *Phytophthora* dieback. It is possible that this trial may be undertaken in consultation with Main Roads Western Australia staff, who are proposing a similar trial for lateritic soils.

8.6 Key Performance Indicators

Area of *Phytophthora* dieback present within Area A 5 years post rehabilitation

8.7 Monitoring to Assess Against KPIs

Prior to clearing, the demarcated 'Infested' areas will be checked monthly to ensure flagging tape/bunting remains in place.

In rehabilitated vegetation, monitoring for *Phytophthora* Dieback would be carried out using visual assessment of susceptible species within the floristic monitoring quadrats and opportunistically, plus sampling followed by laboratory testing of any recent deaths of susceptible species.

8.8 Trigger

Trigger: Detection of *Phytophthora* Dieback

Response: Implementation of contingency measures

8.9 Contingency Measures

Should *Phytophthora* Dieback be detected in Area A post rehabilitation, and affect or compromise the success of rehabilitation such as through significantly reducing native species cover, revegetation with native species resistant to the pathogen would be undertaken to ensure that native species cover targets, as detailed in **Section 9.4.5**, are achieved. The application of phosphite at recommended rates would also be investigated as a contingency response.

9 Rehabilitation

9.1 Clearing and Salvage of Vegetative Material

Addressing MS1030 Conditions 7-2(6)

9.1.1 Closure Objectives

Vegetative material potentially valuable for use in rehabilitation is salvaged from the Area A prior to mining.

9.1.2 Potential or Actual Impact

Failure to salvage vegetative material potentially valuable for use in rehabilitation from Area A prior to mining could lead to a reduction in the quality of rehabilitation, in terms of species diversity and plant vigour and health, as well as increased effects on rehabilitation from erosion.

9.1.3 Completion Criteria

- No less than 26 kg of local provenance seed mixed from the species listed in **Appendix 2**, treated to maximise the likelihood germination, is available for use in direct seeding
- The mix of species within Area A rehabilitation is comprised of species recruited from topsoil and species introduced through direct seeding and species introduced as tubestock grown from seed, cuttings or whole plants salvaged from Area A

9.1.4 Key Performance Indicators

- Number of kilograms of seed available for use
- Species diversity and composition within Area A rehabilitation

9.1.5 Management Actions for Achieving Completion Criteria

Seed for use in rehabilitation will be collected from as many Area A species as possible during the summers of 2016/2017 and 2017/18. A comprehensive species list for Area A, compiled from Matiske (2012) and Ecoedge (2014), is included in **Appendix 1**. Species to be targeted for seed collection, based on an analysis of those species present within Area A that would be feasible to collect from and expect to perform well in direct seeding, with an emphasis on 'keystone' species, are listed in **Appendix 2**. Seed will be collected via use of a combination of pole pruners, secateurs and manual removal. As the vegetation will be cleared, as much seed as can be taken will be taken. Seed will be processed at a Revegetation Industry Association of Western Australia accredited facility, where it will be placed in a drying house to simultaneously encourage seed drop and discourage predation, then fine-cleaned using a thresher and/or vacuum separator. Seed will then be fumigated, sealed into airtight bags, labelled (date, collection location, genus, species) and placed in a temperature-controlled storage facility until rehabilitation.

Vegetative material in the form of cuttings and whole plants from *Phytophthora* free areas (in the case of monocots) will be taken for 'Keystone' and other species listed in **Appendix 2** that are unlikely to perform well in the rehabilitation from direct seeding. These will be taken to a Nursery Industry Association accredited nursery for propagation by cuttings or division or other methods as required. These plants would be introduced in the rehabilitation as tubestock.

Vegetative material also includes removed tree crowns and small woody debris. It is intended that this material will be retained and used in the rehabilitation.

It is intended that clearing of vegetation will take place in the summer of 2017/2018, and be carried out as follows:

- Trees with hollows felled selectively on an initial pass to minimise potential risk of damage to nesting fauna (refer **Section 6** for more information regarding fauna management)
- Trees cleared with the tree-arm of a D7 bulldozer
- Within approximately 25 m of the boundary of Area A, as required, a chainsaw will be used to directionally fell timber inside Area A, thus ensuring no damage occurs to vegetation outside of Area A
- Crowns of trees with a trunk height under 100 mm removed with a chainsaw
- Logs removed from the clearing area with an IT loader or similar
- Vegetative material on the ground, including removed tree crowns and small woody debris, crushed via track-rolling and screened in-situ with a D6 bulldozer, taking care to minimise any disturbance to topsoil.
- Vegetative material stockpiled for use in Area A rehabilitation
- Millable timber retained offsite for reuse where possible. Approximately 10-15 % of the logs – those most suitable for use as habitat - set aside for use in rehabilitation, with the remainder mulched
- Tree mulch disposed of (will not be used in the rehabilitation of Area A)
- *Xanthorrhoea* species salvaged where possible for reuse in rehabilitation
- PVA glue-on or equivalent *Phytophthora* dieback free soil stabilising sealant will be used to seal the Area A land surface post clearing to minimise dust

9.1.6 Monitoring to Assess Against KPIs

- Ongoing monitoring of seed collection actual numbers vs targets to ensure seed from a wide variety of species, and especially from 'Keystone' species, is available for use in rehabilitation

- Onsite inspections undertaken during clearing to ensure as much valuable material is collected and stockpiled as possible
- Monthly visual monitoring of stockpiles to ensure weed cover is kept to a minimum

9.1.7 Triggers

Trigger: Less than 14 kg of seed is collected in the spring/summer of 2016/17

Response: Seed collecting program for 2017/18 summer is expanded to include more collecting days and/or more areas to collect from

Trigger: There are species listed in **Appendix 2** that cannot be collected in the spring/summer of 2016/17, or it is unlikely that they will be collected in sufficient quantities

Response: **Appendix 2** is revised to include other species that were present in Area A prior to clearing that may be able to be successfully included in rehabilitation via cuttings or other vegetative material

Trigger: Presence of weeds in or around vegetative material stockpiles

Response: Undertake weed control; revise weed control program if required.

9.1.8 Contingency Measures

- Should insufficient native seed be collected, or should the seed collected not be viable, additional local provenance seed shall be purchased to ensure there is sufficient quantity available to achieve a high standard of rehabilitation
- Should tubestock planted in year 1 not survive, an arrangement with a local nursery is made to grow additional tubestock from locally collected seed
- Should insufficient vegetative material be available for rehabilitation or should storage conditions compromise the use of material collected from Area A, additional, certified *Phytophthora* dieback free and weed free mulch/vegetative material/compost shall be brought in to improve the likelihood of success of rehabilitation.

9.2 Return of Soil profiles and Landform

Addressing MS1030 Conditions 7-1 and 7-2(8)

9.2.1 EPA Objective

The EPA Objective for the Landforms Key Environmental Factor is “To maintain the variety, integrity, ecological functions and environmental values of landforms.” A description of the management approach that has been developed to achieve this objective is described in this section.

9.2.2 Pre-Mining State

Area A is situated on the lower slopes of the Whicher Scarp and comprises a gentle slope that ranges from about 60 m ASL on the southern boundary to 50 m ASL in the northwest corner. Slopes range from 2.0° in the western part of Area A to 3.5° in the eastern part. A broad, shallow swale is present at the western extremity of Area A.

9.2.3 Description of Proposed Works

All of Area A, except for a (4 m) buffer around the boundary, will be progressively excavated to a depth of up to 7.4 m. Topsoil to a depth of 100 mm from areas known to be *Phytophthora* dieback free, 'Disease Risk Roads' plus their buffers and subsoil/overburden⁶ to a depth of 150-200 mm will be stripped from and stockpiled within Area A. The remaining underlying ore will be transported outside of Area A for the removal of the mineral sands component. Backfilling of the pit will involve return of sand and clay tails, overburden, subsoil and then topsoil to re-establish the landform.

No subsoil or overburden from Area A that is retained for use in the rehabilitation of Area A will be taken outside of Area A or processed in any way. Only material from Area A will be stockpiled within Area A.

It is proposed that overburden from one of the mining blocks east of Sues Road that has a similar clay content to that in Area A will be used in the soil profile reconstruction within Area A. Investigations undertaken by Doral show that soil material suitable for use as overburden occurs in the soil profile of these blocks between the depths of 1.5 – 7 m. Prior to use in rehabilitation, soil samples from these blocks will be sent to Murdoch University's Centre for *Phytophthora* Science and Management for testing to determine their *Phytophthora* status. No overburden from these blocks would be used in Area A soil profile reconstruction unless it is known to be dieback free. Should *Phytophthora* species be isolated from these samples and none of this overburden be suitable for use, a homogeneous mix of co-disposed sand and clay tails would need to be used in soil profile reconstruction.

According to the current mine schedule, overburden from these blocks would be direct transferred to Area A; no storage will be required.

All aspects of landform reconstruction will be carried out by a GPS bulldozer. This allows sufficient accuracy as to be able to recreate the pre-mining topography. After reconstruction, the entire area will again be GPS surveyed to verify that it has been returned to pre-mining topography, and also for subsidence monitoring. Subsidence monitoring will be measured periodically, for instance, after 12 months, and repairs made as required. As the recreated Area A landform will consist of sand tail return and not overburden to depth,

⁶ Note that subsoil is not able to be salvaged from most of Area A as ore is present at or very near to the land surface. Where it and any overburden is present, this will be stripped (i.e. removed) and stockpiled in Area A for use in rehabilitation. As this material is not true 'subsoil', it is referred to as subsoil/overburden.

the risk of subsidence is reduced. Ripping will be undertaken on the contour to prevent erosion.

9.2.4 Closure Objectives

9.2.4.1 Landform

- Final landform is suitable for continued use of the area as State Forest
- The land surface is returned to a level and slope as close as possible to the pre-mining state and is integrated into the surrounding undisturbed landscape
- Soils and landforms exhibit topsoil erosion levels that are consistent with surrounding areas and do not compromise the intended rehabilitated native vegetation land use

9.2.4.2 Soil Profile

- Overburden returned to the Area A mine pit will have a similar clay content to the pre-mining soil substrate
- At a minimum, the top 50 mm and generally the top 70 mm, of the recreated soil profile will consist of replaced Area A topsoil

9.2.5 Potential or actual impact

9.2.5.1 Landforms

Failure to return the soil surface within Area A to the pre-mining slope may lead to an increase in the potential for subsidence and erosion. There may also be an impact to visual amenity if land surface post-mining doesn't blend in with the surrounding landscape.

9.2.5.2 Soil Profile

The original soil profile, to a depth of up to 7.4 m will be destroyed by the mining operation and will be re-constructed during the post-mining backfill of the pit. Changes to the hydrological characteristics, nutrient retention characteristics or erodibility of the soil may occur and could have a detrimental impact on the success of revegetation of Area A.

9.2.6 Completion Criteria

9.2.6.1 Landform

- The slope of the re-created landform is within acceptable limits (+/- 1.0° of pre-disturbance levels)
- The re-created landform is able to support native vegetation
- No erosion or subsidence maintenance is required after 4 years (assessed based on monitoring and maintenance logs)

9.2.6.2 Soil Profile

- Soil physical, chemical and biological characteristics will be consistent with those of the pre-mining soil profile in Area A
- The capacity to retain water and nutrient resources is equivalent to the pre-mining soil profile in Area A
- Soil to the depth of reconstruction has similar pH and salinity as the pre-mining soil profile in Area A

9.2.7 Key Performance Indicators

9.2.7.1 Landform

- Slope of the recreated landform is consistent with pre-mining topography
- Survival of native vegetation
- Number, depth and area of erosion or subsidence zones

9.2.7.2 Soil Profile

- Soil physical, chemical and biological characteristics, including capacity to retain water and nutrient resources, soil pH and salinity

9.2.8 Management Actions for Achieving Completion Criteria

Where possible, progressive pit backfill from subsequent stages will be implemented to allow for direct placement of materials into earlier stages.

It is intended that the return soil profile will be constructed as shown in **Figure 10** and described below, beginning at the land surface:

- 50 - 70 mm topsoil⁷
- 150-200 mm subsoil/overburden (see footnote on p. 52)
- ~1-2 m overburden (from a mining block east of Sues Road)
- ~5-6 m sand tails / clay co-disposal

Sand tails will be hydraulically returned to within between 1.4 and 2.4 m of the final rehabilitation surface. Unprocessed overburden from a mining block east of Sues Road, which has a clay content similar to that found in Area A, will then be added. This will provide a higher quality rooting substrate than co-disposed sand and clay tails. The entire site will then be ripped along the contour to a maximum depth of 400 mm.

⁷ Topsoil from uninfested forest will be stripped to a depth of 100 mm. Topsoil from areas at risk of being infested, primarily Dieback Risk Roads will be stripped to a depth of 100 mm and stockpiled separately for possible use, such as along the Goulden Road track. Topsoil from areas known to be infested with *Phytophthora* dieback will be deep buried in one of the mine pits east of Sues Road. As such, the amount of topsoil remaining to be used in rehabilitation will not be sufficient to provide a final depth of 100 mm, and has instead been calculated to achieve an average depth of 70 mm.

Stockpiled subsoil/overburden from Area A will then be respread, followed by stockpiled topsoil. The site will then be ripped to a maximum depth of 200 mm. Reid *et al.* (2004) studied plant abundance and diversity for plots that were ploughed or deep-ripped and plots that were scarified, and found that plots that were deep ripped recorded the greatest plant abundance and diversity.

The proposed approach above has been designed to enable ripping the soil substrate to break up any compaction layer(s) while minimising the likelihood of weed seed-laden soil from the mining block east of Sues Road being brought to the surface.

Up to 100m³ of topsoil from Area A may be retained within Area A for use in erosion repair and mitigation. Note that it is unlikely this will be required due to the lag between soil profile reconstruction to subsoil, anticipated to be finalised in December 2018 and the placement of topsoil, anticipated to occur in the following autumn. Any settling or subsidence that has occurred prior to topsoil placement will be repaired prior to topsoil placement. Prior to topsoil placement, an assessment of land surface stability will be undertaken, and should it prove to be stable, no topsoil would be retained, and instead all would be used in the rehabilitation

A surface elevation survey will be carried out to confirm slope and land surface elevation pre-mining and post-mining. The post-mining survey will be carried out before the spreading of topsoil.

Inspections and subsequent corrective actions will be undertaken to control erosion to ensure minor erosion does not escalate to create significant damage to the landform.

Specified management actions will be reviewed during implementation and revised as necessary to ensure the consistent achievement of Completion Criteria.

9.2.9 Monitoring to Assess Against KPIs

9.2.9.1 Landform

Survey of slope after rehabilitation of landform, and again at 12 months and further as required to assess variance with pre-mining levels.

Subsidence and erosion monitoring, utilising both GPS surveyed ground surface markers and visual inspection, will be undertaken bi-annually for at least three and up to four years to identify and enable the remedy any affected areas.

9.2.9.2 Soil Profile

A detailed soil survey similar to the pre-mining survey will be carried out 6 to 12 months after rehabilitation has been completed to assess the soil characteristics against KPI levels.

9.2.10 Triggers

Trigger: 2 months after land form is rehabilitated and prior to placement of topsoil, land slope is more than $\pm 2.0^\circ$ of pre-disturbance levels

Response: Land surface is re-contoured. Additional certified *Phytophthora* dieback free and verified weed free material is brought in where required

Trigger: Erosion or subsidence maintenance continues to be required after 2 years

Response: Underlying issues that may be causing instability are investigated and addressed

Trigger: 2 months after recreation of soil profile, soil physical, chemical and biological characteristics, pH, salinity and/or the capacity to retain water and nutrient resources are inconsistent with those of the pre-mining soil profile in Area A

Response: Underlying issues that may be causing inconsistency in soil characteristics are investigated and addressed

Trigger: Within 6 months of rehabilitation of native vegetation, the re-created landform is not able to support native vegetation

Response: Underlying issues that may be causing the inability of the soil profile to support native vegetation are investigated and addressed. This may involve breaking up of compaction layers, the incorporation of fertilisers or applications of other soil ameliorants

9.2.11 Contingency measures

9.2.11.1 Landform

Reformation of the landform.

Where native vegetation is not surviving, investigate reasons why and address through such management action as breaking apart compaction layers, the addition of water and fertiliser.

Where erosion or subsidence occurs, it is remedied by the application of additional Area A topsoil, set aside for that purpose.

9.2.11.2 Soil Profile

Addition of certified *Phytophthora* dieback free, weed free organic matter / compost / mulch followed by ripping to 600 mm (prior to the addition of subsoil and topsoil) to reduce compaction and improve infiltration

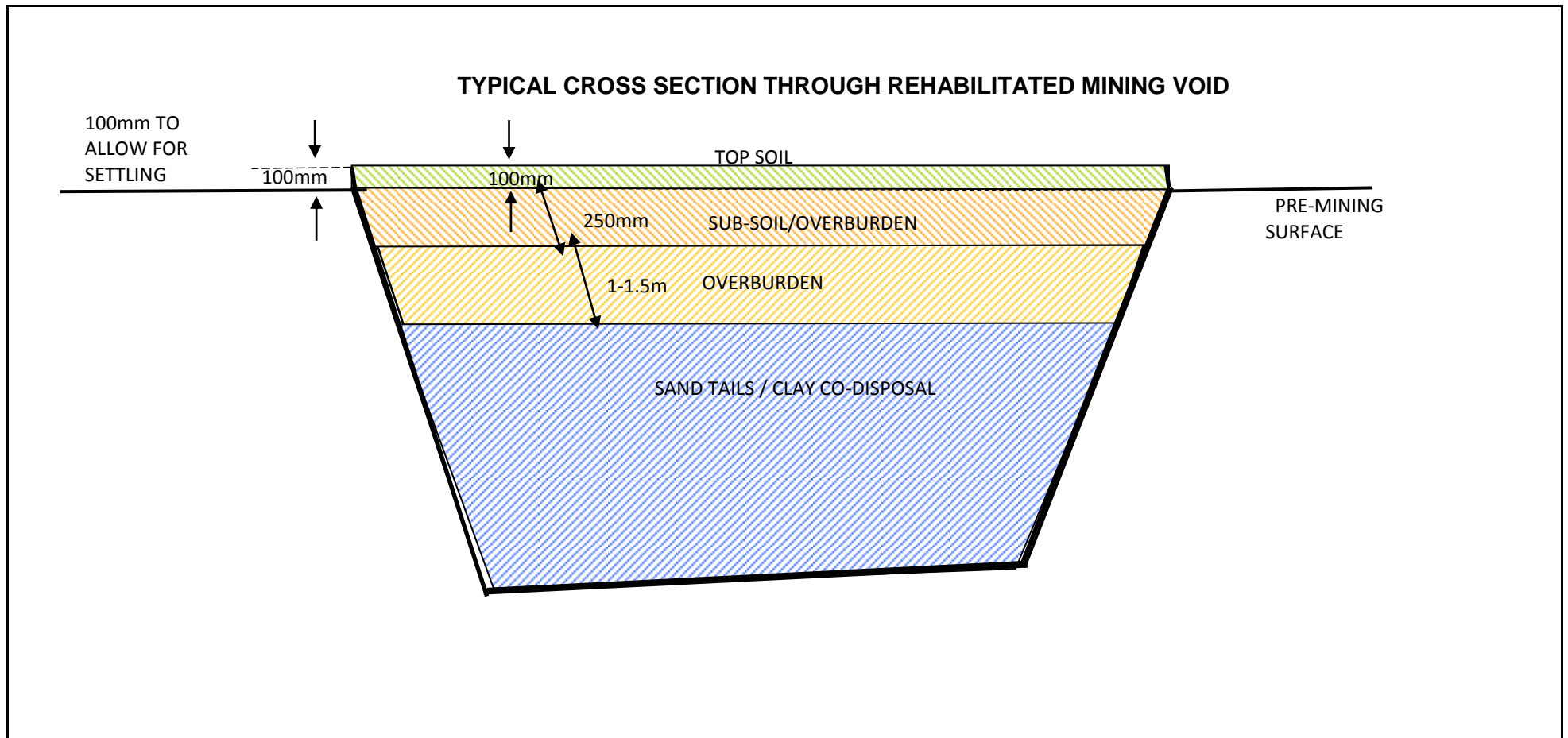


Figure 10. Typical cross section through rehabilitated mine void.

9.3 Topsoil and Subsoil Management

Addressing MS1030 Conditions 7-2(4), 7-2(7) and 7-2(8)

9.3.1 Closure Objective

Post mining, Area A is suitable for continued use as State Forest.

9.3.2 Description of Pre-mining State

The majority of Area A is comprised of undisturbed State Forest, with an intact topsoil layer.

The Goulden Road track and two minor access tracks that run north-south through Area A have little topsoil remaining. As these areas are either at risk of being infested (classified as 'Disease Risk Roads' by DPaW) or known to be infested with *Phytophthora* dieback.

Ore is very close to or at the surface throughout most of Area A.

9.3.3 Description of Proposed Works

All uninfested topsoil from Area A will be removed and stockpiled within Area A for use in rehabilitation.

As ore is close to the land surface throughout most of Area A, subsoil will not generally be able to be retained for use in rehabilitation, except in areas where the ore is located deeper in the soil profile. In these areas, subsoil and overburden will be retained and stockpiled for use in rehabilitation. It is estimated that the quantity of Area A subsoil/overburden able to be retained from these areas could be respread across the site at an average nominal depth of 150 - 200 mm

In order to reduce the threat of spreading *Phytophthora* dieback whilst maximising the topsoil resource available for use in rehabilitation, it is proposed that topsoil from undetermined 'Disease Risk Roads' (**Figure 9**), including parts of Goulden Road, plus a 10 m buffer either side, will be removed and stockpiled on sterile, weed free sand tails on either Block 15 or Block 17 (situated in farmland directly north of Area A), and stored there for potential reuse. The potential re-introduction of this topsoil back into Area A would be assessed by Doral during topsoil replacement. Should it be required to achieve topsoil targets, it would only be placed along the Goulden Road track, which was designated as a 'Disease Risk Road' by DPaW (2016).

Topsoil and subsoil from known infested areas will be deep-buried in a mine void east of Sues Road.

9.3.4 Potential or Actual Impact

- Potential contamination of topsoil with *Phytophthora* dieback
- Potential contamination of topsoil with weeds

- Potential depletion of topsoil value in terms of native seedbank, organic matter and microbial biomass as a result of suboptimum stripping, handling, storage and / or respreading techniques.

9.3.5 Completion Criteria

- Topsoil from Area A is stored within Area A
- Topsoil storage time is less than 18 months
- Topsoil respread thickness averages no less than 50 mm

9.3.6 Management Actions for Achieving Completion Criteria

9.3.6.1 Topsoil and Subsoil/ Area A Overburden Stripping

The following procedures are intended to be applied to topsoil and subsoil stripping:

- Topsoil stripped using a clean-on-entry GPS D6 dozer with a spotter to minimise disturbance and mixing of topsoil with subsoil
- Topsoil stripped to a maximum depth of 100 mm to conserve seed bank density
- Subsoil/overburden stripped where present (i.e. where ore is not at surface) using a clean GPS D6 dozer with a spotter

9.3.6.2 Topsoil and Subsoil/ Area A Overburden Handling

The following procedures are intended to be applied to topsoil and subsoil handling:

- Topsoil stripped in the summer months of 2017/2018
- Topsoil windrowed and relocated to stockpiles by excavator and dump truck (if carry-graders/scrapers are not used)
- Subsoil/overburden stripped in the summer months of 2017/2018
- Subsoil/overburden would be stripped using an excavator and dump truck
- Topsoil and subsoil/overburden salvaged from Area A will not be used for any other purpose than stockpiling or direct placement for rehabilitation of Area A
- Topsoil from Area A will be stored within Area A
- No topsoil or other material of any kind from outside of Area A will be stored within Area A

9.3.6.3 Topsoil and Subsoil/ Area A Overburden Storage

The following procedures are intended to be applied to topsoil and subsoil storage:

- Records of topsoil and subsoil removal and storage locations kept and maintained
- All stockpiles clearly labelled in the field and mapped using GPS
- Direct placement of topsoil and subsoil/overburden implemented where possible

- Topsoil stored for between 12 and 18 months (maximum) as required to enable respreading during autumn
- Stockpiles a maximum height of 2 m
- Other than as is necessary to provide access to mining stages, stockpiles not accessed or trafficked during storage, and will not be mixed with other materials (e.g. drain spoil);
- Stockpiles capped with hydromulch or spray seal material if required to minimise drying, erosion and weed establishment
- Dust suppression measures employed as necessary using clean, non-processed Yarragadee water, such as if the drying of the surface of the stockpiles occurs
- Weed control undertaken on stockpiles as required
- Drainage controls (e.g. shallow drains designed to shed and not retain water constructed around the base of stockpiles) established to prevent the potential for *Phytophthora* dieback infestation from up-gradient surface water flow
- To enable the stockpiling and mining within Area A, some relocation of stockpiles within Area A may be required. This shall be conducted only as deemed reasonably necessary and shall not be done twice with the same stockpile (**Figure 3**)

9.3.6.4 Topsoil and Subsoil/Area A Overburden Replacement

The following procedures are intended to be applied to topsoil and subsoil placement:

- Topsoil respread onto rehabilitation areas in autumn to maximise germination of the native soil seed bank. Ideally, to make best use of the applied seed without jeopardising the establishment of species from the topsoil, pits should be ripped and sown by April (Ward *et al.*, 1996)
- Topsoil respread using a combination of dump truck and GPS D6 bulldozer, both clean on entry
- Topsoil respread to nominal thickness of 70 mm however ensuring a minimum of no less than 50 mm (calculated taking into consideration the loss of sacrificed topsoil from areas at risk from and known to be infested with *Phytophthora* dieback)
- Area A subsoil/overburden replaced to a nominal average thickness of 150-200 mm across all of Area A using a combination of dump truck and GPS D6 bulldozer
- Area A subsoil/overburden replaced directly after replacement of overburden. This stage may be achieved several months in advance of topsoil replacement.
- Water spraying (with clean, unprocessed Yarragadee water) and/or other appropriate measures used for dust control during the placement of topsoil and

subsoil as required. Under high wind conditions, topsoil and subsoil placement will cease.

- Rehabilitation area re-contoured prior to the respreading of topsoil and as close as possible to the pre-mining surface design
- Following topsoil and subsoil replacement, Area A ripped to a maximum depth of 300 mm
- No vehicle traffic shall be permitted onsite once topsoil has been replaced
- Up to 100m³ of topsoil from Area A may be retained within Area A for use in erosion repair and mitigation. Note that it is unlikely this will be required due to the lag between soil profile reconstruction to subsoil, anticipated to be finalised in December 2018 and the placement of topsoil, anticipated to occur in the following autumn. Any settling or subsidence that has occurred prior to topsoil placement will be repaired prior to topsoil placement. Prior to topsoil placement, an assessment of land surface stability will be undertaken, and should it prove to be stable, no topsoil would be retained, and instead all would be used in the rehabilitation.

9.3.6.5 Review

Specified management actions will be reviewed quarterly during operations and revised as necessary to ensure consistent achievement of Completion Criteria.

9.3.7 Key Performance Indicators (KPIs)

- Topsoil storage location
- Length of topsoil storage time
- Average thickness of respread topsoil
- % weed cover in respread topsoil

9.3.8 Monitoring to Assess Against KPIs

- Monitoring of and ensuring consistency between topsoil storage location data records and stockpile location and labelling in the field, and updating these as necessary when topsoil is relocated to provide mining access to the final stage of Area A
- Ongoing monitoring of topsoil storage timeframes and the mining schedule to ensure that topsoil can be respread in autumn whilst still being stored for a maximum of 18 months
- Monitor topsoil depth consistently during respreading to ensure that all areas are being topped with the specified minimum depth of topsoil

- Monitor topsoil depth after resspreading and before application of native seed in a series of at least 18 shallow test pits randomly placed throughout Area A
- Monitoring of fifteen 5 x 5 m sub-quadrats within Area A post rehabilitation to assess herbaceous species cover and abundance, including weeds (refer to **Section 9.4.8**)

9.3.9 Triggers

Trigger: Mining of Area A does not commence in summer of 2018

Response: Re-evaluate the mining schedule and adjust schedule and workloads as necessary to ensure that topsoil will not be stored for more than 18 months and that autumn resspreading of topsoil can be facilitated.

Trigger: Mining of Area A is not completed by the end of December 2017

Response: Re-evaluate the mining schedule and adjust schedule and workloads as necessary to ensure that topsoil will not be stored for more than 18 months and that autumn resspreading of topsoil can be facilitated.

Trigger: When stripping topsoil, it is calculated that insufficient topsoil is removed and stockpiled to enable it to be returned to a minimum thickness of 50 mm across Area A

Response: Consider the placement of topsoil stripped from 'Disease Risk Roads' back to the Goulden Road track, in order to allow more topsoil uninfested with *Phytophthora* dieback to be used in the remainder of the site

Response: Consider the creation of topsoil, as per Main Roads Western Australia (2016)

9.3.10 Contingency Measures

- Maintain the operability of the mine to ensure schedule is maintained
- If topsoil is missing from parts of Area A, topsoil will be taken from areas that have excess and placed in bare areas
- Add constructed topsoil using certified *Phytophthora* dieback free and verified weed free material as specified in Main Roads Western Australia (2016)

9.4 Re-establishment of Native Vegetation

Addressing MS1030 Condition 7-1

9.4.1 Description of Proposed Works

All vegetation within the boundary of Area A will be cleared prior to mining. Rehabilitation of native vegetation will take place immediately upon replacement of topsoil, in autumn and winter 2019.

9.4.2 Closure Objective

Vegetation in rehabilitated areas is suitable for continued use of the area as State Forest (for a management purpose of conservation).

9.4.3 Pre-Mining State

The State Forest sub-area is relatively undisturbed with the majority of the vegetation (97%) rated by Ecoedge (2014) as Very Good or Excellent condition using the vegetation condition ratings according to Keighery (1994), with a small area on the northern boundary (0.08 ha) previously used as a sand pit by others being rated as Completely Degraded and the Goulden Road track (0.14 ha) also being considered Completely Degraded. The portion classified as Very Good rather than Excellent (approximately 73% of the State Forest sub-area), has previously been partly-cleared as evidenced by old windrows of fallen trees scattered throughout. Based on the size of the regrowth eucalypts, the clearing was probably during the period 1950 - 1965; perhaps in preparation for pine planting that did not proceed (Ecoedge, 2014).

Three vegetation units (A3, B1 and C2) were mapped within Area A by Ecoedge (2014). Unit C2 corresponds to Priority One Priority Ecological Community (P1 PEC) 'Central Whicher Scarp Jarrah woodland (Whicher Scarp of coloured sands and laterites community C1)' (FCT C1). 2.8 ha of FCT C1 would be cleared for mining within Area A (EPA, 2015e).

An analysis of data from Mattiske (2012) and Ecoedge (2014) has identified a total of 156 species occurring within Area A, of which 45 have been identified as 'keystone' species. These are listed in **Appendices 1 and 2**.

9.4.4 Potential or Actual Impact

- Loss of approximately 2.8 ha of FCT C1
- Loss of six of the Declared Rare Flora (DRF) *Daviesia elongata* subsp. *elongata* within Area A
- Loss of 12 individuals of the Priority 3 species *Conospermum paniculatum*, as well as several individuals of the conservation significant species *Hemiphora bartlingii* and *Petrophile serruriae*
- Because of changes in the soil profile, and other factors that may be different post-mining, it may be difficult to establish some of the original species in the revegetated area. There may be loss of conservation value because of this.

9.4.5 Completion Criteria

Note: the following criteria relate only to the re-establishment of native vegetation.

- Within 5 years:

- Vegetation composition on the rehabilitated area is representative of the pre-mining state of Area A in species diversity and (potential⁸) vegetation structure
- Mean cover of native species in all 10 m X 10 m monitoring quadrats reaches no less than 70%
- Mean weed cover in 25 m² monitoring sub-quadrats is no greater than 150% of baseline levels
- Mean stems/ha count of species that comprise Black Cockatoo habitat shall be +/- 10% of pre-clearing density
- Mean species richness within 10 x 10 m monitoring quadrats is greater than 50% (and greater than 85%⁹ for overstorey species) of the mean value recorded in all 10 m X 10 m reference plots in comparable unmined areas
- Mean species richness of identified keystone species, as detailed in **Appendices 1 and 2**, in all 10 m X 10 m monitoring quadrats is no less than 70% of the total possible
- 60% of all species present within Area A prior to mining are present within 5 years post-mining
- Average annual health scores of overstorey and understorey plants within 10 x 10 m monitoring quadrats is no less than 3 out of a maximum possible score of 5 (Refer to **Appendix 3** for detail regarding plant health assessment methodology)
- Measured on an annual basis, plants show consistent growth (height or area covered)
- Within 3 years, overstorey species average a minimum of 3 m in height or are likely to attain that height in the short-term future without the need for remedial action
- All plant material used in rehabilitation sourced from within 10 km of the rehabilitation area
- Within 15 years of completion of rehabilitation, rehabilitated areas have the potential to regenerate after fire
- Vegetation structural complexity is restored 12 years post-mining
- Fire is excluded from Area A rehabilitation for a minimum of 15 years to allow sufficient establishment and resilience of vegetation to fire (Koch, 1992; Banning, et al., 2011)

⁸ i.e. given sufficient time for trees to mature and for species composition to evolve from a coloniser-dominant system.

⁹ All overstorey species present in Area A pre-mining except for *Persoonia longifolia* and *Persoonia elliptica* are expected to be present in rehabilitated native vegetation.

9.4.6 Management Actions for Achieving Completion Criteria

9.4.6.1 Re-establishment of Native Vegetation

It is intended that native vegetation will be re-established as follows:

- Natural regeneration from respread topsoil
- Direct seeding at a rate of 3 kg/ha of native seed collected from within Area A and similar vegetation within 10 km radius of Area A, mixed with Bactivate at a rate of 10kg/ha and Bioboost and Seaweed solution, both at 2Lt/ha (refer to **Appendix 2** for the proposed species list)
- Planting of 600 stems/ha of tree species grown from seed collected within 10 km radius of Area A including *Banksia grandis*, *Corymbia calophylla*, *Corymbia haematoxylon*, *Eucalyptus marginata*, *Xylomelum occidentale*
- Propagation (via cuttings or division) and planting out of species with a low likelihood of establishment through topsoil recruitment or direct seeding, especially 'Keystone' species, where possible.

9.4.6.2 Replacement of Vegetative Material

Light woody debris including retained crushed canopies and shrubs will be lightly scattered spread in a thin layer (<10 mm) over the topsoil.

9.4.6.3 Other Related Completion Criteria

In addition to the above, achievement of the 'Ecological Community' completion criteria is reliant on the successful application of management actions specified in the following sections:

- Refer to **Section 6** for management actions relating to ground and surface water management
- Refer to **Section 8** for management actions relating to weed management
- Refer to **Section 9** for management actions relating to *Phytophthora* dieback management
- Refer to **Section 10.1** for management actions relating to the collection and salvage of vegetative material for use in rehabilitation
- Refer to **Section 10.2** for management actions relating to the return of soil profiles and landform
- Refer to **Section 10.3** for management actions relating to topsoil and subsoil management

9.4.7 Key Performance Indicators (KPIs)

- Cover: Respective mean cover of native species and bare earth in 10 x 10 m established monitoring quadrats
- Weed cover: Respective mean cover of weed species in 5 x 5 m monitoring sub-quadrats
- Species richness:
 - Number of native species in 10 x 10 m established monitoring quadrats
 - Comprehensive species list

9.4.8 Monitoring to Assess Against KPIs

A baseline survey consisting of the re-assessment of existing Ecoedge (2014) and Mattiske (2012) floristic quadrats will be undertaken in spring of 2016. This, along with the results of the initial assessments of these quadrats, will provide critical information regarding species diversity, composition and cover measures of Area A vegetation prior to clearing.

It is intended that fifteen permanent 10 x 10 m monitoring quadrats will be installed in stratified random placement within Area A. To achieve this, Area A will be divided into 15 approximately equally sized sub-areas that will be further divided into 9 cells. Within each sub-area, one quadrat will be assigned to one cell using a random number generator. Within each 10 x 10 m monitoring quadrats, a 5m x 5m sub-quadrat will be used to more closely monitor the cover and abundance of both native and exotic herbaceous species.

Quadrat monitoring would be undertaken quarterly to allow the greatest opportunity for remedial action. Quadrat monitoring methods are described in **Appendix 3**. Herbaceous species cover and abundance will be assessed biannually, in autumn and spring.

Parameters to be assessed quarterly in each quadrat are as follows:

- Average height of trees and cover of shrub and groundcover species (herbaceous species are likely to only be evident in spring)
- Average health of overstorey and understorey species
- An estimate of the number of stems/ha of shrubs and trees

Quadrats would be scored annually in spring according to the EPA and DPaW Technical Guide (EPA, 2015f), including assessments of species richness (full species list), and species cover and abundance. Both native and introduced species would be included in this assessment. Species richness would be assessed based on a comparison with mean species richness values in Area A pre-mining quadrats.

A complete survey of Area A using random-meander method as described in Cropper (1993) will be undertaken annually for 5 years to prepare a complete species list for comparison with data collected during the baseline study for Area A.

Data from each monitoring period will be collated and analysed against baseline and calibration values and data collected during previous monitoring periods to identify trends and outlier records. All monitoring data will be consistently maintained and kept for the duration of the monitoring, until project closure.

9.4.9 Triggers

Trigger: 24 months post-rehabilitation, mean cover of native species in all 10 m X 10 m monitoring quadrats is less than 50%

Response: Assess density of stems/ha to determine whether it is likely that the required mean cover target will be reached by 2024 without supplementary planting. If it is decided that reaching mean cover targets is unlikely, suitable tubestock in sufficient quantities to bring mean cover up to target levels, and grown from local provenance seed must be arranged to be available for planting out in the winter of 2022.

Trigger: 36 months post-rehabilitation (i.e. October 2022), mean cover of native species in all 10 m X 10 m monitoring quadrats is less than 60%

Response: Assess density of stems/ha to determine whether it is likely that the required mean cover target will be reached by 2024 without supplementary planting. If it is decided that reaching mean cover targets is unlikely, suitable tubestock in sufficient quantities to bring mean cover up to target levels, grown from local provenance seed must be arranged to be available for planting out in the winter of 2023.

Trigger: If at any time, mean weed cover in 25 m² monitoring sub-quadrats is greater than 150% of baseline levels

Response: Implement appropriate weed control

Trigger: Mean stems/ha count of species that comprise Black Cockatoo habitat is less than 10% of pre-clearing density

Response: Undertake supplementary planting of species that comprise Black Cockatoo habitat

Trigger: If at any time, mean species richness within 10 x 10 m monitoring quadrats is less than 50% (and less than 75%¹⁰ for overstorey species) of the mean value recorded in all 10 m X 10 m reference plots in comparable unmined areas

Response: Investigate options for introducing additional species from the species lists provided in **Appendices 1** and **2**. This may include contracting a local nursery to grow tubestock from specially collected seed.

Trigger: If at any time, mean species richness of identified keystone species, as detailed in **Appendices 1** and **2**, in all 10 m X 10 m monitoring quadrats is less than 60% of the total possible

Response: Investigate options for introducing additional species from the species lists provided in **Appendices 1** and **2**. This may include contracting a local nursery to grow tubestock from specially collected seed.

Trigger: Less than 50% of all species present within Area A prior to mining are present 3 years after rehabilitation, and there is no evidence of ongoing recruitment of new species from the soil seed bank

Response: Investigate options for introducing additional species from the species lists provided in **Appendices 1** and **2**. This may include contracting a local nursery to grow tubestock from specially collected seed.

Trigger: If at any time, average annual health scores of overstorey and understorey plants within 10 x 10 m monitoring quadrats is less than 3 out of a maximum possible score of 5

Response: Investigate reasons for poor health and address as required. This may include the addition of summer watering, fertiliser and/or pest control.

Trigger: If after 2 years post rehabilitation, overstorey species average less than 1.5 m in height or appear unlikely to attain that height in the short-term

Response: Investigate reasons for stunted growth and address as required. This may involve breaking up of compaction layers, addition of summer watering or fertiliser, or other measures.

9.4.10 Contingency Measures

Should the methods for the rehabilitation of native vegetation outlined above not achieve stated targets, a selection or combination of the following responses would be implemented:

¹⁰ All overstorey species present in Area A pre-mining except for *Persoonia longifolia* and *Persoonia elliptica* are expected to be present in rehabilitated native vegetation.

- Supplementary planting and/or seeding with local provenance material
- Engage specialist nurseries to grow from collected seed or cuttings missing 'keystone' species that would usually be expected to be present in rehabilitated vegetation
- Application of smoke-water to encourage germination of native species from the soil seed bank
- Application of Organic compost or other similar product to boost plant growth. Any compost or similar material used in the rehabilitation will be certified weed and *Phytophthora* dieback free.
- Revision of weed management methodology

9.5 Fauna Recolonisation Monitoring

9.5.1 Closure Objective

Vegetation in rehabilitated areas provides habitat for native fauna.

9.5.2 Completion Criteria

Fauna monitoring forms part of the rehabilitation program and the proposed survey methods detailed here will aim to provide evidence of compliance with the fauna recruitment rehabilitation completion criteria, which are:

- Native fauna is utilising the rehabilitation area
- Evidence, based on monitoring data, that increased numbers of fauna are utilising the area

9.5.3 Timing

Doral intend to commence fauna monitoring of Area A five years after rehabilitation has commenced, after the exclusion fence is removed, and then every two years up to and including the 9th year (three monitoring periods). The fauna monitoring will be carried out during November/December each year to provide the best opportunity to record most of the likely fauna species.

Once initiated, the monitoring survey for fauna within the rehabilitation area will be undertaken at approximately the same time of year using a variety of methods to detect the various fauna groups.

Details on the dates, start and finish times and weather conditions at the time of each facet of the monitoring survey will be recorded.

9.5.4 Monitoring Methods

9.5.4.1 Baseline Fauna Data

Data on the expected fauna assemblage for the general area will be taken from the information collected during the two phase seasonal survey undertaken in 2011/12 (Harewood 2014). Data on fauna utilisation collected during the monitoring events will be compared with the information gathered during this survey to gauge the relative level of fauna recolonisation within the rehabilitation area.

9.5.4.2 Ground Dwelling Fauna

To provide some measure of the abundance and distribution of ground fauna (amphibians, reptiles, and some mammals), trapping utilising drift fencing and a combination of cage traps, Elliott traps, pit fall traps and funnel traps will employed within the rehabilitation area.

Doral intend to install a number of trap sites within the rehabilitation area. Each trap site is likely to consist of a ~7 m long drift fence with a centrally located 20L bucket and two funnel traps (one at each end of the drift fence). A large Elliot “B” trap and a cage trap will also be positioned near each trap site. Pit traps will be sealed and left in place between monitoring events. Traps sites will be positioned so as to avoid vegetation monitoring quadrats and any other sensitive areas.

9.5.4.3 Birds

A bird survey transect will be carried out using Birdlife Australia’s “Fixed-Route Monitoring Method”. In accordance with this method, Doral intends to establish a defined transect across the rehabilitation area at 50 m spacings (anticipated total length is approximately ~2.6 km). The transect will be walked once over a set period (~1 hr) and bird species seen or heard within the rehabilitation area, 25 m either side of the transect will be recorded (species and number of individuals). Secondary evidence such as foraging signs will also be recorded if observed.

The transect route will be recorded using GPS so that it can be followed during subsequent monitoring events. Turning points along the transect route will also be marked in the field using steel pegs at.

9.5.4.4 Acoustic Bat Recordings

One night of acoustic bat call recordings using a Wildlife Acoustics SM2+ Bat Detector will be undertaken during each monitoring event. The device will be placed in at a central location within the rehabilitation area.

9.5.4.5 Camera Traps

To assist in the detection of elusive mammal species (e.g. southern brush-tailed phascogale), Doral are intending to install motion sensing, infrared “camera traps” at a

suitable number of locations within the rehabilitation area. The camera traps will be put in place one month prior to the commencement of other fauna monitoring activities.

9.5.4.6 Opportunistic Observations

Opportunistic observations of all fauna species within the rehabilitation area will be recorded during all field survey work detailed above. Secondary evidence of a species presence such as tracks, scats, skeletal remains, foraging evidence or calls were also noted if observed/heard.

9.5.5 Reporting

Preparation of a Performance Compliance Report to evidence compliance with the fauna recruitment rehabilitation completion criteria.

Where the compliance criteria with respect to fauna recruitment is not being achieved, the proponent is to analyse why recruitment of fauna has not continued and where possible, develop and recommend corrective action to be implemented as required.

10 Completion Criteria Summary

Completion Criteria have been agglomerated in Table 2, below.

Table 2. Agglomerated Completion Criteria for the Area A MP.

Completion Criteria	Subsection of MS1030	KPI	Monitoring	Trigger	Contingencies	Reporting
Fencing and Access						
<p>Area A progressively rehabilitated as per Table 1.</p> <p>Vehicle access to Goulden Road within Area A is restricted in the first quarter of 2017</p> <p>The eastern, southern and western boundaries of Area A are fenced prior to entering the area for mining (circa. November/December 2017)</p> <p>The northern boundary of Area A is fenced during decommissioning and rehabilitation, before rehabilitation of native vegetation</p> <p>For 5 years post-rehabilitation of native vegetation, herbivores are excluded from Area A and there is no evidence of grazing within Area A</p>	7-2(5)	<p>Presence of unauthorised vehicles or pedestrians within Area A</p> <p>Presence of herbivores / evidence of grazing within Area A</p>	<p>Visual inspection for restriction of vehicle access to Goulden Road</p> <p>Visual inspection for installation of fencing and shade cloth to Area A eastern, southern and western boundaries prior to entering the area for mining</p> <p>Visual inspection for installation of fencing and shade cloth to the northern boundary of Area A during decommissioning and rehabilitation, before rehabilitation of native vegetation</p> <p>Inspections for grazing impacts and evidence of unauthorised access will be undertaken no less than monthly and more frequently as required for 5 years, as part of the rehabilitation monitoring program detailed in Section 9.4.8.</p>	N/A	<p>Pest animal management and/or control will be undertaken if required to remove animals that have gained access to Area A. This will be carried out either by Doral staff manually herding animals out of the enclosure (in the case of kangaroos) or engaging pest animal contractors as required.</p> <p>An electric top wire may be added to the fence if required to further restrict kangaroo access to Area A.</p>	Bi-annual, annual, Incident reports prepared as necessary
Ground and Surface Water Management						
<p>Groundwater will recover to 90% of pre-mining levels within 3 years and 100% of pre-mining levels within 5 years</p> <p>Groundwater levels in “potential impact area” monitored bores are stable within the range of variation of surrounding “reference” monitoring bores and show the same seasonal patterns as surrounding “reference” monitored bores (Refer to the Flora and Vegetation Monitoring Plan)</p> <p>Groundwater quality (pH, EC, Total Dissolved Salts, Total Acidity, Total Alkalinity, chloride, sulphate, Al, Fe and Mn) in “potential impact area” monitored bores is within the range monitored within the surrounding areas</p> <p>Groundwater levels in “potential impact area” monitored bores are stable within the range of variation of surrounding</p>	7-1	<p>Groundwater levels during mining and at 3 years and 5 years post-mining</p> <p>Groundwater quality measurements</p>	<p>Monthly monitoring of local (mine site and vicinity) bores and quarterly monitoring of regional bores to measure surface and groundwater quality utilising appropriate field meters and samples analysed at a NATA accredited laboratory.</p> <p>Monthly monitoring of bores to determine whether groundwater levels return to 90% of pre-mining levels within 3 years and 100% of pre-mining levels within 5 years</p> <p>Monthly monitoring of soil-moisture levels in bores adjacent to Area A</p> <p>Monthly monitoring of plant stress levels in vegetation adjacent to Area A using a pressure chamber (increased fortnightly if adverse impacts detected)</p>	It is anticipated that water level trigger values at locations outside the predicted 0.5 m drawdown contours (PB numerical modeling) in Superficial and shallow Leederville aquifers will be based on a water level drop that is more than 50% greater than the normal season rise/drop from the average (DoW, 2008). Based on the limited available data from site, the normal season change in water levels for the Superficial aquifer system is 2.1m – i.e. 1.05m above or below the mean. A trigger level that is 0.5m below the historical lows/highs for that bore is seen as appropriate for the area. However, at bore locations within the area where predicted mining related drawdown will be more than 0.5 m, trigger levels will take into account the predicted	<p>Mining to ore floor with geologist supervision to make certain that the underlying Mowen clays (potentially acid sulphate soils) are not excavated, with water level recovery as soon as possible after ore mining completion</p> <p>Mitigate the effect of dewatering activities by accelerating backfill of the pit in the affected area</p>	Bi-annual, annual, Incident reports prepared as necessary

Table 2. Agglomerated Completion Criteria for the Area A MP.

Completion Criteria	Subsection of MS1030	KPI	Monitoring	Trigger	Contingencies	Reporting
<p>monitoring bores and show the same seasonal patterns as surrounding monitored bores</p> <p>Drainage lines flow in the same direction and to the same catchments as they did pre-mining</p>				<p>drawdowns, in addition to the extra 0.5m trigger value.</p> <p>Groundwater chemistry default trigger values have been set by the DoW (2015) and are provided in the Groundwater Operating Strategy (AQ2, 2016)</p>		
Fauna Management						
<p>No trees containing hollows in current use by black cockatoos for nesting purposes felled/disturbed during clearing operations</p> <p>All hollow trees inspected for occupancy by other fauna species with animals encountered being captured and relocated or allowed to vacate of their own accord</p> <p>100% of animals encountered in hollows will be relocated or allowed to move on of their own accord prior to felling</p> <p>100% of trapped/captured fauna that is alive and well will be relocated prior to clearing</p> <p>Direct and indirect impacts on vertebrate fauna that are present during vegetation clearing will be minimise as much as reasonable and practicable</p>	7-2(2) and 7-2(3)	<p>Number of trees containing hollows in current use by black cockatoos for nesting purposes that are felled/disturbed during clearing operations.</p> <p>Proportion of individuals of other fauna species encountered in other hollow bearing trees that are captured and relocated or allowed to vacate area of their own accord</p> <p>Proportion of animals captured/trapped that are relocated prior to clearing</p> <p>% of deaths and injuries recorded against total number of individuals captured and relocated or allowed to vacate area of their own accord</p>	Onsite supervision during clearing shall effectively act as continuous monitoring	Mining schedule (proposed clearing timeframes)	The effectiveness of the management measures employed will be monitored continuously during clearing works. If it becomes clear that some methods being used are ineffective or can be improved, then site works should be ceased (if warranted) and new processes developed/implemented as required.	Bi-annual, annual, Incident reports prepared as necessary

Table 2. Agglomerated Completion Criteria for the Area A MP.

Completion Criteria	Subsection of MS1030	KPI	Monitoring	Trigger	Contingencies	Reporting
Weed Management						
No new weed species (environmental or declared) introduced into Area A Within 5 years of rehabilitation, mean weed cover in 25 m2 monitoring sub-quadrats is no greater than 150% of baseline levels	7-2(9)	% weed cover in 25 m2 monitoring quadrats Presence of previously unrecorded weed species	Visual inspection Quadrat and sub-quadrat monitoring Photographic record	Mean weed cover in 25 m2 monitoring quadrats reaches 150% of baseline levels Any new weed species being found with Area A	Weed control methods such as chemical application will be modified as required to achieve the best practice solution. The use of targeted spray application and adaptive techniques such as weed wipers or rope wick technology will be implemented where required to selectively treat weeds	Bi-annual, annual, Incident reports prepared as necessary
<i>Phytophthora</i> dieback management						
Assessed 5 years after rehabilitation of native vegetation, the area of <i>Phytophthora</i> Dieback mapped within Area A is no larger that was mapped in 2016	7-2(9)	Area of <i>Phytophthora</i> dieback present within Area A 5 years post rehabilitation	Prior to clearing, the demarcated 'Infested' areas will be checked monthly to ensure flagging tape/bunting remains in place In rehabilitated vegetation, monitoring for <i>Phytophthora</i> Dieback would be carried out using visual assessment of susceptible species within the floristic monitoring quadrats and opportunistically, plus sampling followed by laboratory testing of any recent deaths of susceptible species	Detection of <i>Phytophthora</i> Dieback	Should <i>Phytophthora</i> Dieback be detected in Area A post rehabilitation, and affect or compromise the success of rehabilitation such as through significantly reducing native species cover, revegetation with native species resistant to the pathogen would be undertaken to ensure that native species cover targets, as detailed in Section 9.4.5, are achieved. The application of phosphite at recommended rates would also be investigated as a contingency response	

Table 2. Agglomerated Completion Criteria for the Area A MP.

Completion Criteria	Subsection of MS1030	KPI	Monitoring	Trigger	Contingencies	Reporting
Clearing and Salvage of Vegetative Material						
No less than 26 kg of local provenance seed mixed from the species listed in Appendix 2 , treated to maximise the likelihood germination, is available for use in direct seeding	7-2(6)	Number of kilograms of seed available for use	Ongoing monitoring of seed collection actual numbers vs targets to ensure seed from a wide variety of species, and especially from 'Keystone' species, is available for use in rehabilitation Onsite inspections undertaken during clearing to ensure as much valuable material is collected and stockpiled as possible Monthly visual monitoring of stockpiles to ensure weed cover is kept to a minimum Photographic record	Less than 14 kg of seed is collected in the spring/summer of 2016/17	Purchase of additional local provenance seed of target species	Bi-annual, annual, Incident reports prepared as necessary
The mix of species within Area A rehabilitation is comprised of species recruited from topsoil and species introduced through direct seeding and species introduced as tubestock grown from seed, cuttings or whole plants salvaged from Area A	7-2(6)	Species diversity and composition within Area A rehabilitation	Visual inspection Quadrat and sub-quadrat monitoring Photographic record	There are species listed in Appendix 2 that cannot be collected in the spring/summer of 2016/17, or it is unlikely that they will be collected in sufficient quantities	Should tubestock planted in year 1 not survive, an arrangement with a local nursery is made to grow additional tubestock from locally collected seed	Bi-annual, annual, Incident reports prepared as necessary
Return of Soil profiles and Landform						
Landforms: The slope of the re-created landform is within acceptable limits (+/- 1.0° of pre-disturbance levels) The re-created landform is able to support native vegetation No erosion or subsidence maintenance is required after 4 years (assessed based on monitoring and maintenance logs)	7-1, 7-2(8)	Slope of the recreated landform is consistent with pre-mining topography Survival of native vegetation Number, depth and area of erosion or subsidence zones	Survey of slope to assess variance with pre-mining levels Visual inspection Quadrat and sub-quadrat monitoring Photographic record Subsidence and erosion monitoring, utilising both GPS surveyed ground surface markers and visual inspection, will be undertaken bi-annually for at least three and up to four years prior to hand back of the land to identify and enable the remedy any affected areas.	2 months after land form is rehabilitated and prior to placement of topsoil, land slope is more than +/- 2.0° of pre-disturbance levels Within 6 months of rehabilitation of native vegetation, the re-created landform is not able to support native vegetation Erosion or subsidence maintenance continues to be required after 2 years	Reformation of landform Where native vegetation is not surviving, investigate reasons why and address through such management action as breaking apart compaction layers, the addition of water and fertiliser. Where erosion or subsidence occurs, it is remedied by the application of additional Area A topsoil, set aside for that purpose	Bi-annual, annual, Incident reports prepared as necessary
Soil Profile: Soil physical, chemical and biological characteristics will be consistent with	7-1, 7-2(8)	Soil physical, chemical and biological	A detailed soil survey similar to the pre-mining survey will be carried out 6 to 12 months after rehabilitation has been	2 months after recreation of soil profile, soil physical, chemical and biological characteristics, pH, salinity	Addition of certified Phytophthora dieback free, weed free organic matter /	Bi-annual, annual, Incident

Table 2. Agglomerated Completion Criteria for the Area A MP.

Completion Criteria	Subsection of MS1030	KPI	Monitoring	Trigger	Contingencies	Reporting
<p>those of the pre-mining soil profile in Area A</p> <p>The capacity to retain water and nutrient resources is equivalent to the pre-mining soil profile in Area A</p> <p>Soil to the depth of reconstruction has similar pH and salinity as the pre-mining soil profile in Area A</p>		<p>characteristics, including capacity to retain water and nutrient resources, soil pH and salinity</p>	<p>completed to assess the soil characteristics against KPI levels.</p>	<p>and/or the capacity to retain water and nutrient resources are inconsistent with those of the pre-mining soil profile in Area A</p> <p>Within 6 months of rehabilitation of native vegetation, the re-created landform is not able to support native vegetation</p>	<p>compost / mulch followed by ripping to 600 mm (prior to the addition of subsoil and topsoil) to reduce compaction and improve infiltration</p>	<p>reports prepared as necessary</p>
Topsoil and Subsoil Management						
<p>Topsoil from Area A is stored within Area A</p> <p>Topsoil storage time is less than 18 months</p> <p>Topsoil respread thickness averages no less than 50 mm</p>	<p>7-2(4), 7-2(7) and 7-2(8)</p>	<p>Topsoil storage location</p> <p>Length of topsoil storage time</p> <p>Average thickness of respread topsoil</p> <p>% weed cover in respread topsoil</p>	<p>Monitoring of and ensuring consistency between topsoil storage location data records and stockpile location and labeling in the field, and updating these as necessary when topsoil is relocated to provide mining access to the final stage of Area A</p> <p>Ongoing monitoring of topsoil storage timeframes and the mining schedule to ensure that topsoil can be respread in autumn whilst still being stored for a maximum of 18 months</p> <p>Monitor topsoil depth consistently during resspreading to ensure that all areas are being topped with the specified minimum depth of topsoil</p>	<p>Mining of Area A does not commence in summer of 2018</p> <p>Mining of Area A is not completed by the end of December 2018</p> <p>When stripping topsoil, it is calculated that insufficient topsoil is removed and stockpiled to enable it to be returned to a minimum thickness of 50 mm across Area A</p>	<p>Maintain the operability of the mine to ensure schedule is maintained</p> <p>If topsoil is missing from parts of Area A, topsoil will be taken from areas that have excess and placed in bare areas</p> <p>Add constructed topsoil using certified Phytophthora dieback free and verified weed free material as specified in Main Roads Western Australia (2016)</p>	<p>Bi-annual, annual, Incident reports prepared as necessary</p>

Table 2. Agglomerated Completion Criteria for the Area A MP.

Completion Criteria	Subsection of MS1030	KPI	Monitoring	Trigger	Contingencies	Reporting
Completion Criteria	Subsection of MS1030	KPI	Monitoring	Trigger	Contingencies	Reporting
Re-establishment of Native Vegetation						
<p>Within 5 years:</p> <ul style="list-style-type: none"> Vegetation composition on the rehabilitated area is representative of the pre-mining state of Area A in species diversity and (potential) vegetation structure Mean cover of native species in all 10 m X 10 m monitoring quadrats reaches no less than 70% Mean weed cover in 25 m2 monitoring sub-quadrats is no greater than 150% of baseline levels Mean stems/ha count of species that comprise Black Cockatoo habitat shall be +/- 10% of pre-clearing density Mean species richness within 10 x 10 m monitoring quadrats is greater than 50% (and greater than 85% for overstorey species) of the mean value recorded in all 10 m X 10 m reference plots in comparable unmined areas Mean species richness of identified keystone species, as detailed in Appendices 1 and 2, in all 10 m X 10 m monitoring quadrats is no less than 70% of the total possible 60% of all species present within Area A prior to mining are present within 5 years post-mining Average annual health scores of overstorey and understorey plants within 10 x 10 m monitoring quadrats is no less than 3 out of a maximum possible score of 5 (Refer to Appendix 3 for detail regarding plant health assessment) 	7-1	<p>Cover: Respective mean cover of native species and bare earth in 10 x 10 m established monitoring quadrats</p> <p>Weed cover: Respective mean cover of weed species in 5 x 5 m monitoring sub-quadrats</p> <p>Species richness via:</p> <ul style="list-style-type: none"> Number of native species in 10 x 10 m established monitoring quadrats Comprehensive species list 	<p>Visual inspection</p> <p>Quadrat and sub-quadrat monitoring</p> <p>Random-meander survey</p> <p>Photographic record</p>	<p>24 months post-rehabilitation, mean cover of native species in all 10 m X 10 m monitoring quadrats is less than 50%</p> <p>36 months post-rehabilitation (i.e. October 2022), mean cover of native species in all 10 m X 10 m monitoring quadrats is less than 60%</p> <p>If at any time, mean weed cover in 25 m2 monitoring sub-quadrats is greater than 150% of baseline levels</p> <p>Mean stems/ha count of species that comprise Black Cockatoo habitat is less than 10% of pre-clearing density</p> <p>If at any time, mean species richness within 10 x 10 m monitoring quadrats is less than 50% (and less than 75% for overstorey species) of the mean value recorded in all 10 m X 10 m reference plots in comparable unmined areas</p> <p>If at any time, mean species richness of identified keystone species, as detailed in Appendices 1 and 2, in all 10 m X 10 m monitoring quadrats is less than 60% of the total possible</p> <p>Less than 50% of all species present within Area A prior to mining are present 3 years after rehabilitation, and there is no evidence of ongoing recruitment of new species from the soil seed bank</p> <p>If at any time, average annual health scores of overstorey and understorey plants within 10 x 10 m monitoring</p>	<p>Supplementary planting and/or seeding with local provenance material</p> <p>Engage specialist nurseries to grow from collected seed or cuttings missing 'keystone' species that would usually be expected to be present in rehabilitated vegetation</p> <p>Application of smoke-water to encourage germination of native species from the soil seed bank</p> <p>Application of Landsave Organics compost or other similar product to boost plant growth. Any compost or similar material used in the rehabilitation will be certified weed and Phytophthora dieback free.</p> <p>Revision of weed management methodology</p>	Bi-annual, annual, Incident reports prepared as necessary

Table 2. Agglomerated Completion Criteria for the Area A MP.

Completion Criteria	Subsection of MS1030	KPI	Monitoring	Trigger	Contingencies	Reporting
<p>methodology)</p> <p>Measured on an annual basis, plants show consistent growth (height or area covered)</p> <p>Within 3 years, overstorey species average a minimum of 3 m in height or are likely to attain that height in the short-term future without the need for remedial action</p> <p>All plant material used in rehabilitation sourced from within 10 km of the rehabilitation area</p> <p>Within 15 years of completion of rehabilitation, rehabilitated areas have the potential to regenerate after fire</p> <p>Vegetation structural complexity is restored 12 years post-mining</p> <p>Fire is excluded from Area A rehabilitation for a minimum of 15 years to allow sufficient establishment and resilience of vegetation to fire (Koch, 1992; Banning, et al., 2011)</p>				<p>quadrats is less than 3 out of a maximum possible score of 5</p> <p>If after 2 years post rehabilitation, overstorey species average less than 1.5 m in height or appear unlikely to attain that height in the short-term</p>		

11 Reporting and consultation

A brief internal report will be prepared quarterly summarising monitoring activities completed and results of data analysis, including the identification of any trends, and/or outliers in datasets.

Incident reports will be prepared as necessary.

An Annual Environmental Review report, suitable for submission to the EPA, DPaW, DoW and Department of Mines and Petroleum, will be prepared annually that will provide a detailed summary of monitoring, analysis of results and contingency actions undertaken. The annual report will assist in evaluating the effectiveness of the management and monitoring program and will provide information on the current status of the vegetation in relation to the Project.

It is proposed that presentation of monitoring data and trends to nominated DPaW staff would occur at intervals no greater than 6 months apart and notification of a realised trigger would be made to the nominated Departmental staff member no greater than 48 hours, to communicate the details of the trigger and planned course of action to be taken.

12 Review

The Area A MP will be reviewed and revised regularly, as opportunities for improved management practices are identified. A thorough review will be undertaken 12 months after monitoring commences post-rehabilitation, and annually from then on. The Plan will be revised in consultation with DPaW, and will be undertaken according to the protocol presented in **Table 3**. Plan revision protocol. Depending on the outcome of this review, the Area A MP may be expanded, continued unchanged or reduced in scope. If necessary, new management targets will be set using an adaptive management approach (Stem et al. 2005).

Table 3. Plan revision protocol.

Item	Action
Criteria for revision	<ul style="list-style-type: none"> - Specific review of management actions not satisfactorily achieving progress towards Completion Criteria and /or - Review of entire document
Timeframe	First review 12 months after commencement of mining, and every 12 months thereafter
Specific Actions	<ul style="list-style-type: none"> - Initial discussion with DPaW staff if and as required - Document reviewed by Doral staff or delegated consultant - Suggested changes proposed - Document including suggested revisions forwarded to DPaW for comment - Changes agreed on - Plan revised and established as the current version to be implemented
Doral contact personnel	Mr Craig Bovell

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Appendix 1. Revegetation performance indication for species in Area A of the Yoongarillup Mineral Sands Project.

LEGEND

	Almost definite
	Maybe, some issues
	Unlikely
	Unsure - more research required

TAXON	"KEystone"	Propagation	Collection	Rehabilitation Performance	Notes
<i>Acacia extensa</i>	x	Seed	Seed easy to collect	Excellent	
<i>Acacia pulchella</i> var. <i>glaberrima</i>	x	Seed	Seed easy to collect	Excellent	
<i>Acacia stenoptera</i>		Seedlings	May be difficult to find collectable amounts	Good	If small amount collected best to propagate at Nursery
<i>Adenanthos barbiger</i>		Seed	Poor seed set, variable timing. Costly to collect	Ok planted from seedlings	? Explore option for cuttings at Nursery
<i>Adenanthos meisneri</i>	x	Resprouter, seed	Poor seed set, variable timing. Costly to collect	Ok planted from seedlings	? Explore option for cuttings at Nursery
<i>Agrostocrinum hirsutum</i>			Expensive and hard to collect	Unknown	Possibly low Germin-ability
<i>Allocasuarina fraseriana</i>	x	Seed	Seed easy to collect. Bradyspory, collect all year	Good	Can have low viability; collect in bulk
<i>Amphipogon amphipogonoides</i>		Seed	Easy to collect where decent populations are located	Good	Reconnaissance in spring
<i>Amphipogon turbinatus</i>		Seed	May be difficult to find collectable amounts	Good	Reconnaissance in spring
<i>Anarthria prolifera</i>	x	Topsoil			Division may be only option
<i>Andersonia micrantha</i>		Topsoil	Difficult to collect decent quantities		
<i>Anigozanthos bicolor</i>		Seed	May be difficult to find collectable amounts	Good	May only come up in decent quantity in area after fire
<i>Astroloma drummondii</i>			Difficult to collect decent quantities		Hard cased seed difficult to propagate
<i>Babingtonia camphorosmae</i>		Cuttings		Suspected poor	Suspected poor return from seed
<i>Banksia attenuata</i>	x	Seed	Seed easy to collect	Excellent	
<i>Banksia dallanneyi</i> subsp. <i>sylvestris</i>		Seed	Hard to find populations with seed set		Any collection may be best propagated

TAXON	"KEYSTONE"	Propagation	Collection	Rehabilitation Performance	Notes
<i>Banksia grandis</i>	x	Seed	Seed easy to collect	Excellent	
<i>Banksia sessilis</i> var. <i>sessilis</i>		Seed	Timing important for collection	Good	
<i>Baumea vaginalis</i>		Tissue culture or division	Low viability of seed	Good if planted	Seedlings or division
<i>Baxteria australis</i>					
<i>Billardiera floribunda</i>		Seed	Winter collection	Good	
<i>Billardiera variifolia</i>		Seed	Winter collection	Good	
<i>Boronia crenulata</i> subsp. <i>pubescens</i>	x	Seed/ Cuttings	Often grows in small patches, slow to collect. Seed viability may be low		
<i>Boronia defoliata</i>					
<i>Bossiaea ornata</i>	x	Seed	Seed easy to collect	Good	
<i>Burchardia congesta</i>		Seed	Easy to collect however only a small amount of seed on each plant and plants often sparse	Good	
<i>Caladenia attingens</i>					
<i>Caladenia flava</i>					
<i>Calothamnus sanguineus</i>		Seed/ Seedlings	Easy to collect however only a small amount of seed on each plant	Excellent	
<i>Cassytha racemosa</i> forma <i>racemosa</i>					
<i>Chamaescilla corymbosa</i>			Difficult to collect decent quantities		
<i>Chorizema glycinifolium</i>			Collection possible if locations identified		
<i>Comesperma calymega</i>			Difficult to collect decent quantities		
<i>Comesperma virgatum</i>			Difficult to collect decent quantities		
<i>Conostephium pendulum</i>		Seed	Easy to collect if decent populations are found		
<i>Conostylis aculeata</i> subsp. <i>preissii</i>		Seedlings	Often predated, difficult to collect decent quantities		If only small quantity collected, consider nursery propagation
<i>Conostylis setigera</i> subsp. <i>setigera</i>		Seedlings	Often predated, difficult to collect decent quantities		If only small quantity collected, consider nursery propagation
<i>Corymbia calophylla</i>	x	Seed	Seed easy to collect	Excellent	
<i>Corymbia haematoxylon</i>	x	Seed	Seed easy to collect	Excellent	
<i>Cyathochaeta avenacea</i>		Seed	Ok to collect after burn and timing important		
<i>Dampiera linearis</i>	x	Seed	Can be slow to collect		If only small quantity collected, consider nursery propagation

TAXON	"KEYSTONE"	Propagation	Collection	Rehabilitation Performance	Notes
<i>Dasypogon bromeliifolius</i>	x	Seed	Seed fill can be low		
<i>Dasypogon hookeri</i>		Seed	Seed fill can be low		
<i>Daviesia cordata</i>		Seed	Seed easy to collect	Excellent	
<i>Daviesia elongata</i> subsp. <i>elongata</i> (T)		Seed	Threatened, will need license to collect	Unknown	
<i>Daviesia physodes</i>	x	Seed	Collection possible if locations identified		
<i>Daviesia physodes</i>	x	Seed	Collection possible if locations identified		
<i>Desmocladus fasciculatus</i>	x	Vegetative/ transplant			
<i>Drosera erythrorhiza</i>		Topsoil			
<i>Drosera pallida</i>					
<i>Drosera pulchella</i>					
<i>Drosera stolonifera</i>					
<i>Elythranthera brunonis</i>			Difficult to collect seed		
<i>Eucalyptus marginata</i> subsp. <i>marginata</i>	x	Seed	Seed easy to collect	Excellent	
<i>Gompholobium knightianum</i>	x	Seed/ Seedlings	Difficult to find collectable populations	Good	Gompholobium species are best to collect after fire. If only small collections are obtained may be best to send seed to nursery for propagation
<i>Gompholobium marginatum</i>	x				
<i>Gompholobium ovatum</i>					
<i>Gompholobium polymorphum</i>					
<i>Gompholobium preissii</i>					
<i>Grevillea quercifolia</i>		Seed/ Seedlings		Low germin- ability	
<i>Grevillea trifida</i>	x	Seed	Seed easy to collect	Good	
<i>Haemodorum laxum</i>		Seed	Seed easy to collect/hard to clean		Fire responsive
<i>Hakea amplexicaulis</i>	x	Seed	Easy to collect however only a small amount of seed on each plant and plants often sparse	Excellent	
<i>Hakea ruscifolia</i>	x	Seed	Fruits can be cryptic and hard to see on plant though persistence will yield results	Good	
<i>Hardenbergia comptoniana</i>		Seed	Easy to collect	Excellent	
<i>Hibbertia amplexicaulis</i>	x	Cuttings/Seed	Poor seed set, prone to predation		See below
<i>Hibbertia aurea</i>		Cuttings			

TAXON	"KEYSTONE"	Propagation	Collection	Rehabilitation Performance	Notes
<i>Hibbertia commutata</i>	x	Cuttings/Seed	Poor seed set, prone to predation		Staggered flowering period makes collections hard therefore it is recommended to send nurseryman into area to source provenance cutting stock
<i>Hibbertia diamesogenos</i>		Cuttings			
<i>Hibbertia furfuracea</i>		Cuttings			
<i>Hibbertia glomerata</i> subsp. <i>glomerata</i>		Cuttings			
<i>Hibbertia hypericoides</i>	x	Cuttings/Seed			
<i>Hibbertia pilosa</i>		Cuttings			
<i>Hibbertia quadricolor</i>		Cuttings			
<i>Hibbertia vaginata</i>	x	Cuttings/Seed			
<i>Hovea chorizemifolia</i>	x	Seed	Difficult to collect decent quantity		
<i>Hovea trisperma</i>	x	Seed/ Seedlings	Easy to collect if population located		If only small quantity collected, consider nursery propagation
<i>Hypocalymma robustum</i>		Seed/ Seedlings	Easy to collect if population located	Good	
<i>Hypolaena exsulca</i>		Topsoil			
<i>Isopogon sphaerocephalus</i>	x		Seed can be collected but return is generally poor	likely poor	Suspect hard to propagate and establish if seeded
<i>Kennedia carinata</i>		Seed/ Seedlings	Collection possible if population located		
<i>Kennedia coccinea</i>	x	Seed	Easy to collect	Good	
<i>Kennedia prostrata</i>	x	Seed	Easy to collect although large volume unlikely	Good	
<i>Kingia australis</i>					Only seed set after fire
<i>Kunzea recurva</i>		Seed	Easy to collect	Excellent	
<i>Labichea punctata</i>	x	Seed			
<i>Lagenophora huegelii</i>		Seed	Collectable quantities after disturbance only		
<i>Lechenaultia biloba</i>		Seed/ Seedlings	Difficult to find collectable populations		If only small quantity collected, consider nursery propagation
<i>Lepidosperma longitudinale</i>		Seed/ Transplant/ Division		Difficult to establish from seeding	If only small quantity collected, consider nursery propagation / division
<i>Leucopogon conostephioides</i>		Seed/ Seedlings	Easy to collect these species however, large quantities hard to find	Difficult to germinate	If only small quantity collected, consider nursery propagation
<i>Leucopogon propinquus</i>	x	Seedlings			

TAXON	"KEYSTONE"	Propagation	Collection	Rehabilitation Performance	Notes
<i>Leucopogon pulchellus</i>		Seed/ Seedlings	Easy to collect these species however, large quantities hard to find	Difficult to germinate	If only small quantity collected, consider nursery propagation
<i>Leucopogon</i> sp. Margaret River (J. Scott 207)					
<i>Levenhookia pusilla</i>			Difficult to collect. Collectable populations may depend on disturbance		Reconnaissance in spring
<i>Logania serpyllifolia</i>		Seed	Collectable if population found	Good	Reconnaissance in spring
<i>Lomandra caespitosa</i>		Seed/Division	Difficult to collect decent quantity	Good from seedlings	If only small quantity collected, consider nursery propagation
<i>Lomandra hermaphrodita</i>					
<i>Lomandra integra</i>					
<i>Lomandra odora</i>					
<i>Lomandra pauciflora</i>					
<i>Lomandra sericea</i>					
<i>Loxocarya cinerea</i>		Topsoil			
<i>Loxocarya striata</i>		Topsoil			
<i>Lyperanthus serratus</i>					Large Orchid may increase possibility of collection
<i>Macrozamia riedlei</i>	x	Seed	Plants flower after fire	Good	
<i>Melaleuca thymoides</i>	x	Seed	Easy to collect	Excellent	
<i>Mesomelaena tetragona</i>		Topsoil		Poor	
<i>Monotaxis occidentalis</i>			Difficult to collect decent quantity		
<i>Neurachne alopecuroidea</i>		Seed/Topsoil	Collection after disturbance late spring		Reconnaissance in spring
<i>Nuytsia floribunda</i>		Seed/ seedlings			Has to be sown or seeded fresh
<i>Opercularia apiciflora</i>					
<i>Patersonia occidentalis</i>		Seed	Easy to collect	Excellent	
<i>Patersonia umbrosa</i> var. <i>xanthina</i>	x	Seed	Easy to collect	Good	Soak before prop/seeding
<i>Pentapeltis peltigera</i>			Difficult to collect decent quantity		
<i>Pericalymma ellipticum</i> var. <i>ellipticum</i>		Seed	Easy to collect	Good	
<i>Persoonia elliptica</i>	x	Seed, difficult to propagate	Easy to collect fresh drupes	Difficult	Difficult to establish in rehab
<i>Persoonia longifolia</i>	x	Seed, difficult to propagate	Easy to collect fresh drupes	Difficult	Difficult to establish in rehab

TAXON	"KEYSTONE"	Propagation	Collection	Rehabilitation Performance	Notes
<i>Persoonia saccata</i>		Seed, difficult to propagate	Easy to collect fresh drupes if population located		
<i>Petrophile linearis</i>			Easy to collect		Suspect hard to propagate and establish if seeded
<i>Petrophile serruriae</i> (RS)	x		Easy to collect		
<i>Philotheca spicata</i>					
<i>Phlebocarya ciliata</i>					
<i>Pimelea lehmanniana</i> subsp. <i>nervosa</i>		Seed	Easy to collect if populations located	Good	Reconnaissance in spring
<i>Pityrodia bartlingii</i>					
<i>Platysace tenuissima</i>					
<i>Podocarpus drouynianus</i>		Seed	Easy to collect	Unsure	Research propagation methods or put in seed mix
<i>Pterostylis recurva</i>		Topsoil			
<i>Pultenaea reticulata</i>		Seed	Easy to collect, large quantity may be unlikely		If only small quantity collected, consider nursery propagation
<i>Pyrorchis nigricans</i>		Topsoil			
<i>Quinetia urvillei</i>		Topsoil			
<i>Rhodanthe citrina</i>		Seed	Collectable if population found		If find population collect in bulk as a good weed suppressant
<i>Sphaerolobium medium</i>		Topsoil/Seed	Better after burn	Okay	
<i>Stackhousia monogyna</i>		Topsoil/Seed	Easy to collect if if population located; timing crucial	Okay	Reconnaissance in spring
<i>Stirlingia latifolia</i>	x	Low viability of seed, can be propagated by cuttings	Easy to collect post fire, can have low seed set between fires	Difficult	Does not perform well due to often having low viability in seed
<i>Strangea stenocarpoides</i>					
<i>Stylidium amoenum</i> var. <i>amoenum</i>		Topsoil			
<i>Stylidium calcaratum</i>		Topsoil			
<i>Styphelia tenuiflora</i>		Topsoil/seed	Flowers stand out in Spring	Suspected poor	Hard cased seed
<i>Synaphea gracillima</i>		Topsoil	Rarely see with seed	Suspected poor	
<i>Synaphea whicherensis</i>		Topsoil	Rarely see with seed	Suspected poor	

TAXON	"KEystone"	Propagation	Collection	Rehabilitation Performance	Notes
<i>Tetraria octandra</i>					
<i>Tetraria</i> sp. Jarrah Forest (R. Davis 7391)	x				
<i>Tetrarrhena laevis</i>		Topsoil	Hard to collect enough worth seeding	Poor	
<i>Thelymitra ?macrophylla</i>					
<i>Thelymitra crinita</i>					
<i>Thysanotus multiflorus</i>					
<i>Thysanotus sparteus</i>					
<i>Thysanotus triandrus</i>					
<i>Trachymene pilosa</i>		Seed/Topsoil	Easy to collect if populations located	Good	If decent quantity of seed can be sourced would be possible weed suppressant
<i>Thysanotus triandrus</i>		Topsoil	Difficult to collect in sufficient quantities	Poor	
<i>Xanthorrhoea brunonis</i>	x		Flowers after fire	Good, slow growing	Not big populations on Whicher Scarp
<i>Xanthorrhoea gracilis</i>	x	Seed	Easy to collect	Good, slow growing	
<i>Xanthorrhoea preissii</i>	x	Seed/Transplant	Easy to collect	Good, slow growing	Remove healthy plants prior to disturbance
<i>Xanthosia candida</i>					
<i>Xanthosia huegelii</i>					
<i>Xylomelum occidentale</i>	x	Seed	Easy to collect	Good	Good

Appendix 2. Revegetation species list for Area A of the Yoongarillup Mineral Sands Project.

LEGEND

	Almost definite
	Maybe, some issues
	Unlikely
	Unsure - more research required

TAXON	"KEYSTONE"	Propagation method
Acacia extensa	x	Seed
Acacia pulchella var. glaberrima	x	Seed
Adenanthos barbiger		Seed
Adenanthos meisneri	x	Resprouter, seed
Allocasuarina fraseriana	x	Seed
Amphipogon amphipogonoides		Seed
Amphipogon turbinatus		Seed
Anigozanthos bicolor		Seed
Banksia attenuata	x	Seed
Banksia grandis	x	Seed
Banksia sessilis var. sessilis		Seed
Billardiera floribunda		Seed
Billardiera variifolia		Seed
Bossiaea ornata	x	Seed
Burchardia congesta		Seed
Calothamnus sanguineus		Seed/ Seedlings
Conostephium pendulum		Seed
Conostylis aculeata subsp. preissii		Seedlings
Conostylis setigera subsp. setigera		Seedlings
Corymbia calophylla	x	Seed
Corymbia haematoxylon	x	Seed
Cyathochaeta avenacea		Seed
Dampiera linearis	x	Seed
Dasyopogon bromeliifolius	x	Seed
Daviesia cordata		Seed
Daviesia elongata subsp. elongata (T)		Seed
Daviesia physodes	x	Seed
Daviesia physodes	x	Seed
Desmocladus fasciculatus	x	Vegetative/ transplant
Eucalyptus marginata subsp. marginata	x	Seed
Gompholobium knightianum	x	Seed/ Seedlings
Gompholobium marginatum	x	Seed/ Seedlings
Gompholobium ovatum		Seed/ Seedlings
Gompholobium polymorphum		Seed/ Seedlings
TAXON	"KEYSTONE"	Propagation method

Gompholobium preissii		Seed/ Seedlings
Grevillea trifida	x	Seed
Hakea amplexicaulis	x	Seed
Hakea ruscifolia	x	Seed
Hardenbergia comptoniana		Seed
Hovea chorizemifolia	x	Seed
Hovea trisperma	x	Seed/ Seedlings
Hypocalymma robustum		Seed/ Seedlings
Kennedia carinata		Seed/ Seedlings
Kennedia coccinea	x	Seed
Kennedia prostrata	x	Seed
Kunzea recurva		Seed
Lepidosperma longitudinale		Seed/ Transplant/ Division
Leucopogon conostephioides		Seed/ Seedlings
Leucopogon propinquus	x	
Leucopogon pulchellus		
Leucopogon sp. Margaret River (J. Scott 207)		
Lomandra caespitosa		Seed/ Division
Lomandra hermaphrodita		Seed/ Division
Lomandra integra		Seed/ Division
Lomandra odora		Seed/ Division
Lomandra pauciflora		Seed/ Division
Lomandra sericea		Seed/ Division
Macrozamia riedlei	x	Seed
Melaleuca thymoides	x	Seed
Neurachne alopecuroidea		Seed/ Topsoil
Nuytsia floribunda		Seed/ seedlings
Patersonia occidentalis		Seed
Patersonia umbrosa var. xanthina	x	Seed
Pericalymma ellipticum var. ellipticum		Seed
Persoonia elliptica	x	Seed, difficult to propagate
Persoonia longifolia	x	Seed, difficult to propagate
Petrophile linearis		
Petrophile serruriae (RS)	x	
Pimelea lehmanniana subsp. nervosa		Seed
Podocarpus drouynianus		Seed
Pultenaea reticulata		Seed
Rhodanthe citrina		Seed
Stirlingia latifolia	x	Low viability of seed, can be propagated by cuttings
Trachymene pilosa		Seed/ Topsoil
Xanthorrhoea brunonis	x	
Xanthorrhoea gracilis	x	Seed
Xanthorrhoea preissii	x	Seed/ Transplant
Xylomelum occidentale	x	Seed

Appendix 3. Post-rehabilitation Flora and Vegetation Monitoring Methods for Area A of the Yoongarillup Mineral Sands Project

1. Pre-operations Phase

1.1. Re-assessment of Previously Installed 100 m² Floristic Quadrats

Three 100 m² floristic quadrats were installed within the boundary of Area A by Mattiske (2012) and another five were installed by Ecoedge (2013). The quadrats were installed and assessed using the method outlined in (Keighery, 1994). As well as site information such as topsoil texture and colour and landscape position, a complete list of vascular species within the quadrat was compiled, along with cover/abundance of each (**Figure 1**).

It is proposed that the quadrats will be re-visited in spring 2017 to be re-assessed using the methods outlined in the Department of Parks and Wildlife and EPA Technical Guide (2015), which are similar to those of Keighery (1994). The floristic and vegetation structure data obtained from this assessment will be used for guiding revegetation of Area A post-mining.

1.2. Compilation of Complete Species list for Area A

To supplement the species presence information compiled from the floristic quadrat assessments outlined in Section 1.1 above, a survey using the random meander method of Cropper (1993) will be used to produce a more complete list of vascular species occurring within Area A. This survey will also be carried out in spring 2017.

1.3. Transects to monitor herbaceous species cover and abundance

In order to assess whether opening up of the canopy by the development of the mine pit results in an increased influx of weeds, monitoring of weed and native species cover and abundance will be undertaken using stratified random sampling of 5 x 5 m quadrats placed along four transects 160 m to 280 m long, passing north-south from the edge of the private property and extending least 120 m into SF33¹ (**Figure 2**). The quadrat size of 25 m² has been chosen to facilitate more accurate estimation of herbaceous species cover/abundance. The non-native species currently occurring in the Doral mining lease SF33 are all herbaceous taxa (Ecoedge, 2013).

Prior to the period of mine operation (pre-rehabilitation), the section of the transects within Area A will form part of the Area A Management Plan.

¹ In this document "SF33" refers to that part of the State Forest sub-area of Doral mining lease M70/459 (Doral Mineral Sands, 2014) that is outside of Area A as defined in Ministerial Statement 1030 (Government of Western Australia, 2016).

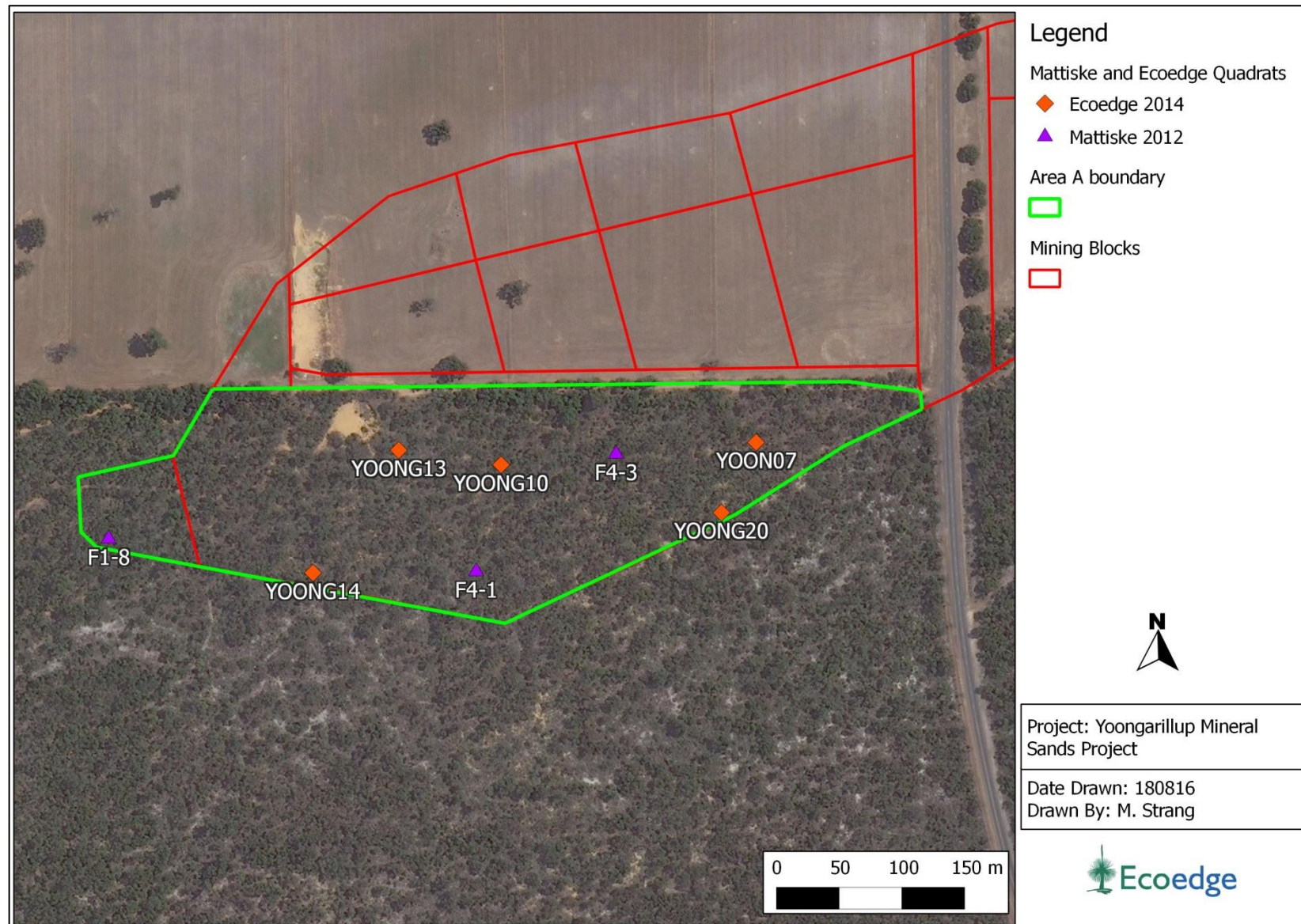


Figure 1. Location of floristic quadrats within Area A from Mattiske (2012) and Ecoedge (2014).

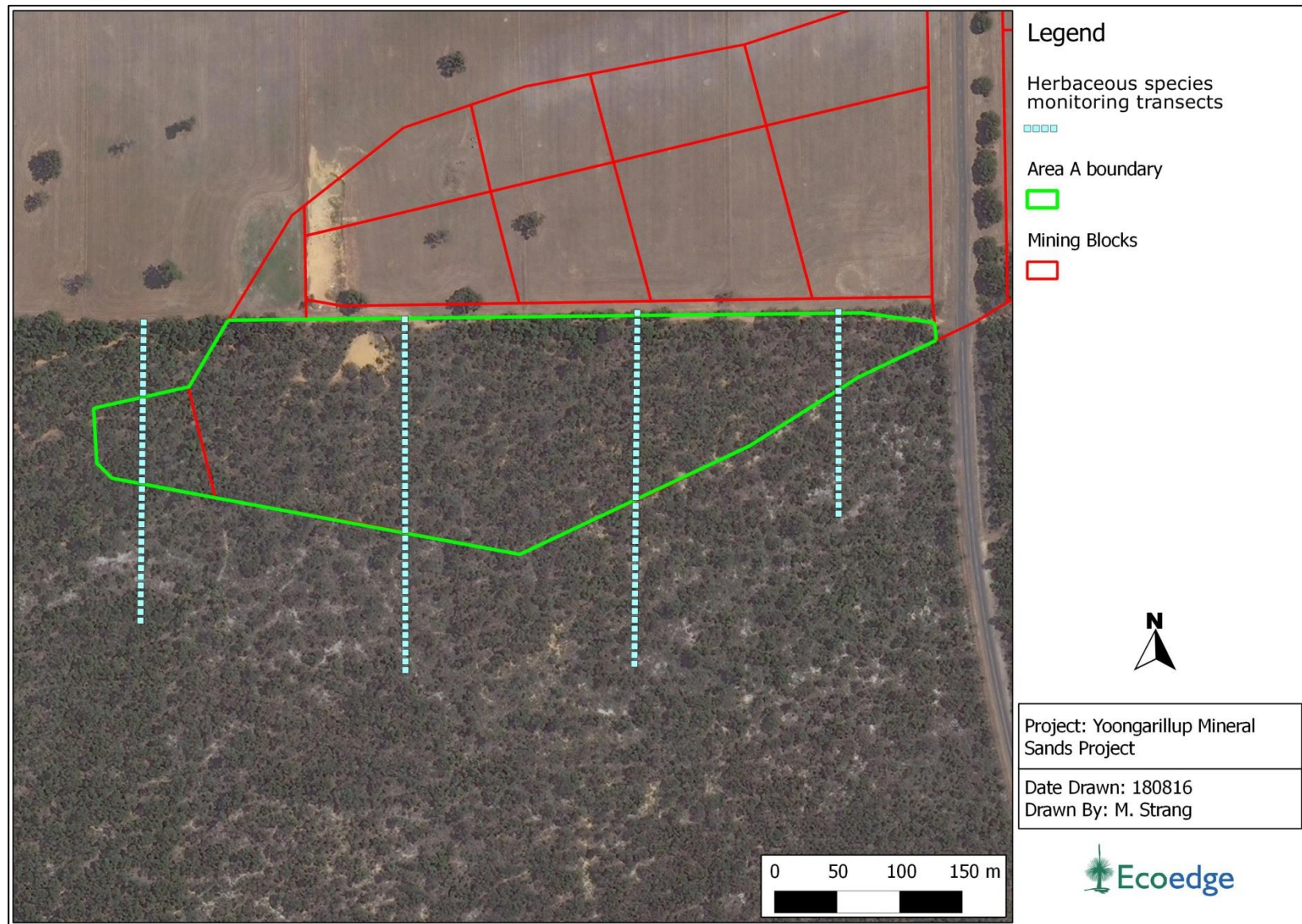


Figure 2. Location of herbaceous species monitoring transects at Yoongarillup.

Herbaceous species monitoring would be carried out over one visit in autumn and two visits in spring (mid-September and early November), commencing in autumn 2017. Within the quadrats, cover/abundance of all native and non-native species will be estimated. Photographs will be taken of each quadrat from the southwest corner at each monitoring visit.

At 40 m intervals along the transects, a minimum of four 5 m² quadrats will be randomly placed, two on either side of the transect at between 0 m and 20 m distance from each side of the centre of the transect (**Figure 3**). The selection of distance from the transect in 1 m intervals will be done using a random number generator. Following the commencement of mining until the completion of monitoring at Yoongarillup the transects will only be monitored from the southern edge of Area A.

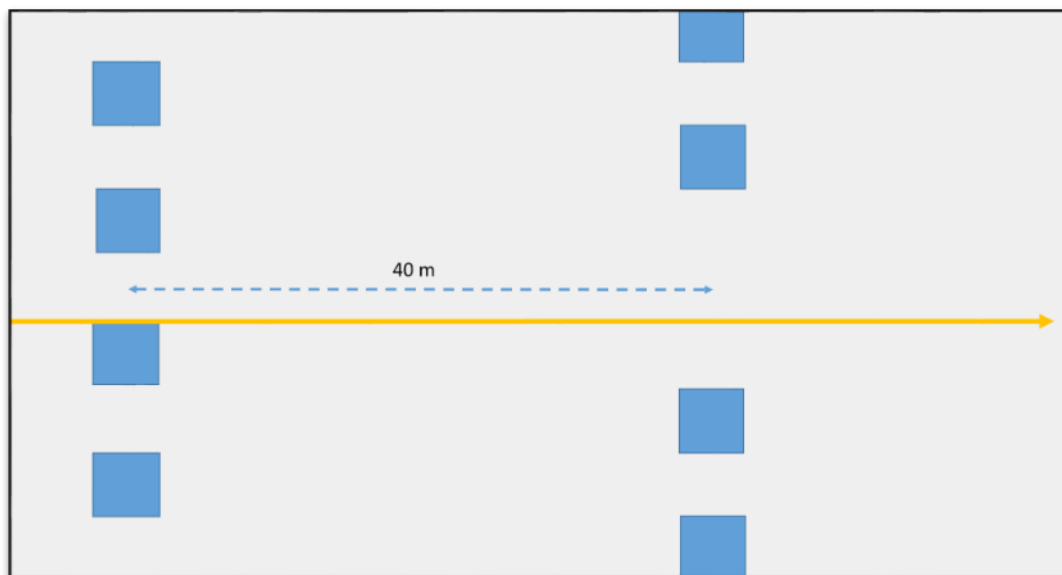


Figure 3. A schematic diagram showing how 5 x 5 m quadrats will be placed either side of the transect at 25 m intervals.

2. Post-revegetation Phase

2.1. Floristic Quadrats

Following rehabilitation of Area A, fifteen permanent 10 x 10 m quadrats will be installed within Area A to be used for monitoring vegetation composition and structure, and also plant health, following the completion of the initial phase of revegetation. The placement of quadrats will be determined using a stratified random method. To achieve this, Area A will be divided into 15 approximately equally sized sub-areas that will be further divided into 9 cells. Within each sub-area, one quadrat will be assigned to one cell using a random number generator. Within each of the 10 x 10 m quadrats, a 5m x 5m sub-quadrat will be used to more closely monitor the cover and abundance of herbaceous species (both native and exotic).

The quadrats will be visited quarterly, with the following assessments being carried out:

- Total species list (mainly compiled during early and mid-spring visits)
- Cover/abundance of native and non-native species (mainly compiled during early and mid-spring visits)
- Average height of trees and cover of shrub species (quarterly)
- Average health of overstorey and understorey species (quarterly)
- An estimate of the number of stems/ha of shrubs and trees (quarterly)

Assessment of the 5 x 5 m sub-quadrats would be undertaken biannually in autumn and spring.

Quadrat setup will be undertaken in accordance with standard procedures (Department of Parks and Wildlife and EPA Technical Guide, 2015). The field sheets used for the initial quadrat setup will be similar to those in Keighery (1994). Particular methods to be used during the assessments are described below.

2.1.1. Cover-Abundance Assessments

Cover/abundance of species occurring within the quadrats will be scored using the following scale:

1. Rare or of low cover (one or two or <2%)
2. Present but in low numbers (a few, 2% - 10%)
3. Common locally, not uniform over whole area (10% - 30%)
4. Common over whole area (30% - 70%)
5. Completely dominating overstorey or understorey (> 70%)

2.1.2. Plant Health Assessments

Plant health will be assessed visually at the time of the quarterly visits to quadrats. In addition to the visual assessments a photograph will be taken of each quadrat from the northwest corner. For eucalypts the assessment method will use scoring based on the method of Backstrom *et al.* (2010) for crown extent and density, and new tip growth, epicormic growth and leaf die off as described in **Tables 1** and **2**, below. For shrubs a method based on that of Lay and Meissner (1985) will be used (**Table 3**).

Table 1. Category scale for reporting Crown Extent and Crown Density Assessments (Backstrom et al., 2010).

Score	Crown Extent and Density
0	None (0%)
1	Minimal (1-10%)
2	Sparse (11-20%)
3	Sparse-Medium (21-40%)
4	Medium (41-60%)
5	Medium-Major (61-80%)
6	Major (81-90%)
7	Maximum (91-100%)

Table 2. Category scale for reporting new tip growth, epicormic growth and leaf die off.

Score	Description	Definition (With regard to the assessable crown)	New tip growth	Epicormic growth	Leaf die-off or yellowing
0	Absent	Effect is not visible			
1	Scarce	Effect is present but not readily visible			
2	Common	Effect is clearly visible throughout			
3	Abundant	Effect dominates the appearance			

Table 3. Small tree (*Banksia*) and shrub health scale partly based on Lay and Meissner (1985).

Score	Description
0	Dead shrub.
1	Shrub with <20% of original canopy; most main branches dead; remaining leaves mostly dying off.
2	Shrub with 21- 40% of original canopy present; some main branches dead (50 -80% canopy); abundant leaf yellowing (>41% canopy).
3	Shrub with 41-60% of the original canopy present; some smaller dead branches evident (21-40% canopy); moderate amount of leaf yellowing (21-40% canopy) .
4	Shrub with 61 – 80% of the original canopy present; occasional dead branches (< 20% of canopy); small patches of leaf yellowing (< 20% of canopy) .
5	Shrub with >81% of the original canopy present; healthy overall; little or no leaf yellowing.

3. Data Storage

Data from flora and vegetation monitoring within Area A will be entered into Excel spreadsheets and uploaded into an Access database for analysis as required.

References

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